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# *Lexicon Technicum:*

Or, An UNIVERSAL

# English Dictionary

OF

# ARTS and SCIENCES:

EXPLAINING

Not only the TERMS of ART, but the ARTS Themſelves.

VOL. II.

BY

*JOHN HARRIS*, D. D. late Secretary to the *Royal Society*, and Chaplain to the *Lord High-Chancellor* of GREAT BRITAIN.

*The* SECOND EDITION.

*LONDON:*

Printed for D. BROWN, J. WALTHOE, J. KNAPTON, B. and S. TOOKE, D. MIDWINTER, B. COWSE, T. WARD, E. SYMON, E. VALENTINE, and J. CLARK. MDCCXXIII.

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TO THE

RIGHT HONOURABLE

*WILLIAM* Lord *COWPER*,

Baron of *WINGHAM*,

AND

Lord High-Chancellor

OF

GREAT BRITAIN.

My LORD,

THE great Honour and Advantage which the former Volume of this Work receiv'd from the Patronage of His Royal Highneſs, the late Prince George of Denmark, encourages me to Dedicate This to Your Lordſhip; as I am alſo oblig'd in Duty and Gratitude to do, for the many Favours I have receiv'd from You; and eſpecially for the great Honour and Happineſs of having been ſo long known, and ſo near to You: For this, my Lord, will ſave me from

*the Fate of thoſe Dedicators, who attempt Characters above Panegyrick: The Publick Part of Your Lordſhip's all the World knows and admires; and tho' I ſee every Day That which renders Your Lordſhip the* Inſtruction, *as well as the* Delight *of all that have the Honour of Your Converſation, yet I* can *no more deſcribe it, than I* dare *attempt it: I ſhall therefore, my Lord, entirely forbear; fearing as much doing Violence to Your Modeſty, as Injuſtice to Your Merit.*

I am,

My LORD,

Your Lordſhip's

Moſt Dutiful, and

Moſt Humble Servant,

*JOHN HARRIS.*

THE

# INTRODUCTION.

THE Design of an INTRODUCTION to a Book, being to lead the Reader into it, and to acquaint him what it contains; I shall observe that Method here.

He is therefore to understand, that when I first began this Work, I foresaw the *Design* could not be accomplish'd in One Volume; but however, I thought it more proper to Publish one Volume first, than to defer Printing *any thing* at all of it till the Whole was finished: For as it is easy to see, that new Matter will continually occur in a Design of this Nature, and, consequently, that there can be no such thing as a *Perfect Book* of this Kind; so I thought it better to send out an *Imperfect one* than none, and to afford *some* Help to Mens Improvement in Philosophy and Mathematical Studies, rather than leave them to stay four or five Years for a *more Compleat* one. And the unprejudic'd Part of the Learned World have been so kind, as to take my Endeavours as I meant them; and by taking off almost Two Impressions of the former Volume, and numerously subscribing to this, make me hope, the Pains I have taken, and the Time I have employed this Way, may be of some Use and Benefit to Mankind, and to the Improvement of Solid and Substantial Philosophy.

In this Second Volume, as I promised both in the *Preface* to the First, and also in the *Proposals* for This, the *Matter* is entirely *New*, and without any Repetition, that I know of, of any thing in the *Former*; and that shall be my Method, if ever I Publish any thing further in this Way.

The Reader will find here many Parts of Natural Philosophy and Anatomy largely treated of, which were either but just nam'd, as it were, or entirely omitted in the former: As in particular, the Affair of *Animal Secretion*; into which Dr. *Keil*'s Book on that Subject, publish'd since my Account was printed, will let you yet further; Discourses on Thunder, a Vacuum, Vapours, Water; with a large Account of Sound, Echoes; the Transmutation of Bodies into one another; the Nature of Light and Colours, the Rays of Light, the Double Refraction found in the Island *Chyrstal*; Elasticity, Electricity, the Cohesion of the Parts of Bodies, *&c.*

And

And in Natural Hiſtory, I have here given Schemes of Birds, Fiſhes, Inſects, Quadrupeds, Roots of Plants, *&c.* by which they are ranged and diſtributed into their proper Orders.

Here are alſo inſerted pretty large Accounts of the Ear, Stomach, Spleen, Skin, *Vena Porta*, Lungs, Gall, and Reſpiration, and of the New Theory of Generation; with Deſcriptions of the Lymphæducts and Glands, and two very fine and large Copper Plates of the Veins and Arteries of a Human Body, which were drawn from the Original Tables, preſented by that great Promoter of Uſeful Learning, *John Evelyn* of *Deptford*, Eſq; to the *Royal Society* of *London*.

You have here alſo a further Account of that moſt amazing Property, the *Attraction* of the Particles of Matter one towards another, firſt diſcover'd by that Incomparable Mathematician and Philoſopher Sir *Iſaac Newton*; who by the wonderful Diſcoveries he hath made about the Nature of *Light* and *Colours*, hath open'd a New World in Natural Philoſophy, as by his Method of Fluxions, *&c.* he had before done in Mathematicks, Mechanicks and Aſtronomy; and hath ſufficiently ſhewn, that what he ſaid in his *Preface* to his *Principia Philoſ. Math.* in theſe Words: *Multa me movent ut non nihil ſuſpicer cætera Naturæ Phænomena, ex viribus quibuſdam pendere poſſe, quibus Corporum particulæ, per Cauſas nondum cognitas, vel in ſe mutuo impelluntur, & ſecundum Figuras regulares cohærent, vel ab invicem fugantur & recedunt*, was what he very well knew *then*, tho' expreſs'd with that Caution and Modeſty, as is ſo peculiar to that Excellent Man.

This was printed in the Year 1687. and the *Queries* at the End of his *Opticks*, and eſpecially as ſince enlarged by him in the *Latin* Tranſlation of it, do ſufficiently ſhew his Thoughts to have been long ago employ'd on this moſt uſeful Subject; and from whence thoſe Propoſitions took their Riſe, which thoſe Ingenious and Induſtrious Brothers the *Keils*, have publiſh'd about this Affair of Attraction: But however, to do the Illuſtrious Author yet further Juſtice, I have, with his Leave, at the End of this *Introduction*, printed a *Latin* Paper of his *De Acido*, with a Tranſlation of my own; and which, tho' never publiſh'd before, was given by him to a Friend, as long ſince as the Year 1692, and which I wiſh had come to my Hands ſooner, to have been inſerted in this *Lexicon* under the proper Head, *Acids*.

And give me Leave here further to inform the Reader, That there is now printing a *Latin* Mathematical Treatiſe or two of Sir *Iſaac Newton*'s, which were written many Years ago, and which by their Date will ſufficiently determine, whether the *New Methods of Fluxions* were known firſt to him, or Mr. *G. Leibnitz*. But to go on: In this Second Part, I have been very full and particular in Aſtronomy; having not only from Mr. *Hayes*'s Excellent Book of Fluxions given a ſhort

a ſhort Syſtem of the New Aſtronomy, but have alſo from the Ingenious and Learned Mr. *Halley*, *Savilian* Profeſſor of Geometry in the Univerſity of *Oxford*, inſerted a *Synopſis* of the Doctrine of Comets; and from the Prelections of Mr. *Whiſton*, Mathematick Profeſſor of the Univerſity of *Cambridge*, ſuch Aſtronomical Tables as are neceſſary for Calculation, illuſtrating largely the Uſes of them, with proper Examples, in the moſt uſeful Aſtronomical Problems, and in the Calculation of Solar and Lunar Eclipſes, and in thoſe of the Satellites of *Jupiter*, &c.

And becauſe I would have theſe Two Volumes to ſerve as a Kind of ſmall Mathematical Library, and prevent in ſome meaſure the Neceſſity and Charge of buying many Books on theſe Subjects; I have alſo, as I deſign'd at firſt, given you in this Volume very good Tables of Logarithms, Sines, Tangents and Secants, with a full Account of the Nature, Uſe and Application of them; ſo that nothing will be wanting here to compleat Trigonometry, both Plain and Sperical, and the Practice of it in Navigation, Dialling and Aſtronomy, *&c.*

I have here alſo given a full and clear Account of the Nature, Conſtruction and Uſes of all the Lines which are uſually drawn on any Mathematical Inſtruments, Rules, Scales, *&c.* and how to uſe thoſe Inſtruments, on which they are drawn, in the ſeveral Parts of Practical Mathematicks for which they were deſign'd.

And I have here and there inſerted ſuch uſeful Tables for the Calculation of Intereſt, Annuities, Purchaſes, Reverſions, *&c.* as I found moſt eaſily and readily ſubſervient to thoſe Uſes. And becauſe of the very many and excellent Uſes of the Table of Incompoſite Numbers, and its being printed no where but in *Brancker*'s Algebra, an obſcure Book, and out of Print; I have here given it you entire, and, I believe, correct; being deſirous to prevent ſo uſeful a Table from being loſt, or buried in Obſcurity.

Here is alſo an Account of the Method of *Levelling*, in order to drain Marſhes, Fens or Moraſſes, or to convey Water from one Place to another.

An Account of the Riſe, Invention and Progreſs of the Art of Printing; with a Deſcription of the Tools and Inſtruments ſubſervient thereunto.

I have added alſo a farther Account of the Phænomena of Priſms and the Rainbow; with a ſhort Syſtem of Opticks from Sir *Iſaac Newton*; and many Improvements in Microſcopes and Teleſcopes; the Art of Perſpective, and the Methods of Projective, Reflective and Refractive Dialling.

In Mechanicks, beſides the Account of the Five Powers and Demonſtrations of the Nature and Principles of that Science, here

are

are many things added about Centres of Gravity and Oſcillation, the Reſiſtance of Mediums, with the Deſcription and Uſes of all ſuch Mechanical Inſtruments, Tools and Engines, as are uſed in Architecture, Fortification, Gunnery, or any Mathematical Arts and Sciences.

In Geometry, here are great additional Improvements; as two Treatiſes of the *Order* and *Quadrature* of Curves, written by the Incomparable Sir *Iſaac Newton*; a Treatiſe of Conick Sections, tranſlated from the Poſthumous Book of the Marquis *de L'Hoſpitall*, with many other Things relating to the Properties of Curves, ſcatter'd up and down under particular Words; ſuch as *Cycloid*, *Helicoid*, *Retrogreſſion of Curves*, *Tranſcendental Quantities*, &c. Here are alſo added many new Things in Arithmetick and Algebra, and in the Doctrine of Fluxions; as about *Alternations*, *Combinations*, the *Laws of Chance* in Play, *Infinite Series*, and *Political Arithmetick*; and about the *Roots of Equations*, *Renewing of Leaſes*, *Reverſions*, &c.

I have alſo here given a large Account of the Ways of Finding, Dreſſing, Melting, *&c.* of all the ſeveral Ores from whence our Metals are taken; deſcribing alſo the Works, Engines, Tools and Terms of Art uſed by Miners; as alſo the Ways of making Salt, Allum, Coperas, Vitriol, and ſuch like Mineral Productions.

In Muſick, here is given an Account of the Nature and Grounds of Harmony from Dr. *Holder*, and a new ſhort Syſtem of Muſick by the Ingenious Mr. *Perk*.

In Navigation I have added many things; as the Way of finding and allowing for the ſetting of Currents; an Account of the Power of the Winds on the Sails of Ships, and of the Signals uſed at Sea, both by Day and Night, in Sailing, and in an Engagement; together with a new Traverſe Table, and its Uſe and Application: And at the End, you will find two very accurate Cuts of the *Inſide* and of the *Rigging* of a Firſt Rate Man of War; with the ſeveral Parts deſcrib'd, and referr'd to by proper Letters and Numbers.

I have alſo inſerted Tables of the Sun's Place, Right Aſcenſion, and Declination; together with a Catalogue of the Right Aſcenſion, Declination, Longitude and Latitude of about fifty of the principal Stars, which Mr. *Hodgſon* ſupplied me with; as alſo a Table of the Longitude and Latitude of the moſt eminent Places on the Globe; all which will be very uſeful in Aſtronomy, Navigation and Dialling.

I have added alſo a Copper Plate, deſcribing a new *Hydroſtatical Balance*, which is very ready and expeditious to find the Specifick Gravity of Bodies, as is there ſhewn.

I have

# INTRODUCTION.

I have here, under the Word *Microſcope*, given the Reader the Figure, Nature, Uſe and Advantages of Mr. *Wilſon*'s Glaſſes of that Kind, which I could only juſt mention in the *Introduction* to my former Volume, and which I think my ſelf oblig'd again to ſay, are the moſt ready, commodious, and univerſally uſeful, of any Microſcopes, I ever ſaw.

And that I might do further Juſtice to our Excellent Mathematical Inſtrument-Maker Mr. *John Rowley*, in *Johnſon's-Court* in *Fleet-ſtreet*, I have given the Reader a Plate of a New Sextant lately made by his moſt accurate Hand, for the Obſervatory now building in *Trinity*-College in *Cambridge*; and which for its univerſal Uſe, far exceeds any Aſtronomical Inſtrument ever yet made; as you will eaſily perceive by the Deſcription of it, which I have added to the Figure.

I have only one thing more to acquaint the Reader, and that is, That the ingenious and Accurate Mr. *Derham*, Rector of *Upminſter* in *Kent*, and Fellow of the Royal Society, hath lately obtain'd from *Florence* an Account of the Meaſures and Weights uſed there: And we find by Menſuration and Tryal, that the *Florentine Semibroccio*, or Half-Brace, is in Length 11.475 of our *Inches*, or in *Foot-Meaſure* .956 of our *Foot*: And the *Florentine* Ounce is 17 *Peny-weight*, 12 *Grains*, and three Fourths of a *Grain Troy-weight*.

The following Paper of Sir *Iſaac Newton*'s is excellently well worth the Philoſophical Reader's moſt ſerious and repeated Peruſal; for it contains in it the Reaſon of the Ways and Manner of all Chymical Operations, and indeed of almoſt all the Phyſical Qualities, by which Natural Bodies, by their ſmall Particles, act one upon another.

# *INTRODUCTION.*

## DE
## NATURA ACIDORUM.
## Is. Newton. 1692.

*Acidorum particulæ ſunt Aqueis Craſſiores, & propterea minus Volatiles, at Terreſtribus multo ſubtiliores & propterea multo minus fixæ. Vi magna attractivâ pollent, & in hac vi conſiſtit earum Activitas, quâ & corpora diſſolvunt & Organa ſenſuum agitant & pungunt. Mediæ ſunt Naturæ inter Aquam & Corpora, & Utraque attrahunt. Per vim ſuam attractivam congregantur circùm particulas corporum ſeu Lapideas ſeu Metallicas iiſq; undiq; adhærent arctiſſimè, ut ab iiſdem deinceps per Diſtillationem vel ſublimationem vix poſſint ſeparari, Attractæ vero & undique congregatæ, elevant, diſſjungunt & diſcutiunt particulas corporum ab invicem, id eſt corpora diſſolvunt; & per vim Attractionis quâruunt in particulas commovent fluidum & ſic calorem excitant, particulaſq; nonnullas adeo diſcutiunt ut in Aerem convertant & ſic Bullas generant. Et hæc eſt* Ratio *Diſſolutionis & Fermentationis; Acidum verò attrahendo Aquam æquè ac Terram efficit ut particulæ diſſolutæ prompte miſceantur cum aquâ eique innatent ad modum ſalium. Et quem admodum Globus terræ per vim Gravitatis attrahendo aquam fortiùs quam Corpora leviora, efficit ut leviora aſcendant in Aquâ, & fugiant de Terrâ. Sic particulæ Salium attrahendo Aquam fugant ſe mutuò & ab invicem quam maxime recedendo, per Aquam totam expanduntur.*

*Particulæ Salis Alkali ex Terreis & Acidis ſimilitèr Unitis conſtant; ſed hæ Acidæ vi maxima Attractivâ pollent ut per ignem non ſeparentur à Sale; utq; Metalla diſſoluta præcipitant attrahendo ab ipſis particulas Acidas quibus diſſolvebantur.*

*Si particulæ Acidæ in minori proportione cum Terreſtribus jungantur, hæ tam arcte retinentur à Terreſtribus, ut ab iis ſupprimì ac occultari videantur. Neq; enim ſenſum jam pungunt neq; attrahunt aquam. Jed corpora dulcia & quæ cum aquâ ægre miſcentur, hoc eſt* pinguia, *componunt; ut fit in Mercurio dulci, Sulphure communi, Luna* Cornea *& Cupro quod Mercurius Sublimatus corroſit. Ab Acidi vero ſic Juppreſſi vi attractivâ fit ut pinguia Corporibus prope Univerſis adhæreant & flammam facile concipiant, ſi modo Acidum calefactum inveniat alia Corpora in fumo accenſorum quæ fortius attrahat quam propria. Sed & Acidum in Sulphureis ſuppreſſum fortius attrahendo particulas aliorum corporum (ſcilicet Terreas) quam proprias, Fermentationem lentam & Naturalem ciet & fovet uſq; ad Putrefactionem Compoſiti.*

*Quæ Putrefactio ſita eſt in eò quod Acidæ Fermentationem diu foventes tandem in interſtitia minima & primæ* Compoſitionis *partes interjacentia ſeſe inſinuant, intim q; iis partibus Unitæ mixtionem Novam efficiunt non amovendam nec cum priore commutandam.*

### Cogitationes Variæ ejuſdem.

*Flamma eſt Fumus Candens; differtque à Fumo ut Ferrum rubens ab ignito ſed non rubente.*

*Calor eſt Agitatio Partium quaqua verſum.*

*Nihil eſt abſoluté quieſcens ſecundum partes ſuas & ideo frigidum, præter atomos, vacui ſcilicet expertes.*

*Terra augetur, Aquâ in eam converſâ, & omnia in aquam (vi ignis) reduci poſſunt.*

*Nitrum abit diſtillatione magnam partem in Spiritum Acidum, relictâ terrâ, quia Acidum Nitri attrahit Phlegma; & idcirco ſimul aſcendunt conſtituuntq; Spiritum: at nitrum Carbone accenſum magnum partem abit in Sal Tartari, quia ignis eo modo applicatus partes Acidi & Terre in ſeſe impingit fortiuſq; unit.*

*Spiritus ardentes ſunt Olea cum* Phlegmate *per Fermentationem Unita.*

*Tinctura Cochinellæ cum Spiritu Vini facta in aquæ magnam molem immiſſa, parva licet doſi, totam aquam inficit: Sc. quia particulæ Cochinellæ magis attrahuntur ab aquâ quam à ſe mutuo.*

*Aqua non habet magnum vim diſſolvendi quia pauco Acido gaudet. Acidum enim dicimus quod multum attrahit & attrahitur, videmus nempe ea quæ in aquâ ſolvuntur lente & ſine Effervescentiâ ſolvi, at ubi eſt attractio fortis & particulæ menſtrui undiq; attrahuntur à particulâ Metalli, vel potius particula metalli undiq; attrahitur à particulis menſtrui, hæ illam abripiunt & circumſiſtunt, hoc eſt metallum corrodunt: Hæ eadem particulæ ſenſorio applicatæ ejus partes eodem modo divellunt doloremq; inferunt; à quo Acidæ appellantur, relictâ ſcilicet terrâ Subtili cui adhærebant ob majorem attractionem ad liquidum linguæ, &c.*

*In*

*In omni Solutione per Menſtruum particulæ ſolvendæ magis attrahuntur a partibus Menſtrui quam à ſe mutuo.*

*In omni Fermentatione eſt Acidum ſuppreſſum quod coagulat præcipitando.*

*Oleam cum nimis magnâ mole phlegmatis intime mixtum, fit Salinum quiddam & ſic Acetum conſtituit, hic etiam Tartari ſeu Terræ admiſtæ habenda eſt ratio.*

*Mercurius attrahitur id eſt corroditur ab Acidis & ſicut pondere Obſtructiones tollit ita vi attractrice Acida infringit.*

*Mercurius eſt Volatilis & facile elevatur calore quia ejus particulæ* ultimæ Compoſitionis *ſunt parvæ & facile ſeparantur ſeparatæq; ſeſe fugant ; ut ſit in particulis Vaporis, fluidorumq; rarefactorum.*

*Aqua cum primi non poteſt quia ejus particulæ jamjam ſe tangunt. Et ſi ſe tangerent particulæ Aeris ( nam Aer comprimi poteſt, quia ipſius particulæ nondum ſe tangunt ) Aer evaderet in Marmor. Seq. ex* Prop. 23. *Lib.* 2. *Princ.* Philoſoph.

*Aurum particulas habet ſe mutuo trahentes ; minimarum ſummæ vocentur* primæ Compoſitionis, *harum ſummarum ſummæ* ſecundæ Compoſitionis, *&c.*

*Poteſt Mercurius, poteſt Aqua* Regia *poros pervadere, qui particulas* ultimæ Compoſitionis *interjacent at non alios.*

*Si poſſet menſtruum alios illos pervadere vel ſi auri partes* primæ & ſecundæ Compoſitionis *poſſent ſeparari fieret Aurum, vel Fluidum, vel ſaltem magis malleabile. Si Aurum fermenteſcere poſſet in aliud quodvis corpus poſſet transformari.*

*Viſciditas eſt vel ſolum defectus fluiditatis, quæ ſita eſt in partium parvitate & ſeparabilitate ( intellige partes ultimæ Compoſitionis ) vel defectus lubricitatis ſeu lævioris partes unius ſupra alias labi impediens. Hujus viſciditatis Acidum ſæpe cauſa eſt ; ſæpe Spiritus alius lubricus terræ junctus, ut oleum Terebinthinæ capiti ſuo Mortuo redditum ſit tenax.*

Ratio *cur Charta Oleo in uncta Tranſitum Oleo non Aquæ concedat eſt quia Aqua Oleo non miſcetur ſed fugatur ab eo.*

*Cum Acidæ partes, minores ſcilicet, aliquid diſſolvunt, id faciunt, quia partem rei ſolvendæ includunt undiq; utpote Majorem quâlibet Acidi partium.*

## *Some Thoughts about the* NATURE *of* ACIDS; *By Sir* ISAAC NEWTON.

THE Particles of Acids are of a Size groſſer than thoſe of Water, and therefore leſs volatile ; but much ſmaller than thoſe of Earth, and therefore much leſs fix'd than they. They are endued with a great Attractive Force ; in which Force their Activity conſiſts ; and thereby alſo they affect and ſtimulate the Organ of Taſte, and diſſolve ſuch Bodies as they can come at. They are of a middle Nature, between Water and Terreſtrial Bodies, and attract the Particles of both.

By this attractive Force they get about the Particles of Bodies, whether they be of a metallick or ſtony Nature, and adhere to them moſt cloſely on all ſides; ſo that they can ſcarce be ſeparated from them by Diſtillation or Sublimation. When they are attracted and gather'd together about the Particles of Bodies, they raiſe, disjoin and ſhake them one from another; that is, they diſſolve thoſe Bodies.

By their attractive Force alſo, by which they ruſh towards the Particles of Bodies, they move the Fluid, and excite Heat ; and they ſhake aſunder ſome Particles, ſo much as to turn them into Air, and generate Bubbles: And this is the Reaſon of Diſſolution, and all violent Fermentation ; and in all Fermentation there is an Acid latent or ſuppreſs'd, which coagulates in Precipitation.

Acids alſo, by attracting Water as much as they do the Particles of Bodies, occaſion that the diſſolved Particles do readily mingle with Water, or ſwim or float in it, after the manner of Salts.

And as this Globe of Earth, by the Force of Gravity, attracting Water more ſtrongly than it doth lighter Bodies, cauſes thoſe lighter Bodies to aſcend in the Water, and to go upwards from the Earth: So the Particles of Salts, by attracting the Water, do mutually avoid and recede from one another as far as they can, and ſo are diffuſed throughout the whole Water.

The Particles of *Sal Alkali*, do conſiſt of *Earthy* and *Acid* united together, after the ſame manner : But theſe Acids have ſo great an Attractive Force, that they can't be ſeparated from the Salt by Fire ; they do alſo precipitate the Particles of Metals diſſolv'd in *Menſtrua*, by attracting from them the Acid Particles, which before had diſſolved them, and kept them ſuſpended in the *Menſtruum*.

If theſe Acid Particles be join'd with Earthy ones, in but a ſmall Quantity, they are ſo cloſely retain'd by them, as to be quite ſuppreſs'd and hidden as it were by them; ſo that they neither ſtimulate the Organ of Senſe, nor attract Water, but compoſe Bodies which are not Acid, *i. e.* Fat and Fuſible Bodies, ſuch as are *Mercurius dulcis*, *Common Brimſtone*, *Luna Cornea*, and *Copper* corroded by *Mercury Sublimate*.

From the Attractive Force in theſe Acid Particles thus ſuppreſs'd, ariſes that univerſal Property of almoſt all fat Bodies, that they adhere or ſtick to others, and are eaſily inflammable, if the heated Acid Particles meet with other Particles of Bodies in Fume, which the Acid attracts more ſtrongly than it doth the Particles to which it is united. And thus the Acid that lies ſuppreſs'd in ſulphureous Bodies, by more ſtrongly attracting the Particles of other Bodies (Earthy ones for Inſtance) than its own, promotes a gentle Fermentation, produces and cheriſhes Natural Heat, and carries it on ſo far ſometimes, as to the Putrefaction of the Compound: Which Putrefactio n ariſes hence, That the Acid Particles which have a long while kept up the Fermentation, do at long run inſinuate themſelves into the leaſt Interſtices that lie berween the Particles of the *firſt Compoſition*, and ſo intimately uniting with thoſe very Particles, do produce a new Mixture or Compound, which cannot fall back again into the ſame Form.

Note, *The Paper hitherto deſcrib'd, ſeems to have been a continued Diſcourſe; but what follows are ſhort Minutes of Thoughts relating to the ſame Subject.*

Nitre, in Diſtillation, leaving its Earthy Part behind, turns moſt of it into an Acid Spirit; becauſe the Acid of the Nitre attracts the Phlegm, and therefore they aſcend together, and conſtitute a Spirit. But Nitre, kindled with a Coal, turns chiefly into a Salt of Tartar; becauſe the Fire applied this Way, drives th e Acid and Earthy Parts towards, and makes them impinge on, and more ſtrongly unite one with another.

The Reaſon why Water hath no great diſſolving Force, is, becauſe there is but a ſmall Quantity of Acid in it: For whatever doth ſtrongly attract, and is ſtrongly attracted, may be called an Acid: And ſuch things as are diſſolved in Water, we ſee, become ſo, *eaſily*, without any Effervеſcence: but where the Attraction is ſtrong, and the Particles of the Menſtruum are every where attracted by thoſe of the Metal, or rather, where the Particles of the Metal are every way attracted by thoſe of the Menſtruum; then the Particles of the Menſtruum environ thoſe of the Metal, tear them to pieces, and diſſolve it.

So when theſe Acid Particles are applied to the Tongue, or to any excoriated Part of the Body, leaving the ſubtil Earth in which they were before, they ruſh into the Liquid of the Senſory, tear and disjoint its Parts, and cauſe a painful Senſation.

Mercury is attracted, and therefore corroded by Acids; and as it opens Obſtructions by its great Weight, ſo it breaks and obtunds the Power of Acids (in the Body) by its attractive Force.

All Bodies have Particles which do mutually attract one another: the Sums of the leaſt of which may be called Particles of the *firſt Compoſition*; and the Collections or Aggregates ariſing from the Primary Sums, or the Sums of theſe Sums, may be called Particles of the *ſecond Compoſition*, *&c.*

Mercury and *Aqua Regis* can pervade thoſe Pores of Gold or Tin, which lye between the Particles of *its laſt Compoſition*; but they can't get any further into it; for if any Menſtruum could do that, or if the Particles of the firſt, or perhaps of the ſecond Compoſition of Gold could be ſeparated; that Metal might be made to become a Fluid, or at leaſt more ſoft. And if Gold could be brought once to ferment and putrify, it might be turn'd into any other Body whatſoever.

And ſo of Tin, or any other Bodies; as common Nouriſhment is turn'd into the Bodies of Animals and Vegetables.

N. B. *The ſmall* Difference *which there is between this* Tranſlation *and the* Latin *above, was its being taken from another Copy a little different from this* Latin *Paper. And having been ſupervиſed and approved by the Illuſtrious Author, I have not alter'd it ſince.*

LEXI-

# LEXICON TECHNICUM:

OR, AN

# UNIVERSAL *ENGLISH* DICTIONARY

OF

# Arts and Sciences.

## VOL. II.

## A B A — A B C

ABACUS. Besides the former Account of the *Abacus*, I find that *Mauclerc*, in the Ionick Order, designs what the Workmen call an O. G. with a Fillet over it for the *Abacus:* Which Fillet is half the Breadth of the O. G. and he calls it the *Fillet of the Abacus.* In the *Corinthian* Order, he describes the *Abacus* as a seventh Part of the whole Capital. *Palladio* calls the *Plinth* about the *Boultin* (or *Eckinus*) the *Abacus:* Which from its Form, saith he, is commonly called *Dado*, or the Dye; and this is $\frac{1}{8}$ of the whole heighth of the Capital.

*Scamozzi* calls a certain Hollow or Casement, which is the Capital of the Pedestal of the *Tuscan* Order, by this Name *Abacus.*

ABASE, in the Sea Language, is to *Lower* or *Take in. To Abase the Flag*, is to take in the Flag.

ABBACY, is the Government of a Religious House, with the Revenues and Persons subject to an *Abbat.*

ABBAT, is a Spiritual Lord, having the Rule of Religious Houses according to our Common Law. Some *Abbats* in *England* were call'd *Mitred Abbats*; and such were exempted from the Juri diction of the Diocesan, having Episcopal Authority themselves within their Limits, and were also Lords of Parliament. These were sometimes call'd *Abbats Sovereign*, and *Abbats General.* The other *Abbats* were subject to the Diocesan in all Spiritual Government. There were also *Lords Priors*, which had exempt Jurisdiction, and were Lords of Parliament. Of these *Lords Abbats* and *Priors*, Sir *Edw. Coke* saith there were 29 that sat in Parliament, 27 *Abbats* and 2 *Priors.* But sometimes their Number was varied, there being but 25 *Abbats* and 2 *Priors* in a Parliament held in the 20 *Rich.* 2.

ABREUVOIRS, are the Intervals or Spaces between the Stones, or the Joints where the Mortar lies in any Pillar, Wall, or Building.

ACCORD, according to the Modern (*French*) Account of Musick, is the Production, Mixture and Relation of two Sounds; of which the one is *Grave*, and the other *Acute.* They make two Kinds of *Accord*; those which are pleasant and agreeable, and which they call *Consonances*; and such as are harsh and unpleasant, which are call'd *Dissonances. Which see in* Vol. I.

ACERIDES, is a Plaister made without Wax, such as that call'd *Emplastrum Norimbergense.*

ACTION *Civil*, is that which tends only to the Recovery of what is due to any one by Contract, *&c.* as if a Man seek by Action to recover a Sum of Money formerly lent.

ACTION *Penal*, is that which aims at some Penalty or Punishment in the Party sued, whether Corporal or Pecuniary; as in the *Action Legis Aquiliæ* in the Civil Law, and in the Common Law in Case of Appeals for Murder.

ACTION *Prejudicial* or *Preparatory*, is that which grows from some Doubt in the *Principal*; as suppose a Man sue a younger Brother for Land descended from his Father, and 'tis objected that he is a Bastard, the Bastard must be first tried; that is call'd *Actio Prejudicalis*, because it must be first judg'd or determin'd.

ACTION

ACTION *Anceſtrel*, is in oppoſition to Perſonal, being that which a Man hath by ſome Right deſcending from his Anceſtors: This is either *Droiturel* or *Poſſeſſory*: See *Co.* 2 *Inſtit. f.* 291.

ACTOR, is ſometimes uſed for a Proctor or Advocate in Civil Courts or Cauſes. *Actor dominicus* was alſo the Term formerly for the Lord's Bailey or Attorney. *Actor Eccleſiæ* was ſometimes the Foreign Term for the Advocate or Pleading Patron of a Church. *Actor Villæ* was the Steward or Head Bailey of a Town or Village.

ADDICTIO *in Diem*, in the Civil Law, is an Agreement between Buyer and Seller, that the Seller may Contract with any other Perſon who will offer a better Price, before a certain Day.

ADDITION, is the Term in our Common Law for the Title which is given to any Perſon beſides his Chriſtian and Sirname, in order to diſtinguiſh him by his Degree, Eſtate, Myſtery, Trade, Place of Abode, *&c.*

And 'tis particularly prov'd by the *Stat.* 1 *H.* 5. *c.* 5. that in Suit of Action where Proceſs of Utlars lies, ſuch Additions ſhall be given to the Name of the Defendant; and that *Writs* not having ſuch Additions ſhall *Abate*, if the Defendant take Exceptions thereunto.

ADVANCE *Foſſe*, is a Ditch of Water round the *Eſplanade* or *Glacis* of a Place, to prevent its being ſurpriſed by the Beſiegers: But of late this Work hath been diſus'd, becauſe as ſoon as the Enemy could drain it, it was a Trench ready made for the Advantage of the Beſiegers.

ADVOCATIONE *Decimarum*, is a Writ that lies for the Claim of a fourth Part, or upward, of the Tithes belonging to any Church.

ADVOWEE or AVOWEE, in *Latin Advocatus*, was formerly us'd for him that had Right of Preſentation to a Benefice; and the *Avowee Paramount* was the higheſt Patron, or the King. By the Statute of Proviſors, 25 *E.* 3.

ADVOWSON of a Religious Houſe; as the Builders and Endowers of a Church were the Patrons of it, ſo thoſe that Founded any Religious Houſe, had the *Advowſon* or *Patronage* of it. Sometimes the Patron had the ſole Nomination of the *Prelate*, *Abbot* or *Prior*, either by Inveſtiture (or Delivery of a Paſtoral Staff) or by direct Preſentation to the Dioceſan. And if a free Election was left to the Religious, yet a *Conge d'eſlire*, or Licenſe of Election, was firſt to be obtain'd of the Patron; and the Perſon Elected was confirm'd by him. If the Founder's Family was extinct, the Patronage of the Convent went to the Lord of the Mannor.

ADZ, is an Inſtrument whoſe Blade is made thin and ſomething bending, and hath not its Edge parallel to its Handle, as the Axe and Hatchet hath, but placed athwart to it. It is ground to a Baſil on the Inſide to its outer Edge. Its general Uſe is to take off thin Chips of Timber or Boards, and ſuch Irregularities as the Axe can't come at, and where a Plane, tho' *rank Set*, will not make riddance enough. 'Tis much us'd in taking off the Irregularities of Floors when they are pinned and framed together; and ſometimes on Poſts framed upright, and ranged in with other Work framed to them, where the Edge of the Axe can't come.

ÆSTUARY, is an Arm of the Sea running up a good way into the Land, like the *Briſtol* Channel, *&c.*

AGE, in the Common Law, is that particular Time which enables a Perſon to do that, which before he could not do for want of Age: Thus at 14 Years a Man is ſaid to be at the *Age of Diſcretion*; and at 21, at full Age. At 12 Years of Age a Man may take the Oath of Allegiance at a Leet; at 14 he may conſent to marry, and in *Soccage* chuſe his Guardian; at 15 he is of Age for the Lord to have *Aid pur fuir fitz Chivalier*, and may be ſworn to keep the King's Peace; at 12 he is bound to Appearance before the Sheriffs and Coroner for Enquiry after Robberies.

A Woman might heretofore at 7 Years of Age, her Father being the Lord, diſtrain his Tenants for *Aid pur fill Marier*, and at thoſe Years conſent to marry, ſaith *Bracton*. At 9 Years ſhe is dowable; for then, or within half a Year after (*Fleta, lin.* 5. *c.* 22. *Lit. Lib.* 1. *c.* 5.) ſhe is able *promereri dotem & virum ſuſtinere*: But this *Bracton* limits to 2 Years. At 12 ſhe is able to ratify and confirm a former Conſent given to Matrimony; at 14 ſhe is able to receive her Lands into her own Hands, and ſhall be out of Ward, if ſhe be at that Age at her Anceſtor's Death; at 16 ſhe ſhall be out of Ward, tho' ſhe was under 14 at the Death of her Anceſtor; at 21 ſhe is able to alienate her Lands and Tenements.

AGOGICE, is the Art of making Images or Figures in Metals, when Wax is us'd to effect or further the Deſign.

AIDE, in the Law, hath ſeveral Significations; ſometimes 'tis the ſame with *Subſidy*; ſometimes a Proteſtation due from Tenants to their Lords. This Word is alſo us'd in matter of Pleading for a Petition made in Court, for the calling in of the Help from another that hath an Intereſt in the Cauſe in Queſtion. Thus a Tenant for Term of Life, by Courteſy, Tenant in Tail after Poſſibility of Iſſue extinct, for Term of Years, at Will, by Elegit or by Statute Merchant, being impleaded touching her Eſtate, may *pray in Aid* of him in the Reverſion; that is, deſire the Court that he may be called in by Writ, to alledge what he thinks good for the Maintenance both of her Right and his own; but this Courſe hath been diſus'd. If a King's Tenant holding in Chief be demanded a Rent of a common Perſon, he may pray in *Aid of the King*; and ſo may a City or Burgh, having a Fee-Farm of the Crown, when any thing is demanded againſt them belonging thereunto.

AIR, the admirable Sir *Iſaac Newton*, in the Obſervations mention'd in the 2d Book of his Opticks, by conſidering the Colour'd Rings made by Compreſſing two Priſms, or two Object Glaſſes of large Teleſcopes together, comes to a Calculation of the Thickneſs of the Air contain'd between the Priſms and Object Glaſſes in ſuch a State of Compreſſion; and at laſt he ſeems (he ſaith) to gather this Rule, That the Thickneſs of the Air is proportionable to the *Secant* of an Angle, whoſe *Sine* is a certain mean Proportional between the Sines of Incidence and Refraction. And that mean Proportional, ſo far as by the Meaſure he took could be determin'd, he found was the firſt of 106 Arithmetical Mean Proportionals between thoſe Sines accounted from the greater of the Sines (*i. e.*) from the Sine of Refraction, when the Refraction is made out of the Glaſs into the Plate of Air; or from the Sine of Incidence, when the Refraction is made out of the Plate of Air into Glaſs. And in Obſervation 14. Page 18. He ſaith that the *Thickneſs* of the Air between the Glaſſes there, where the Rings are ſucceſſively made by the Limits of the 7 Colours, Red, Orange, Yellow, Green, Blue, Indico and Violet, in order; are to one another as the Cube Roots of

the Squares of the eight Lengths of a Musical Chord which Sound the Notes in an Eighth, *Sol, la, fa, Sol, la, mi, fa, Sol*: That is as the Cube Roots of the Squares of the Numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$.

And according to his most accurate Observations, the Thickness of the thinned Air, which between two Glasses exhibited the most Luminous Parts of the first six Rings of Colours, were $\frac{1}{178000}$ $\frac{3}{178000}$ $\frac{5}{178000}$ $\frac{7}{178000}$ $\frac{9}{178000}$ $\frac{11}{178000}$ Parts of an Inch.

'Tis highly probable that True and Permanent Air is made by Fermentation, (saith the same Author) and Rarefraction of Bodies that are of a very fixt Nature: Those Particles flying and avoiding one another with the greatest Force *at a Distance*, which when *very near*, *attract and adhere* to one another with the greatest Violence.

The Particles therefore of true and permanent Air, being Extracted from the Densest and most fix'd Bodies, will be Denser and Crasser than those of Vapour; and from hence it is likely, may be Heavier also than those, and that the Parts of a Humid Atmosphere may be Lighter than those of a dry one, as in Fact it appears to be; by the rising of the Mercury in dry Weather, and by Clouds and Vapours rising into and floating in our Atmospherical Air. And he very justly thinks that the Rarefraction and Condensation of the Air cannot be accounted for from the Spring or Elastick Forms of the Particles, without a Supposition that they are endued with some Centrifugal *Force* or *Power*, by which they *Fly and avoid one another*, and the Dense Bodies from whence they are Extracted. *See Attraction.*

And that this *Repelling Force*, which is the Cause of *Filtration* and of the Ascent of Water in small Capillary Tubes to much greater Heights than the Surface of the Water in the open Vessel, in which they are placed. The Air within the Tubes being much *rarer* than in more open Spaces, and by that means not pressing so much on the Surface of the Water *within* the Tubes as *without*. And this Account Dr. *Hook* had hinted at long ago. Sir *Is.* did in his admirable *Prin. Philo. Mathem. Prop.* 23. *P.* 301. long ago demonstrate, *That Particles endeavouring to recede from or avoid one another with Forces reciprocally proportional to the Distance between their Centers, will compose an Elastick Fluid whose Density shall be proportionable to its Compression*, and from such a Property all the Appearances of our Air may be very well accounted for. And I think much better than from the Supposition of its Particles being *Spires* contorted into *Spheres*, through whose Interstices the Rays of Light may freely pass, *&c.* tho' this be very ingenious: But I think can never solve the prodigious Rarefraction of this most useful Fluid.

AIRS *Resistance*: See *Resistance*.

AIRS *Weight*, in Proportion to the same Bulk of Water, seems pretty nicely determin'd by an Experiment lately made before the Royal Society by the ingenious Mr. *Hauksbee* (See *Phil Transf. N.* 305.) to be nearly 885 to 1.

ALARM *Post*, is the Ground appointed to each Regiment by the Quarter-Master-General, for them to march to in Case of an *Alarm*; in a Garrison 'tis the Place where every Regiment is order'd to draw up in on all Occasions.

ALBULA. This Word is used sometimes for a Spot in the Eye, and then seems to be the same with *Albugo*: But in the Plural *Albulæ*, signifies such very astringent Mineral Waters as have a great deal of Allum in them, and are chiefly used externally for Cleansing and Healing of Wounds and Ulcers.

ALCOLA, is sometimes used for *Aptha*, and sometimes signifies a Tartarous Sediment in Urine, and from hence Urine is sometimes call'd *Alcolita*.

ALGEBRA, besides the Authors mention'd in the Account of this Science under this Word in *Vol.* I. those that please to have a thorough insight into this wonderful and useful Art, may consult the following Authors,

*Diophanti Alexandrini Arithmeticorum Lib. 6, &c. cum Comment. C. G. Bacheti & Observationibus D. P. de Fermat. cui accessit Doctr. Analyticæ inventum novum. Tholosæ.* 1670. *Fol.*

*Labyrinthus Algebræ per Job. Jac. Ferguson.* 1667, 4*to.*

*Kersey's Algebra*, 2 *Vol. Fol. Lond.* 1683.

*Baker's* Geometrical Key of Equations. *Lond.* 1681.

*Tractatus de Principiis Calculi Exponentialis.*

*Analysis Geometrica, sive nova & vera Methodus Resolvendi tam Probl. Geometr. tam Quæst Arithmeticas pars prima, de Planis. Authore Hugo de Omerique Sanlacarense. Cadiz.* 1698.

*Vietæ oper Math. Lugd. Bat.* 1646. *Fol.*

*Jeak's* Arithmetick. *Lond.* 1696.

*Des Cartes Geometria cum Commentariis Schooteni. Amster.* 1659.

*Brancker's* Algebra, by Dr. *Pell. Lond.* 1668.

*Erasm. Bartholini Dioristice, seu determinatio Equationum. Hauniæ.* 1663.

*Wallisii Opera Mathematicæ. Oxon.* 1657.

his Algebra *English. Lond.* 1685.

*Comercium Epistolicum. Lond.* 1653.

*De Billy's Diaphantus Redivivus. Lugdu.* 1670.

*Wells's Arithmeticæ numerosæ & Speciosæ Elementa. Oxon.* 1698.

*Oughtredi Clavis Mathematica denuo Limata, Oxon.* 1667.

*Moor's* Algebra. *Lond.* 1660.

*Parsons* and *Wastell's Clavis Arithmetica. Lond.* 1703.

*Sturmii Mathesis Enucleata.*

*Balaam's Algebra. Lond.* 1653.

*Ward's* Algebra. *Lond.* 1698. and his Young Mathematicians Guide. 1706.

*Harris's* Algebra. *Lond.* 1705.

*Hays's* Fluxions. *Lond.* 1709.

*Bern. Nieuwentiit Analysis Infinitor. Amst.* 1695.

*Arithmetica Universalis*, by Sir *Isaac Newton. Cambridge.* 1707.

ALGEBRAIC-*Curve*, in Geometry, is of such a Nature, that its *Abscissæ* or *intercepted Diameters* bear always the same Proportion to their Respective *Ordinates*. Thus if the Product of any *Abscissa* multiplied into one and the same determinate Quantity be always equal to the Square of its corresponding Ordinate; then if that determinate Quantity be call'd $p$, the Abscissa $x$ and the Ordinate $y$; the Expression of the Nature of the Curve by way of Equation will be $px = yy$, where $p$ is the *Parameter* or *Latus Rectum* of the Figure; and the Curve is the common Apollonian Parabola; and because the two *indeterminate* or *flowing* Quantities $x$ and $y$, do here denote *strait Lines*; therefore the Curve is call'd an *Algebraick* or *Geometrick Curve*. And 'tis plain that the Number of such Curves must be infinite; because there may be an Infinity of Proportions or Relations between the *Ordinates* and the *Abscissa*.

But when the Nature of any *Curve* is expreſſed by an Equation, wherein one of the indeterminate or flowing Quantities repreſents a *Curve Line*; then that Curve is call'd a *Tranſcendental Curve*, and if the Curve which enters the Equation be *Geometrical*, or a Curve, as they call it, of the firſt *Kind* or *Degree*; then the tranſcendent Curve is call'd a *Curve of the ſecond Kind or Degree:* And when the Curve which enters the Equation repreſents a Curve of the ſecond Kind or Degree; then tne *Tranſcendental Curve* is call'd one of the *Third Kind*; and ſo on infinitely.

ALLUM-*Works*, *Allum* is made of a Stone of Sea-weed and Urine. The Stone is found in moſt of the Hills between *Scarborough* and the River of *Tees* in the County of *York*, and alſo near *Preſton* in *Lancaſhire*; 'tis of a blueiſh Colour, and will cleave like *Corniſh* Slate. The Mine which lies deep in the Earth and is pretty well moiſtned with Springs is the beſt. The dry Mine is not good, and too much Moiſture cankers and corrupts the Stone, making it nitrous. In this Mine are found ſeveral Veins of Stone call'd *Doggers*, of the ſame Colour but not ſo good. Here are found thoſe alſo which are commonly call'd *Snake-Stones*. For the more convenient working of the Mine which ſometimes lies 20 Yards under the Surface or Cap of the Earth (which muſt be taken off and barrow'd away) they begin their Work on the Declivity of a Hill, where they may be alſo well furniſh'd with Water. They dig down the Mine by Stages, to ſave Carriage, and ſo throw it down near the Places where they calcine it. The Mine before it is calcin'd, being expos'd to the Air will moulder into Pieces, and yield a Liquor whereof *Copperas* may be made: But being calcin'd it's fit for *Allum*; as long as it continues in the Earth, or in Water, it remains an hard Stone. Sometimes a Liquor will iſſue out of the Side of the Mine, which by the Sun's Heat is turn'd into natural *Allum*. The Mine is calcin'd with Cinders of *New-Caſtle* Coal, Woods and Furzes; he Fire made about two Foot and $\frac{1}{2}$ thick, two Yards broad, and ten Yards long. Betwixt every Fire are Stops made with wet rubbiſh; ſo that any one or more of them may be kindled, without Prejudice to the reſt. After, there are 8 or 10 Yards Thickneſs of broken Mine laid on this Fewel, and 5 or 6 of them ſo covered; then they begin to kindle the Fires, and as the Fires riſe towards the Top, they ſtill lay on freſh Mine: So that to what Height you can raiſe the Heap, which is oftentimes about 20 Yards, the Fire without any farther Help of Fewel, will burn to the Top ſtronger than at the firſt kindling, ſo long as any Sulphur remains in the Stones.

In calcining theſe Stones, the Wind many times does hurt, by forcing the Fire too quickly through the Mine, leaving it black and half burnt; and in others, burning the Mine too much, leaving it red. But where the Fire paſſes ſoftly and of its own Accord, it leaves the Mine *whole*, which yields the beſt and greateſt Quantity of Liquor.

The Mine thus calcin'd is put into Pits of Water ſupported with Frames of Wood, and ramm'd on all Sides with Clay; They are about ten Yards long, 5 broad, and 5 deep, and ſet with a Current that turneth the Liquor into a Receptory, from whence 'tis pumpt into another Pit or Mine. So that every Pit of Liquor, before it comes to boiling, is pumpt into four ſeveral Pits of Mine; and every Pit of Mine is ſteeped in four ſeveral Liquors before it be thrown away, and the laſt Pi being always of the freſh Mine.

This Mine thus ſteeped in each of the ſeveral Liquors 24 Hours, or thereabouts, is of courſe four Days in paſſing the four ſeveral Pits from whence the Liquors paſs to the boiling-Houſe.

The Water, or Virgin Liquor often gains in the firſt Pit, two Pounds Weight; in the ſecond it increaſeth to five Pounds, in the third to eight Pounds, and in the laſt Pit which is always freſh Mine to twelve Pounds; and ſo in Proportion according to the Goodneſs of the Mine, and its being well calcin'd. For ſometimes the Liquors paſſing the four ſeveral Pits, will not be increas'd to above ſix or ſeven Pounds Weight, and at other times above twelve Pounds; ſeldom holding a conſtant Weight one Week together: Yet many times Liquor of ſeven or eight Pounds Weight produces more *Allum* than that of ten or twelve Pounds Weight, either through the Badneſs of the Mine, or its being ill calcin'd, which is the uſual Reaſon.

And if by paſſing the weak Liquor thro' another Pit of freſh Mine, you bring it to be ten or twelve Pounds Weight, yet you ſhall make leſs *Allum* with it, than when it was but eight Pounds Weight. For what it gains from the laſt Pit of Mine will be moſt *Nitre* and *Slam*, which poiſons the good Liquors, and diſorders the whole Houſe, till the *Slam* be wrought off.

That which they call *Slam*, is firſt perceived by the Redneſs of the Liquor when it comes from the Pit, occaſion'd either by the Badneſs of the Mine, or more uſually its being over or under calcin'd, which in the *Settler* ſinks to the Bottom, and there becomes a muddy Subſtance, and of a dark Colour. That Liquor which comes whiteſt from the Pits is the beſt.

When a Work is firſt begun, they make *Allum* of the Liquor only that comes from the Pits of Mine, without any other Ingredients. and ſo might continue, but that it would ſpend ſo much Liquor as not to quit Coſt.

*Kelp* is made of a Sea-weed call'd *Tangle*, ſuch as comes to *London* in Oyſter Barrels. It grows on Rocks by the Sea-ſide, between high and low Water Mark. Being dry'd it will burn and run like Pitch; when cold and hard, 'tis beaten to Aſhes, ſteeped in Water, and the Lees drawn off to two Pound Weight or thereabouts.

Becauſe the Country People who furniſh the Work with Urine, do ſometimes mingle it with Sea-Water, which cannot be diſcover'd by Weight, they try it, by putting ſome of it to the boiling Liquor; For then if the Urine be Genuine it will work like Yeaſt put to Beer or Ale; but if mingled, it will ſtir no more than ſo much Water.

They obſerve that the beſt Urine for that Purpoſe, is ſuch as comes from poor labouring People who drink but little ſtrong Drink.

The boiling Pans are made of Lead, nine Feet long, five broad, and two $\frac{1}{2}$ deep, ſet upon Iron Plates about two Inches thick; which Pans are commonly new Caſt, and the Plates repair'd five times in two Years.

When the Work is begun, and *Allum* once made, then they ſave the Liquor which comes from the *Allum*, or wherein it ſhoots, which they call the *Mothers*, with this they fill $\frac{2}{3}$ of the Boilers, and put in $\frac{1}{3}$ of the freſh Liquor which comes from the Pits. Being thus fill'd up with cold Liquor, the Fires having been never drawn out, it will boil again

again in less than two Hours time. And in every two Hours time the Liquor will waste four Inches, and the Boilers are fill'd up again with Green Liquor.

The Liquor if good, in the boiling, will be greasy, as it were, at the Top: If Nitrous, it will be thick, muddy and red. In boiling 24 Hours it will be 36 Pound Weight. Then is put into the Boiler about an Hogshead of the Lees of *Kelp*, of about two Penny Weight, which will reduce the whole Boiler to about 27 Pound Weight.

If the Liquor be good, as soon as the *Kelp Lees* are put into the Boiler, they will work like Yeast put to Beer. But if it be Nitrous, the *Kelp Lees* will stir it but very little; and in that Case the Workmen must put in more and stronger *Lees*.

Presently after the *Kelp Lees* are put into the Boiler, all the Liquor together is drawn into a *Settler*, as big as the Boiler and made of Lead, in which it stands about two Hours, and in that time most of the Nitre and *Slam* sink to the bottom.

This Separation is made by the help of the *Kelp Lees*, for when the whole Boiler consists of Green Liquor drawn from the Pits, it is of power strong enough to cast off the Slam and the Nitre; but when the *Mothers* are us'd, the *Kelp Lees* are needful to make the said Separation.

Next the said Liquor is scooped out of the *Settler* into a *Cooler*, made of Deal Boards, and ramm'd with Clay. Into this is put 20 Gallons, or more of the Urine, according to the Goodness or Badness of the Liquor, for when the Liquor is Red and Nitrous, the more Urine is requir'd.

In the Cooler, the Liquor in temperate Weather stands four Days; the second Day the *Allum* begins to strike, gather and harden about the Sides, and at the bottom of the Cooler.

If the Liquor should stand above four Days, then it would turn to Copperas.

The Use of the Urine is as well to cast off the *Slam*, as to keep the *Kelp Lees* from hardning the *Allum* too much.

In hot Weather the Liquor will be a Day longer in cooling, and the *Allum* in gathering, than in temperate Weather. But in Frost, the *Allum* shoots or strikes too soon, not giving time for the Nitre and Slam to sink to the bottom, whereby they are mingl'd with the *Allum*. This produces double the Quantity, but being foul 'tis consumed in washing.

When the Liquor hath stood four Day in the Cooler, than that call'd *Mother*, is scooped into a Cistern, the *Allum* remaining on the Sides and Bottom; and from thence the Mothers are Pumpt back into the Boilers again: So that every five Days the Liquor is boil'd again, until it evaporate or turn into *Allum* or *Slam*.

The *Allum* taken from the Sides and Bottom of the Cooler, is put into a Cistern and washed with Water, that they use for the same Purpose; being about 12 Pound Weight, after which it is *Roached* as follows.

Being washed, it is put into another Pan with a Quantity of Water, where it Melts and Boils a little; then 'tis scooped into a great Cask, where it commonly stays 10 Days, and is then fit to take down for the Market.

The Liquors are weigh'd by *Troy* Weight; so that half a Pint of Liquor must weigh more than so much Water, by so many Penny Weight. *From Phil. Transf. N.* 142.



ALMAN *Furnace* or *Almond*, as some write it, is a Furnace us'd by *Refiners*, and by them call'd the *Sweep*: By it all sorts of Metals are separated from Cinders, parts of melting Pots, Tests, Bricks and all other harder Bodies; which must first be beaten to Powder, before they are put into the Furnace.

This Furnace is about six Foot High, four Wide and two Thick, made of Brick, having a hole in the midst at the top, eight Inches over, and growing narrow towards the Bottom, whereon the forepart ends in a small hole environed with a Semicircle of Iron, to keep the melted Metal; about the middle of the Back there is another hole to receive the Nose of a great pair of Bellows.

When the Furnace is *Annealed* with Charcoal and hot, they throw two or three Shovels of Coal to one of the forementioned powder'd Stuff, and so proceed during the whole Work, which continues without Intermission three Days and Nights.

After eight or ten Hours the Metal begins to run; and when the Receiver below is pretty full, they lade it out with an Iron Ladle, and cast it into *Sows*, in Hollows, or *Forms* made with *Ashes*.

ALMONER, is an Officer in a King's or Prince's House, whose Business is to distribute Alms to the Poor; he hath Forfeiture of all *Deodands* and the Goods of *Felons de se*, which he is to dispose of to the Poor. *Terms de Ley* 39.

ALNAGER, *Aulnager*; properly one that measureth Cloth by the Ell, the doing of which is *Alnage*. He is a publick sworn Officer of the King, who either by himself or his Deputy, looks to the Assize of Woollen Cloth throughout the Kingdom, and to the Seals for that purpose ordain'd. Now there are three Officers belonging to this Affair, the *Searcher*, the *Measurer*, and the *Alnager*; which last is now become the Collector of the Subsidy granted to the Crown by several Statutes.

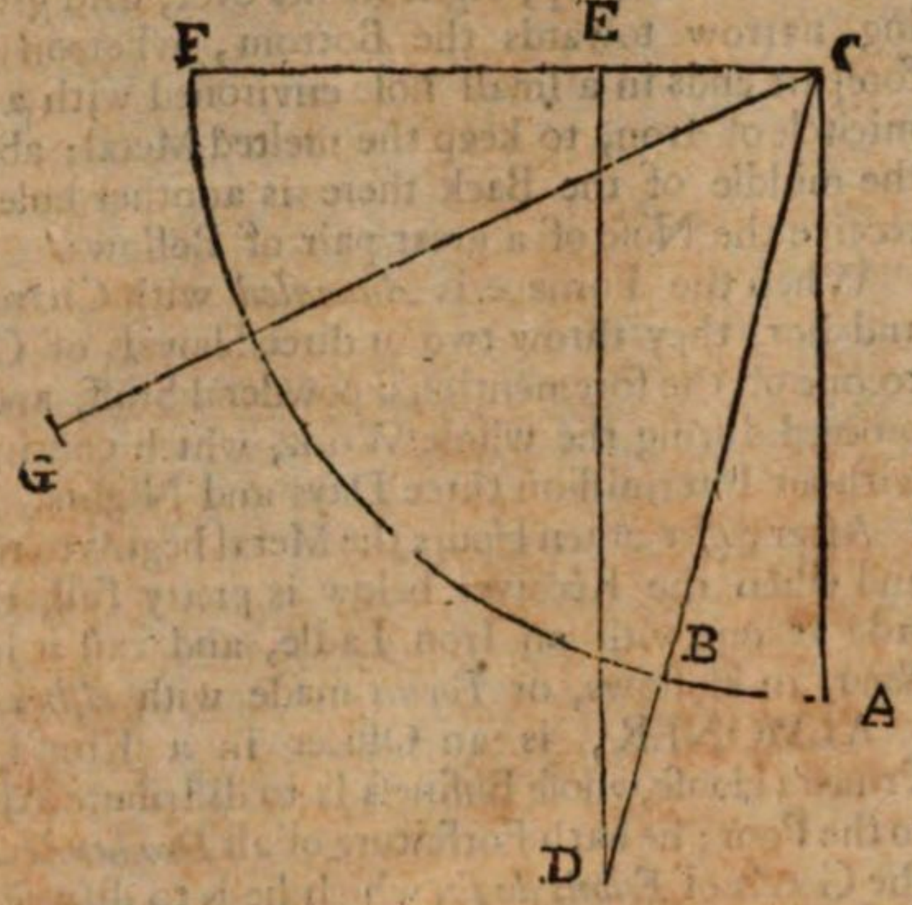
ALOOF, is a Sea Term, signifying as much as *keep your Luff*; being a Word of Command from him that *Conns*, to the Man at the Helm to keep the Ship near the Wind, when she Sails upon a Quarter Wind.

ALOPEX, is by some Writers, a Term us'd for the Muscle *Psoas*.

ALTITUDE of the Eye in Perspective; See Height. *Vol.* II.

ALTITUDE of the Sun. *To find it readily at any time without a Quadrant or ſuch like Inſtrument.*

On any plain Place erect a Pin or Wire perpendicularly as in the point *C:* From which point, you had before with 60 of a Line of Chords, deſcribed the Quadrantal Arch *A F*, make *C E* equal to the Heigth of the Pin or Wire, and through *E*




draw *E D* parallel to *C A*, and make it equal to *C G* the Length of the Shadow. Then will a Ruler laid from *C* to *D*, interſect the Quadrant in *B*, and *B A* is the Arch of the Sun's Altitude, when meaſur'd on the Line of Chords.

ALVUS, is the lower Belly; but in a medical Senſe is ſometimes us'd rather for the State and Condition of the Inteſtines and their Contents. If the Patient be too *Laxative*, they call it *Alvus Liquida* or *Fluida*: if he be too *Coſtive*, *Alvus dura*; and when he is ſo in a very great Degree, *Alvus adſtricta*.

AMABYR, or *Anvabyr*, was the old Cuſtom of the *Pretium virginitatis Domino Solvendum*. *Henry Faſted Arundel*, by Deed dated 31 *Aug.* 3, 4. of *Phil.* and *Mar.* releas'd this Cuſtom to his Tenants by the Name of the Cuſtom of *Amabyr* and *Cherage*.

AMAASA, are ſuch Pieces of Glaſs as are us'd in Enammelling, and are ſometimes call'd *Encauſta*; by ſome *Smalta* and *Terræ Saracenicæ*. *Bruno.*

AMARACINON, is a very precious Ointment prepared with rich Oyls and highly Aromatick Spices.

AMBIGENAL *Hyperbola*, is an Hyperbola which hath one of its infinite Legs inſcrib'd in it, and the other circumſcrib'd about it.

AMERCEMENT. Dr *Kennet*, in the Gloſſary at the End of his *Parochial Antiquities*, ſhews that *Amerciamentum* is a pecuniary Puniſhment impos'd upon Offenders *a la mercie*, at the Mercy of the Court; and therefore in our Law is frequently call'd *Miſeri cordia*, and there is this ſtated Difference between *Fines* and *Amercemenes*; *Fines* are Puniſhments certain and determin'd by ſome Statute; but *Anercements* are Arbitrary Impoſitions proportion'd to the Fault, at the Diſcretion of the Court.

AMETHYSTA, are ſuch Medicines as will preſerve Men from being ſoon inebriated with Wine or ſtrong Liquor. *Bruno.*

AMMONION, is by ſome Writers us'd for *Collyrium*. Which ſee.

AMPHORA, was anciently a Meaſure of Capacity, ſometimes call'd κεβα'μιον, and was of 2 Sorts; the *Italian Amphora*, which *Galen* ſaith, held 72 Pound of Water: The *Attick Amphora*, which was larger, and was call'd μετρε'ω. See *Weights and Meaſures.*

ANALEMMA, when all the whole Furniture of this kind of Projection is drawn on a large Plate of Braſs or Wood; with an *Horizon* and *Curſor* fitted to it; then that Inſtrument is call'd an *Analemma*; and is indeed a very uſeful one. For by it may readily and univerſally be found, ſuch things as theſe:

I. *Having the Pole's Height and Day of the Month; to find the time of the Sun's Riſing and Setting, and conſequently the Length of Day and Night any where.*

Count the Latitude from the polar Point where all the Elliptical Meridians meet either *N* or *S*, as ſuppoſe 49 *deg.* and bring the Fiducial Edge of the Horizon to that degree of Latitude in the Limb, and mark where the Horizon cuts the Parallel for that Day; as ſuppoſe *April* 20. or when the Sun enters into ♉. Obſerve alſo which of the Hour Circles that point of Interſection is neareſt to; and that will give you the Time of the Sun's Riſing, in this Caſe about five or a little after; and therefore it will Set as much before 7. The time of its Setting being doubled gives the Length of the Day; and that of its Riſing doubled, gives the Length of the Night.

II. *To find the Length of the longeſt Day in any Latitude.*

Bring the moveable Horizon to the Pole's Height in the Limb as before; and then mark the Point where it cuts the Parallels of ♋ or ♑; (according as your Latitude is *North* or *South*) and then obſerve which of the Hour Circles is neareſt to that Point of Interſection as before.

III. *Having the Latitude, Sun's Place, and Altitude, to find the Hour of the Day.*

Bring the Horizon to the Latitude, ſuppoſe as before 49 *deg. N.* and the Sun's Place being ♌ of ♉ and his Altitude obſerv'd by a Quadrant or otherwiſe 18 *deg.* Then ſince the Degrees of the Curſor denote the ſeveral Parallels of Altitude, move the Curſor till 18 *deg.* on it, will juſt cut the Parallel of ♌ ♉ or *April* 20. for then that Hour Circle, which (as before) is next the Point of Interſection, will ſhew the time of the Day, which in this Inſtance will be either ſeven in the Morning or five in the Afternoon. And this will give the Hour very well, except between 11 and 12, and 12 and 1, where the Hour Circles run a little too cloſe to ſhew it exactly.

How to find the Sun's *Declination*, *Right Aſcenſion*, *Altitude*, *Azimuth* and *Hour*, &c. by a ready and eaſy Projection of part of the *Analemma*; you will find under theſe Words.

ANALYSIS *of Infinites.* Se *Fluxions* and *Geometry.*

ANCESTOR. The Law diſtinguiſhes between *Anceſtor* and *Predeceſſor*, the former being applied to a Natural Perſon; as *A B* and his *Anceſtor*;

the latter to a Body Politick or Corporate; as a Bishop and his Predeceſſors.

Tho' the Word *Anteceſſor*, whence *Anceſtor* is deriv'd, is not applied to the *Anceſtor* of a Family, but to the Prepoſſeſſor of an Eſtate, or a Predeceſſor in Office. *Anceſtrel* Homage, is ſuch Homage as hath been perform'd by our *Anceſtors*.

ANCHORS, in *Architecture*, is a certain Kind of Carving, in the Form of an Anchor or Arrow Head, which is placed by way of Ornament to the *Boultins* of Capitals of the *Tuſcan*, *Dorick* and *Ionick Orders*; and alſo to the *Boultins* of Bed Mouldings, of the *Dorick*, *Ionick* and *Corinthian* Corniſhes. The Anchors and Eggs being placed alternately.

ANCIENT *Demeſne* or *Demayn*, is a certain Tenure whereby all Manors belonging to the Crown in St. *Edward*'s or *William the Conqueror*'s Time were held. The Numbers and Names, &c. of ſuch Manors were entred by the *Conqueror*, in a Book call'd *Doomſday Book*, and now remaining in the *Exchequer*; ſo that ſuch Lands as by that Book appear'd to have belong'd to the Crown at that Time, are call'd *Ancient Demeſne*. The Tenants in *Ancient Demeſne* are of two Sorts; one that hold their Lands frankly by Charter, the other by Copy of Court-Roll, or by the Verge at the Will of the Lord, according to the Cuſtom of the Manor. The Advantages of this Tenure are, 1. That Tenants holding by Charter cannot be rightfully impleaded out of their Manor; and when they are, they may *abate* the Writ by pleading the Tenure. 2. They are free from Toll for all things relating to their Livelihood and Huſbandry: Nor can they be impannell'd upon any Inqueſt.

ANCONY, is the Term in the Iron Works for a *Bloom*, wrought into the Figure of a flat Iron Bar of about three Foot long, with two ſquare rough Knobs, one at each End, which are afterwards to be wrought at the *Chafery*. See *Iron*.

ANGARIA, was formerly the Word for any troubleſome or vexatious Duty or Service paid by the Tenant to the Lord.

ANGEL, the Name of a Gold Coin in *England*, which ſeems to be ſo call'd from the Figure of an Angel impreſs'd upon it: Its Value in 1 *H.* 6. was 6 *s.* 8 *d.* in 1 *H.* 8. 7 *s.* 6 *d.* in 34 *H.* 8. 8 *s.* in 6 *Ed.* 6. 10 *s.* and the half Angel, or as it was ſometimes call'd the *Angelet*, was the Moiety of this. *Chron. Precioſ.*

ANGLE *of Inclination* of the Plane of a Planet's or Comet's Orbit to that of the Ecliptick, is the Angle made by the Interſection of the Planes of thoſe two Orbits. For the Orbits of the Planets are by no means all in the ſame Plane, but diverſely inclined to one another and to the Orbit of the Earth; which is taken for the Standard, and is call'd the Plane of the Ecliptick, in the *N.* Aſtronomy. And to this Plane the Planes of the Primary Planets Orbits are thus inclin'd. The Angle of *Saturn*'s Orbit with the Earth's Orbit is 2°. 30'. that of *Jupiter* is 1°. 20'. that of *Mars* a little leſs than 2 Degrees; that of *Venus* a little more than 3°. 20'. and that of *Mercury* almoſt 7°. 00'.

ANGUINEAL *Hyperbola*, is one of an Eel-like Figure, which cuts its Aſymptote with contrary Flexions, and is produced both ways with contrary Legs. See *Curves*.

ANGULAR *Motion*, in Aſtronomy, is the Increaſe of the Diſtance between any two Planets, &c. revolving round any Body as the Centre of their Motion; and is expreſs'd by two Right Lines drawn from the ſaid Centre to the Revolving Bodies, which will open wider, and conſequently grow greater, as the Revolving Bodies part farther and farther from one another.

ANIMAL *Secretion*, is that Action in an Animal Body, whereby, by means of the Glands, all proper Separations of Particles proper to be ſecerned or ſeparated from the Blood are made, throughout its whole Courſe of Circulation. How theſe *Secretions* are every where made in the Body, 'tis of very great Uſe to underſtand; and ſome of our Modern Phyſicians, who have apply'd themſelves to conſider the wonderful Machine of a Human Body Geometrically and Mechanically, have made great Advances this way; ſuch as *Borelli*, *Bellini*, *Baglivi*, *Pitcairne*, *Cheyne*, *Wainwright*, &c. from whom you have the following Account of this important Affair.

The Nature of *Secretions* in general depends upon theſe three Things. (1.) *The different Diameter of the Orifice of the Secretory Duct*; for thereby all Particles, whoſe Diameters are greater than thoſe of the Ducts, muſt be excluded; and it may be concluded, that any Peccant or Morbifick Matter may be evacuated therefore by any of the Glands, provided that their Orifices be but ſufficiently enlarg'd, together with the Diameters of the Secretory Ducts.

(2.) *The different Angle which the Secretory Duct makes with the Trunk of the Artery.* For all Fluids preſs the Sides of the containing Veſſels in a Direction perpendicular to its Sides; and this is evident in the Pulſation of the Arteries, ſince 'tis to that *Preſſure* that this Pulſation is owing. It is likewiſe evident, that the Blood is urg'd forward by the Force of the Heart; ſo that this *Motion of Secretion* muſt be compounded of both theſe Motions. Now this *Lateral Preſſure* is greater when the Velocity of the *Longitudinal Motion* is ſo too; but yet 'tis not in the Proportion of this Velocity. For the *Lateral Preſſure* is conſiderable, even when the Fluid is at reſt; being then in Proportion to the Specifick Gravity of the Fluid. And in a Fluid, like the Blood in the Arteries, which is urg'd by a Longitudinal Direction, this *Lateral Preſſure* is in a Compound Proportion of both: From whence it will follow, that if two Particles of equal Diameters, but of unequal Specifick Gravity do arrive, with the ſame Velocity, at an Orifice capable of admitting them, yet they will not *both* enter it and paſs, becauſe their *Motion of Direction* is different. So that this *Diverſity in the Angles*, which theſe Ducts make with the Trunk of the Artery, ſeems altogether neceſſary to account for the poſſible Diverſities of *Secerned* Fluids, even ſuppoſing their Diameters and Figures to be the ſame: For no doubt the Blood is a *Heterogeneous* Fluid, and contains Parts of very different Specifick Gravities, Cohæſions and Denſities; whereas the ſeparated Fluid muſt be *Homogeneous*, in order to perform the uniform Functions of Life.

(3.) *The different Velocities with which the Blood arrives at the Orifices of theſe Secretory Ducts.* For ſince the Secretions are made in Form of a *Fluid*, no poſſible Reaſon can be aſſign'd, why ſince Animals have a ſoft looſe Texture and Union of the Solid Parts, and why one Part of the Body is of a tender, looſe, eaſily ſeparable Texture, and others of an harder, firmer, and more cloſe Cohæſion; but this different *Velocity* of the Blood, at the Orifices of the *Secretory Ducts*. And tho' the Diver-

Diverſity of the Diameters of theſe Ducts, is certainly that which is of the greateſt Moment in this Affair of *Secretion*; yet 'tis impoſſible to account for the Similarity of the Secerned Fluids from one ſo *Heterogeneous*, as the Blood is from *this alone*: Since all Particles of never ſo different Kinds and Natures will be indifferently ſeparated there, if their Diameters are leſs than thoſe of the *Secretory Ducts*, and their *Direction* right.

Again, more particularly from what the above-mention'd Authors have deliver'd, ſuch Propoſitions as theſe may be eſtabliſh'd.

I. *That of an Heterogeneous Fluid at reſt in the Body, and equally preſs'd, the moſt Liquid Part muſt be forc'd out firſt.* II. That of ſuch an Heterogeneous Fluid as the Blood, when it *ſtagnates*, its heavy Parts will precipitate, and its light be elevated; and all will take place according to their Specifick Gravities. And when it doth not *ſtagnate*, the Separation of the heavy Parts from the light, will be in Proportion to the Slowneſs of the Motion of the Fluid. III. The red Fibrous Part of the Blood on its Stagnation retires to its Centre, and forces the *Serum* to the Sides of the Veſſel which contains them; and from theſe two Propoſitions it will follow, that the *ſlower* the Blood's Motion is, the more *Serum* will be ſeparated from it, *cæteris paribus*. IV. The moſt viſcid Parts of the *Serum* are the higheſt, *viz.* ſuch as are ſeparated in the Glands of the Noſe, Mouth, Palate, Windpipe, Stomach, Guts, *&c.* becauſe theſe *ſwim* in Water, which is lighter than *Serum*. V. Fluids reſiſt the Motion of ſuch Bodies moſt, whoſe Surfaces are greater in Proportion to their Solidities, or whoſe Specifick Gravities are the leaſt. Wherefore the moſt viſcid Part of the *Serum* muſt be *the leaſt Suſceptible of Motion*, or muſt be moved with the greateſt Difficulty through the Arteries. VI. A Fluid forc'd thro' a Concave Cylinder (and much more ſo thro' a Concave Cone) moves with greater Celerity at the *Axis* than at the Sides. This *Baglivi* ſaith, he hath obſerv'd in the Arteries of Frogs. Wherefore the lighteſt Parts being leaſt ſuſceptible of Motion, will be forc'd to the Sides of the Arteries where there is the leaſt Motion: So that where there is the leaſt Motion, there will the lighteſt or moſt viſcid Part of the *Serum* be ſeparated: and from hence it will follow alſo, *That the Viſcidity of the ſeparated Fluid will be reciprocally as the Celerity of the Blood at the Orifice of the ſeparating Canal.* Again, Since *Bellini* hath prov'd that the Velocity of the Blood, at the Orifice of the Secretory Duct, is as the Number of Plications, Folds or Turns in the complicated Artery (*Prop.* 40. *de Motu Cordis*,) therefore the *Viſcidity of the Secerned Matter, will be alſo as the Number of Plications in the complicated Artery.* VII. When the Motion of the Blood is too ſlow, the moſt *Serous* Part is thrown on thoſe Arteries which are the ſmalleſt, moſt complicated, or at the greateſt Diſtance from the Heart. VIII. The *Inteſtines* in an Animal are a *Gland*, and the *Lacteals* are the *Secretory Veſſels*. IX. The Orifices of the Excretory Veſſels of any Gland are *Circular*, becauſe all the Veſſels of the Body, in which the Blood or other Fluids move, are either hollow Cylinders or Cones: for the Preſſure of a Fluid being always Normal to the Sides of the containing Veſſel, and being at equal Diſtances from the Centre, the Sides muſt be every where equally diſtracted, *viz.* a Section perpendicular to the Axis of the Veſſel muſt be a Circle, and therefore the Veſſel muſt be either of a *Cylindrick* or *Conical* Figure. Now from hence it will follow, that the Orifices of Secretory Ducts of different Glands, differing not in Figure but only in Magnitude; *The Fluids ſeparated in different Glands, will differ only in Degrees of Cohæſion and Fluidity.* X. *The Relaxed Coat of any Gland increaſes the Viſcidity of the Secerned Matter*, vice versâ. The Reaſon of which is, that the Matter will grow much more Viſcid by ſtaying longer in the Gland, the thin Parts being evaporated by the Heat of the Body. XI. *Such Glands, whoſe Compounding Arteries are moſt complicated, ſecern the moſt Viſcid Matter from the Blood*; for in theſe Arteries, the Reſiſtance being greater than in *ſtrait* ones, the Motion of the Blood muſt be ſlower *in Proportion to the Number of their Plications*; *and where the Blood runs ſloweſt, its Viſcidity will be greateſt*, &c. XII. *The Quantity of Fluid Matter ſeparated in any Gland, is in Compound Proportion of the Quantity of the Blood*; *its Celerity at the Orifices of the Excretory Veſſels, and the Wideneſs of thoſe Orifices directly, and the Viſcidity of the Blood reciprocally.* XIII. *An increas'd Quantity of Blood increaſes the Fluid Secretions, in a Proportion greater than the Viſcid*; *and a decreas'd Quantity will leſſen the Fluid Secretions more than the Viſcid.* XIV. *An increas'd Celerity of the Blood's Motion increaſes the Fluid Secretion more than the Viſcid*, & vice versâ. XV. *An Univerſal Enlargement of the Orifices of all the Glands increaſes the Fluid Secretions*, &c. & vice versâ. XVI. An increas'd Viſcidity *of the Blood decreaſeth the Fluid Secretions more than the Viſcid*: *& vice versâ*, an increas'd Fluidity increaſeth the Fluid Secretion more than the Viſcid ones. See Dr. *Moreland*'s Letter to Dr. *Mead* about the Secretions in an Animal Body, *Philoſ. Tranſ.* N. 283. See alſo an Account of the Nature of Animal Secretion, by *Franciſcus Spolatus*, in the *Leipſick Acts* of *Nov.* 1687.

ANNIVERSARY, was called by our Forefathers, a *Year-Day* and a *Mind-Day*, i. e. a *Memorial-Day*; and is properly the yearly Return of the Day of the Death of any Perſon: And this Day the Religious regiſtred in their Obitual or Martyrology, and annually obſerved in Gratitude to their Founders and Benefactors.

ANNUALIA. The Learned Author of the *Chron. Preciſum* ſaith, that theſe were ſuch Oblations as were made by the Relations of deceas'd Perſons on the Day of their Deaths every Year: Which Day our Forefathers called the *Year's-Day*, or *Year's-Mind*; and on it Maſs was celebrated with very great Solemnity.

ANNUITY: For the Recovery of an Annuity no Action lies, but only a *Writ of Annuity* againſt the *Grantor*, his Heir, or Succeſſors.

ANNULETS in Architecture, this ſignifies a narrow flat Moulding, which is common to other Parts of a Column, the Baſes, *&c.* as well as the Capital. And 'tis the ſame Member which ſometimes is called a *Fillet*, a *Liſtelle*, a *Cincture*, a *Supercitium*, *Liſte*, *Tince*, *Square*, and *Rabit*.

ANTÆ, the ſame with *Antes*.

ANTIPÆGMENTS, in Architecture, are the Ornaments or Garniſhings in Carved Work which are ſet on Architraves, whether of Wood or Stone.

ANTIPATHY, is properly an Affection of a contrary Nature to another; and therefore what we do in a very high Degree diſlike, or have an

Averſion againſt, we ſay we have an *Antipathy* to.

'Tis eaſy to ſee that this may have place in the Affections and Paſſions of Mankind; but whether there be any ſuch thing in the Properties of Natural Bodies, has been queſtioned; and I think, as Dr. *Hook* hath long ſince obſerved, the Effects which ſome have thought owing to ſome ſecret Antipathies in the Natures of Things, ought rather to be aſcribed to an *Incongruity*: See *Congruity*.

ANTIQUE, is a Word much uſed by Architects, Sculptors, and Painters; and by it they mean all the ancient Pieces of Architecture, Sculpture, and Painting, from the Time of *Alexander the Great*, to the Irruption of the *Goths*; as alſo *Intaglias* within that Time: All which they call *Antique*; and whatever is done in Imitation of the great Maſters of that Age, they ſay is after the *Antique Manner*.

APERTIONS, in Architecture, are the Openings in any Buildings; ſuch as Doors, Windows, Stair-caſes, Chimneys, Outlets or Inlets for Light, Smoak, *&c.*

APHRODITARIUM, is a dry Medicine made of an equal Weight of Frankincenſe, Pomegranate, Ceruſs, Meal, and Scales of Braſs; and *Galen* calls a kind of *Collyrium* by this Name.

APHROGEDA, is Milk beat into an entire Froth, and was a Medicine uſed by *Galen*.

APRON, is a piece of Lead which laps over or covers the *Vent* or *Touch-hole* of a great Gun.

APPETITUS *Caninus*, is an Inordinate extravagant Hunger, to the Degree of a Diſeaſe, ſo that Men come to devour every thing like Dogs, 'Tis attended with a Lienteria uſually, or ſome ſuch Cœliacal Flux, by which it is diſtinguiſh'd from βυλιμία: 'Tis called ſometimes *Phagedæna*.

APPROPRIATION, is the granting a Parochial Church, or the great Tithes and better Profits, *ad Proprios uſus*, to the proper Uſe of ſome religious Houſe, to enjoy for ever: Whence it was call'd *Perpetuum Beneficium*.

ARCHES, are part of the inward Support of any Superſtructure, and they are either Circular, Elliptical or Streight. Of the Circular Arches ſome are exactly Semi-circular, as the Arches of Bridges, *&c.* ſome are ſuch as the Workmen call *Skeen* or *Scheme*, which are flatter Arches, leſs than a Semi-circle. Some Circular Arches are ſuch as thoſe in our *Gothick* Buildings, *di Tarzo & di quarto acuto*, as the *Italians* call them, or as we ſay of the third and fourth Point. Becauſe they conſiſt of two Arches of a Circle (meeting in an Angle at the Top) and drawn from the Diviſion of a Chord into three or four, or more Parts at pleaſure. *Eliptical Arches* were formerly much us'd inſtead of Mantle-Trees in Chimneys: They had a *Key-ſtone*, and *Chaptrels* or *Impoſts*, and conſiſted of two Hanſes and a Scheme. *Strait Arches* are us'd over Windows and Doors, *&c.* having plain ſtrait Edges both upper and under; theſe Edges are parallel, but both the Ends and Joints do all point towards a certain Centre. They are now uſually about a Brick and a half thick, which when rubbed is abour 12 Inches. The Workmen call the levelling End of this Arch the *Skew-back*; and the level Joints between the Courſes of Bricks in the Arch, they call the *Sommering*.

ARCHES, the Judge of the Court of the Arches is call'd the *Dean of the Arches*, or the *Official of the Arches Court*, &c. with this *Officialty* is commonly joined a peculiar Juriſdiction of 13 Pariſhes in *London*, term'd a *Deanery*, and exempt from the Authority of the Biſhop of *London*, and belonging to the Archbiſhop of *Canterbury*: Of which the Pariſh of *Bow* is one, and the Principal, becauſe the Court is kept there. Others think he was firſt call'd the *Dean of the Arches*, becauſe the *Official* to the Archbiſhop being many times employ'd abroad in Embaſſies for the King and Realm, the *Dean of the Arches* was his Subſtitute in this Court, and by that means the Names became confounded. The Juriſdiction of this Judge is ordinary and extendeth it ſelf through the whole Province of *Canterbury*, ſo that on any Appeal made, he forthwith, and without any farther Examination of the Cauſe, ſends out his Citation to the Appellee, and his Inhibition to the Judge from whom the Appeal was made. *Vid. Hiſtor. de Antiq. Eccleſ. Britan.* and 4. part of *Inſtit. Folio* 337. *&c.*

ARCH-DEACON, being only a Perſon choſe out of thoſe Deacons which were originally the Attendants on, and Servants to the Biſhop in Spiritual Affairs, at firſt was a Perſon employ'd by the Biſhop in more ſervile Uſes, and he always was in Sub-ſervience to the *Urbans or Rural Deans* of Chriſtianity; to whom Arch Deacons were as much inferior, as their Order of Deacon was to that of Prieſt. Till by the Advantages of a Perſonal Attendance on the Biſhop, and a Delegation to examine and report ſome Cauſes, and a Commiſſion to viſit ſome remoter Parts of a Dioceſe, their Power and Dignity was advanc'd above the *Arch-Presbyter* or *Dean*. Dr. *Kennet's* Gloſſary. 'Tis now allow'd, that Arch-Deacons have a Power, not only to Viſit, but to Suſpend, Excommunicate, and in many places to prove Wills, and in ſome to Inſtitute to Benefices. 'Tis one part of the Arch-Deacon's Office to Induct all Clerks into their Benefices within his Juriſdiction, and by the Act of Uniformity he is now obliged to be in Prieſt's Orders.

ARCHITECTURE. Some Writers on this Subject.

*Vitruvius* in *Latin* at *Amſterdam*, 1649. *Fol.*

In *Engliſh* by Mr. *Chriſtopher Waſe*.

In *French* by Mr. *Claude Perrault*. *Paris*, 1673. *Fol.*

*Courſe d' Architecture Enſeigni dans l' Academie Royal d' Architecture. Par Mr. Fran. Blondell, a Paris*, 1675. *Fol.*

Mr. *Evelyn's* Parallel of Architecture, laſt Edit. 1706. *Lond. Fol.*

*Adami Boecleri Architectura curioſa nova cum multis Figuris. Norimberg.*

*Albert Dureri*, *Architectura & Geometria. Paris*, 1535.

*Potſi's* Architecture in 2 *Vol. Fol.* in *Latin* and *Italian*, and lately done into *Engliſh*.

*L' Architecture par Jacques Androuet du Cerceau Paris*, 1615.

*L' Architectura d' Andria Palladio. Venet.* 1642. *con Fig.* This is tranſlated into *Engliſh*.

*Vitruvius* and *Vignoia*, abridged by Mr. *Perault*.

*Palladio's* Architecture.

*Scamozzi's* } Architecture.
*Wotton's* }

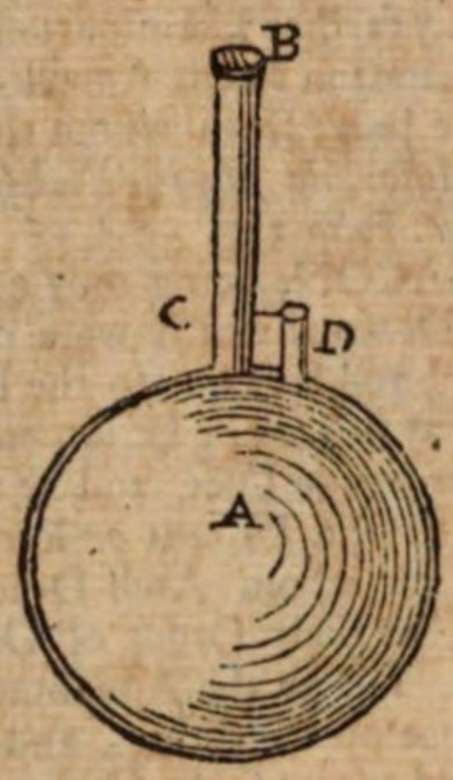
ARCHIVES, are the *Rolls*, *Chancery*, *Exchequer Office*, or any Places where ancient Records, Charters and Evidences are kept.

ARCH-PRESBYTER, the ſame with *Rural Deans*.

ARCUALIA *Oſſa*, are the Bones of the *Sinciput*; and according to *Barthol.* were the *Oſſa Temporum*. And the *Coronal Suture*, is by ſome Writers call'd alſo *Arcualis*.

AREO-

AREOMETER, beſides that mention'd in *Vol.* I. Mr. *Homberg* of *Paris* hath invented a new Inſtrument of this Kind, which is deſcrib'd in *Phil. Tranſ. N.* 262. Thus, *A* is a Glaſs-Bottle or Matraſs with ſo ſlender a Neck, that a Drop of Water takes up in it about five or ſix Lines, or $\frac{6}{11}$ of an Inch. Near that Neck is a ſmall Capillary Tube *D*, about ſix Inches long, and Parallel to the Neck.




When the Veſſel is filled, the Liquor is poured in at the Mouth *B* (which is widen'd to receive a Tunnel) till it run out at *D*; that is, till it riſe in the Neck to the Mark *C*, by which means you have always the ſame Bulk or Quantity of Liquor; and conſequently, can eaſily tell when different Liquors fill it, which weighs moſt, or is moſt intenſively heavy. But ſome Regard is to be had to the Seaſon of the Year and Degree of Heat and Cold in the Weather: For ſome Liquors will rarify with Heat, and condenſe with cold; and accordingly take up more or leſs Room, See the Memoirs of the *French* Academy of Sciences for the Year 1699.

ARIETUM *Levatio*, an Old Sportive Exerciſe, frequently forbidden in our Epiſcopal Synods and Conſtitutions, and ſeems to have been the ſame with the Quintane or Quintal, as Dr. *Kennet* thinks. See his *Paroc. Antiquities.*

ARITHMETICK, Authors on this Subject are, *Wingate*'s Arithmetick, the laſt Edition.

*Tacquet*'s Arithmetick in *Latin* or *Engliſh.*

*Willisford*'s Arithmetick Natural and Artificial, *Lond.* 1656. a good old Book.

*Diophanti Alexandrini Arithmeticorum Lib. 6, & de Numeris Multangu'is lib. unus cum Commentariis G. Bocheti, & Obſervationibus P. P. de Fermat. cui acceſſit Doctrinæ Analyticæ inventum Novum. Toloſæ* 1670. *Folio.*

*Moor*'s Arithmetick.

*Parſon's and Waſtall*'s Arithmetick and Algebra.

*Jeak*'s Arithmetick in Folio.

*Wel*'s Arithmetick in *Latin. Oxon.*

Sir *Iſaac Newton*'s *Arithmetica Univerſalis. Cambridge.* 1607.

Ward's *Arithmetick, in his young Mathematician's Guide.*

ARMINGS, in a Ship, are the ſame with *Waſt-cloaths*, which are Red-cloaths hung about the out-ſides of the Ship's upper Works fore and aft, and before the *Cubbridge* Heads; and there are ſome alſo hung round the Tops, and theſe are call'd *Top Armings.*

ARQUEBUSS *a Croc*, is a Sort of ſmall Fort Arms, carries a Ball of about $3\frac{1}{2}$ Ounces, and is now us'd only in Old *Caſtile*, and in ſome Gariſons of the *French.*

ARTERIA *Bronchialis*, is a ſmall Artery (deſcribed by Mr. *Ruyſh*) which in the Lungs creeps along upon the Branches of the *Trachæa*, or the *Bronchia.*

## ARTERIES and VEINS.

*A Deſcription of the* Veins *and* Arteries *of a Human Body in the two Plates annexed, as preſented to the* Royal Society *in* London, *by that Generous Promoter of all uſeful Learning*, John Evelyn, *late of* Say's Court *in* Deptford, *Eſq; and explained and illuſtrated by that accurate Anatomiſt and Surgeon, Mr.* William Cowper.

* *Fig. 1ſt, 6th, and 8th.*

THESE * Figures are cloſely drawn after the Original Schemes, and I am apt to flatter my ſelf they will be acceptable to the inquiſitive. It is ſome Satisfaction, that I find the *Arteries* here ſo agreeable to a Figure which I drew and publiſhed not long ſince, from the *Arteries* of a *Fœtus* injected with Wax. But this Figure of the *Veins* differs ſo much from any extant, as would incline one to ſuſpect all of the Subject hitherto publiſhed are fictitious, not excepting even thoſe of *Veſalius.* But firſt of the *Arteries.*

That the *Arteries* are the Veſſels which convey Blood from the *Heart* to all Parts of the Body, is well known; and we ſee by Fig. the 1ſt, that the common Practice of Nature in diſtributing theſe Veſſels, to ſupply the Parts with Blood, is from the next adjacent Trunk, till their aſcending and deſcending Trunks become Conical, as well as their collateral Branches: Not that all the Trunks and Ramifications of *Arteries* are uniform, and become Conical in the ſame manner; nor do all of *them* paſs directly to the Parts to which *they* convey Blood; nor do all Parts receive *Arteries* from the neighbouring Trunks.

The Trunks of the *Carotid*, *Vertebral* and *Splenick Arteries* are not only *contorted* in their Progreſs, in the *Adult*; but the *Diameters* of their Bores are variouſly *dilated* in divers Parts of *them*, eſpecially where *they* are *contorted*; but as theſe Dilatations of their Trunks are caus'd by the Reſiſtance the Blood meets with at thoſe *Angles of Inflection*; ſo thoſe *Enlargements* of them afterwards contribute to retard the Protruſion of the Blood to the Extremities of thoſe *Arteries*: Hence it is, That as the *Arteries* of the *Fœtus* are not *contorted* in ſuch Acute Angles as in full grown Bodies, ſo their Trunks are more Conical, and not here and there dilated in divers Parts of them, as in the *Adult.*

The

The Trunk of the *Splenick Artery* has a ſtraight Progreſs in the *Fœtus* and in *Infants*; but in the *Adult* I have hitherto conſtantly found it very much *contorted*, as is expreſs'd in Fig. 1, 2, 3.

The peculiar Contrivances of the *Spermatick Arteries* of *Quadrupeds* as well as *Men*, ſhew a conſtant Deſign in Nature of taking off that Velocity with which the Blood would otherwiſe paſs thro' the *Glands* of the *Teſtes*: It ſeems to be for this End that the *Teſtes* of moſt Animals (eſpecially *Men* and *Quadrupeds*) hang out of the Cavities of their *Abdomens*, that the Canals of their Blood Veſſels may be lengthened: For the *Spermatick Arteries* (contrary to all others) ariſe from their Great Trunk, at a far greater Diſtance from the *Teſtes* than the *Arteries* of any other Part of the Body. Nor would the *Teſtes* (which are ſuch neceſſary Organs) have been thus expoſed to external Injuries, if the End of Nature in lengthening their Blood Veſſels had not been very conſiderable. Beſides this lengthening of the *Spermatick Arteries*, we find Nature ſtill contriving other Impediments to *check* the Current of the Blood in thoſe Parts; it ſeems for this End that the *Spermatick Arteries* are leſſen'd at their Original from the Trunk of the *Arteria Magna* in *Men*, and that the *Spermatick Arteries* of *Quadrupeds* are ſo much *contorted* before they reach their *Trifles*.

The principal Inducement of Nature in making uſe of theſe different Contrivances in the *Spermatick Arteries* of *Men* and *Quadrupeds* ſeems to be,

That if the *Human Spermatick Arteries* were contorted, as in *Quadrupeds*, before they reach their *Teſtes*, the Apertures in the *Abdominal Muſcles* of *Man* muſt be much larger than they now are, and would frequently let the *Inteſtines* deſcend into the *Scrotum*; which we know nevertheleſs often happens: Such *Ruptures* (as they are call'd) are not ſo incident to *Quadrupeds*, tho' the Paſſages for their *Spermatick* Veſſels (through their *Abdominal Muſcles*) are much wider than in *Men*, becauſe the Poſition of the Trunks of their Bodies is *Horizontal*, and their Inteſtines therefore cannot preſs on the Proceſſes of the *Peritonæum*, as in *Men*, who are *erect*.

Beſides theſe *Artifices* in diſpoſing the Trunks of *Arteries*, I doubt not much more will be detected by the inquiſitive: In the mean time, I ſhall, at preſent, purſue the Thread, and deſcribe the Extremities of the *Arteries*, with their *Communications* with the *Veins*, and afterwards produce ſome Inſtances of the Art of Nature in conveying the refluent Blood to the *Heart*.

After the *Circulation of the Blood* through the Heart, Lungs, and large Blood Veſſels, was demonſtrated by Dr. *Harvey*, it was only gueſs'd how the Extremities of the *Arteries* tranſmitted the Blood to the *Veins*, till Mr. *Lewenhoeck*'s *Microſcopes* had diſcovered the Continuation of the Extremities of thoſe Veſſels in *Fiſh*, *Frogs*, *&c.* which is now commonly ſhewn by *Microſcopes* made by other *Hands*: Yet there are not wanting *thoſe*, who doubt of the like Continuations of the Extremities of *Arteries* and *Veins* in *human Bodies* and *Quadrupeds*; ſince thoſe *Animals* it has hitherto been ſeen in (to any Satisfaction, as Mr. *Lewenhoeck* confeſſes) have been either ſuch *Fiſh*, or of the *Amphibious Kind*, that have but *one Ventricle* in their Hearts, and their Blood actually cold, except in Bats, in which it appears very obſcurely: Add to this, that the Blood in thoſe Creatures does not circulate with ſuch Rapidity as in *Animals* whoſe Hearts have *Two Ventricles*. For all Animals that have *Biventrous Hearts*, the Veſſels of the reſt of the Body return their Blood to the Heart in equal Time and Quantity with thoſe of the Lungs, notwithſtanding the Inequality of their Courſe.

This Difference in the principal Organs of the *Circulation of the Blood* in thoſe Creatures (on which only theſe *Experiments* have been hitherto made) mov'd me to make ſome, on *Animals* whoſe Organs differ only from the *Human* in their groſs Figure, and not in their intimate Structure: For this End I took a young *Cat*, about ten or twelve Days old, and faſtned it to a Board as in Viveſection; and making an Inciſion thro' the *Linea Alba*, the *Omentum* and Inteſtines were extruded, then cauſing the Creature to be ſo held (on the Board) under a large *double Microſcope*, where a flat Glaſs for receiving of Objects was placed Horizontally, on which I expanded the *Omentum* or Caul, (a Light being placed underneath) I ſaw the Globules of the Blood move very ſwiftly in the ſmall Veſſels, which are only to be ſeen in the moſt *tranſparent* Parts of the *Membranes* of its *Omentum*; but the Motion of the Blood ſoon abated, and its Globules were withdrawn from the Extremities of its Blood Veſſels; and in a little time became ſtagnant in their larger Branches.

This Appearance of the Continuation of the Extremities of the *Arteries* with the *Veins*, while the Blood was moving in them, in the *Omentum* or Caul, is expreſs'd by Fig. 4. A A ſhews the Trunks of the *Arteries*, B B the *Veins*, which were diſtinguiſhable by contrary Currents of the Globules of the Blood in each Veſſel. C C C ſhews the branching of the Extremities of the *Arteries* and *Veins*, that no longer aſſociate with each other, but are united, as here expreſs'd. After I had ſeen this, I attempted to ſhew the like to ſeveral *Friends*, but did not always ſucceed ſo well as when Mr. *Chambers* and Mr. *Buckeridge* favoured me with their Preſence, at a time when I happened to have a young lean Dog, that was not large; in whoſe *Omentum* we ſaw it very well; but by the Aſſiſtance of an Inſtrument I had prepared to expand the *Meſentery*, we all ſaw it there much better, that Part having not only larger and clearer Spaces than the *Omentum*, but its Blood Veſſels are diſtributed more regular, as appears by Fig. the 5th, where the ſame Letters of Reference ſerve as above.

Thoſe who will entertain themſelves in viewing the tranſparent Parts of living Creatures with *Microſcopes*, will find that the Extremities of their *Arteries* and *Veins* are not all equally leſſen'd, tho' united. In the Tail of the *Lacerta Aquatica*, *Tadpols*, and in moſt Fiſh (I have examin'd) I have frequently obſerv'd ſeveral Communications between the *Arteries* and *Veins*; in which more than two Globules of Blood have paſs'd abreaſt: And in the ſame *Area* I have ſeen ſome of thoſe *Communications* ſo ſmall, as that but one Globule could paſs, and that very ſlowly before the other. In young *Fiſh*, particularly in Grigs, I have frequently obſerv'd a *Communicant Branch*, ſo very ſmall as that one Globule of Blood only has paſs'd it in two or three Seconds of a Minute: At other times I have found conſiderable Intervals in paſſing

sing of one Globule in such a Communicant Branch, even half a Minute, a whole Minute, and once in two or three Minutes I have seen one Globule of Blood only pass in a particular Tract.

The prompt passing of Liquors injected by the *Splenick Arteries*, to the *Veins*, shews the Communications between those Vessels are more open than the *Arteries* and *Veins* of other Parts, of which I have elsewhere spoken.

Liquors also injected into the *Pulmonick Arteries* pass to their *Veins*, tho' not altogether so freely as in the *Spleen*.

On viewing the Extremities of the *Pulmonick* Blood-Vessels in a living Frog with my *Microscope*, I found their *Communications* much larger than *those* that I had before seen in the Membrane between the Toes and in the Feet of the same Creature. Nor can we reasonably doubt of the like patent Communications of the *Arteries* and *Veins* of *Human Lungs* and those of *Quadrupeds*, when we consider the *Blood* of their Lungs must return to the Heart in equal *Time* and *Quantity*, with *that* of all the Parts of the Body besides, as before noted. Hence it appears, the Bronchial Blood Vessels (first taken Notice of by the accurate *Ruysch*) are absolutely necessary, else the Parts of the Lungs could not receive Nourishment; nor could the Glands of the *Bronchia* separate their Liquor, if they were supplied with *Blood* from the Pulmonick Blood Vessels *which* is so quickly dispatched thro' the Lungs.

On viewing the Membrane that is between the Toes of one of the hinder Feet of a living Frog, after I had frequently taken hold of the same Leg of that Creature, to apply it to the Microscope, I found that Membrane very transparent, and without any Motion of the Globules of the Blood in it, as if the Part had been dead; but while I was looking on it, it was, I confess, not a little entertaining to see the Globules creep into it by Degrees, and at length the Blood move in all the Branches of its *Veins* and *Arteries* as before when no Violence had been offered to the Part: while the Blood is thus leisurely creeping through the Vessels, yon may plainly see its Globules compress'd into Oval Figures, which are made more or less oblong, by the Resistance those Globules meet with, by the Contraction of the Sides of the Vessels they pass through; and this I have more than once observed in the Tails of the Water *Newts* or *Lizzards*: But on examining the Blood of these Creatures with a Microscope, and comparing it with the Human Blood, I found the Globules of the *Lizzard*'s Blood more incline to an oval Figure, and were as big again as the Globules of Human Blood, and that of a small Fish; which I in like Manner viewed at the same Time. It is not unlikely a sudden Retrocession of Blood, from the Extremities of its Vessels often happens, and its *Circulation* in the same Vessels is afterwards carried on without any Impediment; as on some Passions of the Mind, Deliquiums by the Effusion of Blood, or otherwise. But if the Blood is once become stagnant in its Vessels, (especially the *Arteries*) the Part is in no small Danger of a Mortification, unless its neighbouring Vessels, which enjoy the Motion of the Blood, drive on the stagnant Blood, and it escape by the Sides of the Vessels that retain'd it. Experience assures us, that in Bruises when the Blood is extravasated, it goes off either by *Transcolation*, or else causes an *Abscess*; for there's little Reason (in my Opinion) to suspect any of the stagnant Globules of the Blood will be fit to re-unite with the *Circulating* Mass. But that the Blood after Stagnation in its Vessels will sometimes pass their Sides, appear'd to me from the following Experiment.

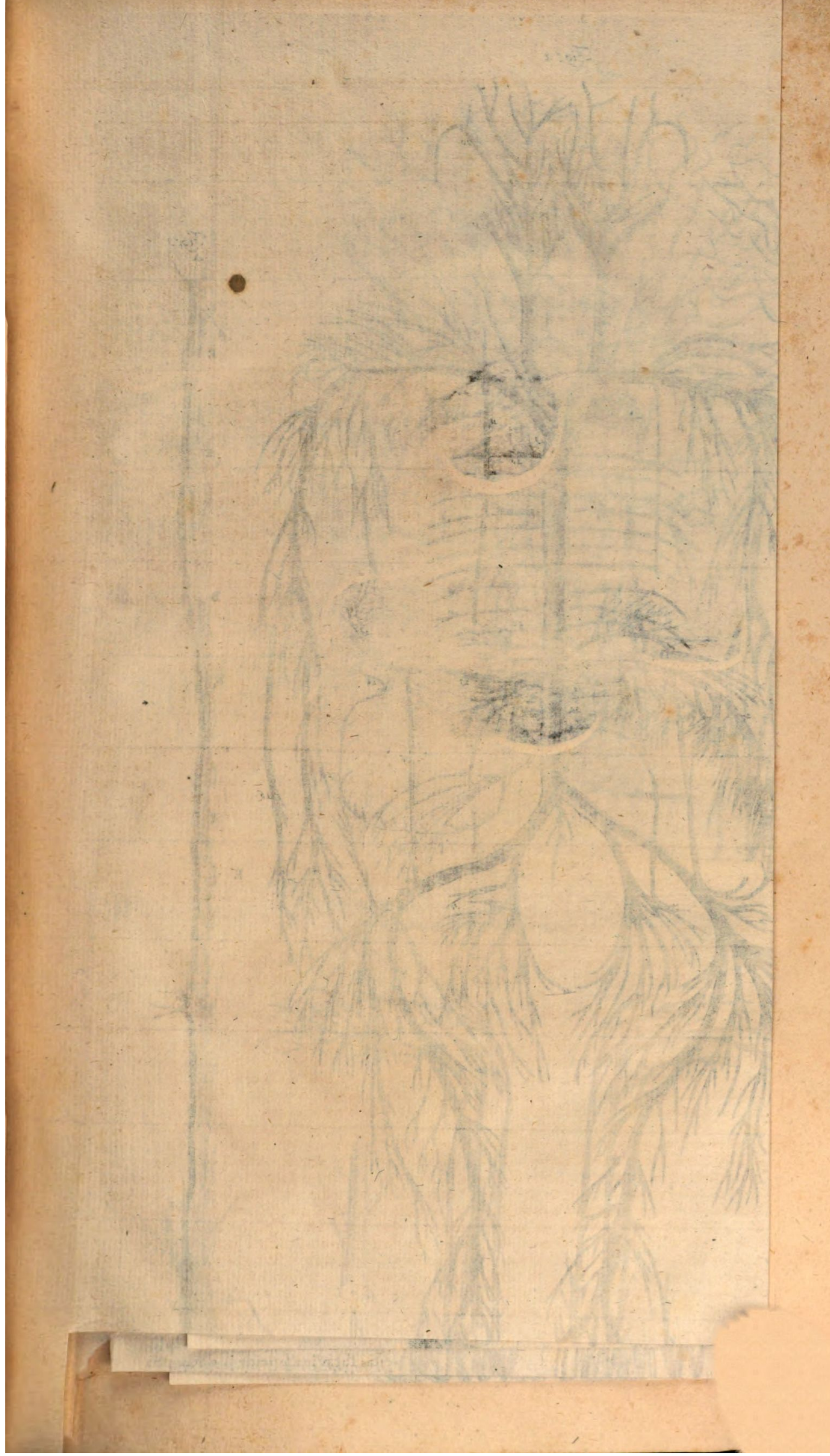
On viewing the *Mesentery* of a Dog when living, in which I had before seen the Blood passing the Extremities of the *Arteries* and *Veins*, I consider'd how to preserve the Blood in its Vessels that I might afterwards at any Time see it in their Extremities when stagnant: For this End I caus'd several Parts of the *Mesentery* to be tied on as many Pieces of small round *Pill-Boxes*, cut transversly like little Hoops; on which, *Portions* of the *Mesentery* were extended like the Head of a *Drum*; and on viewing *them* afterwards with my *Microscope*, I found the Extremities and Branches of the Blood Vessels charged with Blood, which before appeared in Motion; some of which *Parts* of the *Mesentery* I still keep by me. On laying one of these *Parts* of the *Mesentery* (thus expanded) in Water, the stagnant Blood in its Vessels disappear'd; but on just immersing another of those *Pieces* in Water, I could with my naked Eye see the stagnant Blood diffused in the Interstices of the Blood Vessels, and between the Membranes of the *Mesentery*: Hence it's evident, the Blood may pass the Sides of its *Vessels* after Stagnation in *'em*; but whether its *Globules* are broken, or what Figure renders *them* fit to pass those Pores that are in the Sides of the Vessels, I leave to the inquisitive; but we must return to our *Tables*, and first of that of the *System* of the *Vena Cava*.

As the *Arteries* are known to export the Blood, so the Veins carry it back again to the *Heart*; but having already described their Extremities, we come next to the large Trunks of the Veins; and here, as in the *Arteries*, we find the common Practice of *Nature*, in disposing the Branches of *Veins* to discharge the refluent Blood into the next adjacent Trunk, and so on to the Heart. As the *Arteries* afford Abundance of Instances of *Checks* given to the Velocity of the Current of the *Blood* through several Parts, so the *Veins* supply us with as many *Artifices* to assist its regular Return to the *Heart*, as well as to favour those *Contrivances* in the *Arteries*.

The Trunks of the *Carotid*, *Vertebral* and *Splenick Arteries* are not only variously contorted, but are also here and there *dilated*. The Beginnings of the internal *Jugulars* have a *Bulbous* Cavity (Fig. 7. H, H,) which are *Diverticuli* to the refluent Blood in the *Sinus*'s of the *Dura Mater*, lest it should descend too fast into the Jugulars. The like has been also taken notice of by Dr. *Lower* in the *Vertebral Sinus*'s. The *Splenick Vein* has divers *Cells* opening into it near its Extremities in human Bodies, but in Quadrupeds the *Cells* open into the Trunks of their *Splenick* Veins.

The *Spermatick* Veins do more than equal the Length of the *Arteries* of the *Testes* in *Men*; their various *Divisions* and several *Inosculations*, and their Valves, are admirably contriv'd to suspend the Weight of the Blood, in order to discharge it into the larger Trunks of the *Veins*; and were it not that the refluent Blood from the *Testes* is a *Pondus* to the influent Blood from the *Arteries*, and still lessens its current in the *Testes*, these Spermatick Veins, like *those* of other Parts, might have discharged their Blood into the next adjacent Trunk.

Who



Who can avoid Surprize at the Art of Nature, in contriving the *Veins* that bring Part of the Refluent Blood from the lower Parts of the Body? when they conſider the Neceſſity of placing the Human Heart, as well as that of moſt Quadrupeds, ſo far from the *Centre* of the Body towards its upper Part? It is for that End neceſſary the large Trunks of the *Veins* and *Arteries* ſhould not aſſociate each other; for if all the Blood ſent to the lower Parts, by the deſcending Trunk of the *Aorta*, ſhould return to the Heart again by one ſingle Trunk (as it is ſent out from thence) the *Weight* of ſo much Blood in the aſcending Trunk of the *Vena Cava*, (Fig. 6. C, C, A) (for ſo its lower Trunk is call'd) would oppoſe the Force the Heart could give it from the Arteries, and hinder its Aſcent; For this Reaſon the *Vena Azygos* (Fig. 6, b.) or *ſine pari*, is contriv'd to convey the Blood ſent to the Muſcles of the Back and *Thorax* into the deſcending Trunk of the *Vena Cava*, (ib. B. A.) above the Heart: Hence 'tis evident, more Blood comes into the Heart by the deſcending, or upper Trunk of the *Vena Cava*, (Fig. ib. B, A.) than paſſes out by the aſcending Trunks of the *Aorta*. Nor does this Quantity of Blood convey'd to the Heart by the *ſuperior Trunk* of the *Cava*, ſeem without ſome other Deſign in Nature, beſides tranſporting it thither to free the *inferior Trunk* from its Weight: But perhaps it was neceſſary ſo much Blood ſhould be ready there to joyn with the Chyle, (Fig. 6. †) for its better Mixture, before it reaches the right Auricle of the Heart.

I might here add the Deſcripition of a *peculiar Valve*, I lately diſcovered in the *lower Trunk* of the *Vena Cava*, near the right Auricle of the Heart; but the annex'd Figures have taken up too much Room in thoſe Copper Plates to inſert it: For the ſame Reaſon, the Figures of ſome Contrivances in the *Arteries* here mention'd, particularly the *Spermaticks*, are omitted: This being what occurr'd to my Thoughts at preſent on this Subject, which is not to be found (at leaſt not commonly) in the Books of *Anatomy*: The greateſt Part of which have been added to theſe Papers, on their lying by me ſince the *Graver* began the Figures.

## *The Explications of the Figures.*

### FIG. 1.

REpreſents the Trunks and large Branches of the *Arteries*, diſſected from an *Adult Human Body*, when diſplayed and dried; as they are now to be ſeen in the *Repoſitory* of the *Royal Society*.

1. The Trunk of the *Aorta* cut from the *Baſis* of the Heart.

2. That Part of it, whence the Coronary Artery of the Heart does ariſe.

3. That Part of the *Arteria magna*, where the *Canalis Arterioſus* of the *Fœtus* terminates; which in an *Adult* becomes a Ligament. Vid. Fig. 2, 3.

4. That Part of the *Axillary-Arteries*, by ſome called the *Subclavian Arteries*.

5. The left *Carotid Artery* (in this Subject it ſeems) ariſing from a common Trunk with the right *Carotid* and *Axillary Arteries*, as in ſome Quadrupeds.

6. The left *Cervical* Artery, in this Subject ariſing from the Trunk of the *Arteria Magna*, as expreſs'd in a Figure given by *Bergerus* in the *Acta Eruditorum An.* 1698. pag. 295. But in all the human Bodies in which I have hitherto examined theſe *Arteries*, I have conſtantly found *them* as expreſs'd Fig. 2. 6. 6.

7. The *Arteries* that carry Blood to the lower Parts of the Face, Tongue, adjacent Muſcles and Glands.

8. The Trunk of the *Temporal Artery*, ſpringing from the Carotid, and parting with Branches to the Parotid Gland 9, and Temples 10, and Parts adjacent.

11. The *Occiputal Arteries*.

12. The *Arteries* that convey Blood to the *Fauces*, *Gargareon*, and adjacent Muſcles.

13. The Trunk of the *Carotid Artery* cut off, before it is *Contorted* in paſſing the Skull.

14. The Trunk of the *Artery* of the Arm parting with Branches to the adjacent Muſcles and Parts.

* That Part of this *Artery* which is ſometimes prick'd in letting Blood, and makes an *Aneuriſma*, in which Caſe this Trunk of the Artery muſt be bared and *firmly tyed above* the *Aneuriſma*; and if it afterwards happens (as it has been frequently known) that the Flux of Blood to the *Aneuriſma* in the *Artery* is not very much abated, tho' the *Artery* has been *tyed above*; the *Operator* in that Caſe muſt make another Ligature on the Trunk of the *Artery below* its *Aneuriſma*: Theſe Collateral Communications of the Trunk of the Artery at the bending of the Cubit, preſerve the Circulation of the Blood in the Cubit and Hand, tho' the *Trunk* is totally compreſs'd both *above* and *below*; and the ſame *Trunk* afterwards divided between thoſe Ligatures. Hence it is, if one Ligature made above the Wound in the Artery is not ſufficient, but the Blood ſtill pours out from below, the *Patient* will ſooner recover the Action and Strength of the Muſcles of the Cubit, than thoſe in whom the upper Ligature proves ſufficient; the Reaſon of which is obvious to any who conſider that the *Communicant Branches* muſt be larger where the lower Ligature is required, than when the ſuperior Ligature only is ſufficient: Theſe *communicant Branches* (as I have ſeen them in ſome Subjects) are here mark'd out in prick'd Lines, *vid.* the Figure.

While theſe Papers were lying by me, the two following Inſtances happen'd, in which the *Communications* of the large Trunks of the *Arteries* of the Cubit and Arm were remarkable. The firſt was

A *Boy* of thirteen Years, who, about three Weeks before I ſaw him, receiv'd a Wound near the middle of the *Cubit* in which the *Trunk* of the *Artery* (mark'd in the Fig. †) was divided. The *Surgeon* who was firſt call'd, had frequently bound up the Wound, and put a Stop to the ſeveral diſcharges of Blood (which they told me did not amount to leſs than 6 or 7 Quarts at Times) but not without a Compreſs on the Trunk of the *Artery* above the Wound. On another impetuous

Flux was I call'd; but seeing no small Quantity of Blood discharged, I was contented to let the Wound be bound up, in the same Manner as it had been done before; omitting the Compress on the Trunk of the *Artery* above, and adding a Piece of Deal-board, on which the Hand and Cubit were fastened, to prevent any Motions of those Parts, as well as the Fingers; Three Days after, the Applications were taken off, and little or no Blood appear'd; but two or three Hours were scarce elapsed e're I was alarm'd with Notice of a fresh Flux. The *By-standers* being instructed in that Case, to compress the *Trunk* of the *Artery* above the *Cubit*, *they* had thereby prevented no small Effusion of Blood, which must otherwise have happen'd; his *Surgeon* being out of the Way, I laid the Trunk of the Artery bare above the Wound as expeditiously as I could, being forced more than once to let loose the Compress above to discover its Orifice by the Flux of Blood. I passed a *Needle* with strong waxed Thread under the Artery, and made a Ligature on its Trunk, which lay concealed in the Interstice of the *Musculus Flexor Digitorum*, and the *Musculus Ulnaris Flexor Carpi*; but notwithstanding this Ligature on the Trunk of the Artery above the Wound, the Blood still flow'd from the *lower Trunk* of the *Divided Artery*; yet the Velocity of its Current was so much abated, that it seem'd like Blood flowing from a Vein. I left the Wound with a Digestive, and the Part without hard Bandage; it being now five Weeks since, I hear the Wound is almost *cicatriz'd*. The Learned Dr. *Harris* was present at the other *Operation*, by which the *Communications* of the large Trunks of the Arteries of the Arm were very evident.

A Boy about eight Years of Age, who came to Town with an *Aneurisma* of the left Arm, upon bleeding six Weeks before. The *Tumour* was indeed very large in Proportion to so small an Arm. After laying the *Aneurisma* or *Tumour* bare, and making a Ligature on the *Superior* Trunk of the *Artery* (in the annex'd Fig. * ....) I found, on loosening the *Compress* on the superior Trunk of the Artery, very little Abatement of the *Pulsation* of the *Aneurisma*; I then passed a Ligature in like manner on the Trunk of the Artery below the Tumour; but notwithstanding, the *Pulsation* continued, tho' much abated. I then discovered another Trunk of the *Artery*, arising from the lower Part of the *Tumour*, on which also I made another Ligature, and the Pulsation was then taken off. However, on cutting off the Surface of the *Cystis* or dilated *Artery*, and clearing it of the coagulated Blood, which was soon stopped with a common Astringent, I left the Part without any other Ligature or hard Bandage. It is now eighthen Days since the *Operation*, the *Ligatures* on the *Arteries* are all come off, and the *Pulsation* of the *Artery* of the *Wrist* begins to be very manifest, nor does any Symptom appear that threatens Success.

15. The Division of the Trunk of the Artery of the Arm below the Flexure at the Cubit.

16. The external Artery of the Cubit, which makes the *Pulse*, that is commonly felt near the *Carpus*.

17. The Arteries of the Hand and Fingers.

18. The Mammary Artery.

19. 19. The descending Trunk of the *Arteria magna*.

20. 20. The Intercostal Arteries.

21. The *Arteria Cæliaca*.

22. The *Arteria Hepatica*.

23. The Trunk of the *Arteria Splenica*.

24 The *Arteria Epiploica Sinistra*.

25. A Branch of an Artery which passes to the Bottom of the Stomach.

26. The superior Coronary Branch of the Stomach.

27. 27. The superior Mesenterick Artery.

28. 28. The emulgent Arteries.

29. The inferior Mesenterick Artery.

30. 30. The Lumbal Arteries.

31. 31. The two Spermatick Arteries, which in this Subject, seem to arise at a greater Distance from each other than commonly.

32. The Iliack Artery.

33. The *Arteria Sarca*.

34. The internal Iliack Branch.

35. The external——

36. The Epigastrick Artery.

37. Branches of the external Iliack Artery, passing to the oblique Muscles of the *Abdomen*.

38. 38. The Arteries that pass to the Muscles of the Thigh and *Tibia*.

39. The Crural Artery.

40. The Umbilical Artery, with those of the *Penis*.

41. That Part of the Crural Trunk that passes the Ham.

42. The three Trunks of the Arteries of the Leg.

43. The Arteries of the Foot and Toes.

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FIG. 2.

THE Trunks and some of the Ramications of the Arteries of an adult human Body fill'd with Wax, to shew the Variety in Nature, and supply the Defects of the former Figure.

1. The *Aorta* cut off at the *Basis* of the Heart.

A. The three semilunary Valves as they appear when the Heart is in *Diastole*, and hinder the Blood coming back from the Arteries into the left Ventricle of the Heart.

B. A Portion of the Trunk of the *Arteria Pulmonalis*. b, b. its Division before it passes to the right and left Lobes of the Lungs.

C. The descending Trunk of the *Arteria Magna*.

D. D. The internal Mammary Arteries.

2. The Trunk of the Coronary, cut off.

3. The *Ligamentum Arteriosum*. Which in the *Fœtus* is the *Canalis Arteriosus*, and conveys Blood from the Pulmonick Artery to the great Artery.

4 The Trunk of the subclavian Artery.

5. 5. The Carotids.

6. 6. The Vertebrals.

7. 7. The Arteries which pass to the lower Parts

Parts of the Face, Tongue, adjacent Muſcles and Glands.

8. 8. The Trunks of the Temporal Arteries ariſing from the Carotids, giving Branches to Parotid Glands (9. 9.) and the Temples (10. 10.) *&c.*

11. 11. The Occiputal Arteries.

12. The Arteries of the *Fauces*, *Gargareon*, &c.

13. 13. The Contortions of the Carotid Arteries, as they paſs the *Baſis* of the Skull: Theſe Trunks of the Carotid Arteries in Dogs (like thoſe I gueſs of moſt Quadrupeds) are very much contorted before they reach the *Baſis* of the Skull: On filling theſe Veſſels of that Animal with Wax, I found thoſe Branches of *them* which paſs to the Brain, firſt clipping the hinder Parts of the lower Jaw, immediately under its condiloide Proceſſes; where thoſe Ateries are received in two *Sinus's* of that Bone, which *Sinus's* may alſo be ſeen in the Jaw-bones of other Quadrupeds, but not in human Bodies.

14. 14. Thoſe Parts of their Trunks that paſs by each Side of the *Sella Turcica*, whence divers ſmall Branches ariſe, and help to compoſe the *Rete Mirabile*; which is more conſpicuous in Quadrupeds than in human Bodies.

15. 15. The Contortions of the Vertebral Arteries, where we find their Trunks conſiderably dilated.

16. The vertebral Arteries, as they aſcend on the *Medulla Oblongata* towards the Annular Protuberance or *Pons Varoli*.

17. 17. The communicant Branches of the *Vertebral* and *Carotid* Arteries.

18. 18. The Arteries of the Brain diſplayed.

## FIG. 3.

I Chuſe to place this Figure on the *Copper Plates* of one of the Trunks of the Arteries of the *Tibia* (diſſected from the Leg after *Amputation*) rather than the following *Diſtich*, which I find written on the *Original Table* of this Scheme of the *Arteries*.

*Pulſificus Sanguis de Cordis Ventre ſiniſtro.*
*Funditur ut Corpus nutriat hiſce viis.*

Before I explain the Letters of Reference of this third Figure, it will be neceſſary to let you know that Mr. *Stringer* was in his ſixty ſeventh Year when this Artery was taken from him, and near twenty Years before loſt the Uſe of both his *Legs*; and in that time he had been ſo perſecuted with Convulſions in *them*, that neither Leg was free a quarter of an Hour together, whether ſleeping or waking. At length one of his little Toes mortified, which was taken off by Mr. *Coldwyer*, an *expert Surgeon* of *Salisbury*; not long after more Toes of the ſame Foot followed the like Fate: The Convulſions following that Leg ſtronger and quicker: That Part of the Foot next the Toes became tumid and inflam'd, the Tumour extending it ſelf above the *Maleoli*: a ſinuous Ulcer paſſed by the Side of one of the *Metatarſal Bones*; the Extremity of which Bone (whence the Toe was taken off) lying bare. In this Condition I found the left Foot and Leg of this *Gentleman*, when I had the Honour to wait on him, by Command of the *Right Honourable* the preſent *Earl of Shaftsbury*, he living in the Neighbourhood of that *Noble Peer* in *Wiltſhire*; where I met with Mr. *Goldwyer* above-mention'd; and finding the Leg very chilly, the Neceſſity of parting with it was too evident; which Mr. *Stringer* ſuffer'd with extraordinary Fortitude, *He* not ſo much as expreſſing the leaſt Outcry during the *Operation*, tho' the Part did not want the moſt exquiſite Senſe of feeling: On the Abſciſſion (which was about five or ſix Inches below the Knee) it was unexpected by me, I muſt confeſs, to ſee ſo little Blood ſpouting from the *Arteries*. The Stump being bound up, and committed to the Hands of two or three Servants, a leſs Number not being ſufficient to hold it, by Reaſon ſuch ſtrong convulſive Motions purſued the Part on the Operation. I was very deſirous to examine the *Arteries* of the amputated Leg, having before diſcovered the Cauſe of a Mortification of the Arm of a *young Gentlewoman*, who dy'd not long after an Amputation of the Part, tho the *Gangreen* did not appear to reach near the Place where the Abſciſſion was made: (*i. e.* below the ending of the *Muſculus Deltoides*.) In which *Caſe*, I found the Sides of the Trunk of the *Artery* of the Arm ſo thicken'd, that the *Diameter* of its *Bore* was *contracted* to leſs than a third Part, and would ſcarce admit a common Probe to paſs it, *vid.* Fig. G. H. I. When I had found the Ends of the *Arteries* in the Leg above-mention'd, I endeavour'd to paſs my Probe into one of *them*, but meeting with ſome Oppoſition, I ſuſpected I had miſtaken the *Vein* for the *Artery*, and that the Valves oppoſed the paſſing of the Probe that Way; but on further Diſſection I clear'd the Trunks of both thoſe Blood Veſſels, and found the *Veins* in their natural State; but the Sides of the *Arteries* were grown *Bony* or *Stony*; having clear'd two of *their Trunks*, I left one of *them* at *Saliſbury*, the *other* I brought to Town, and is here figur'd.

A. The upper Part of the Artery cut off in the Amputation of the Leg; from A to

B. The Trunk of the Artery diſtended and dry'd to ſhew its Canal.

C. That Part of the Trunk of the Artery which was ſo contracted by the Putrefaction or Oſſification, that a Probe would not paſs its Canal; from C to

D. The Trunk of the Artery opened and expanded.

E, E. The Putrefactions or Oſſifications in the Sides of the Artery.

F, F. Their Specks in the lower Part of the Artery, not ſo large as in the upper Part, and placed at greater Diſtances.

a, a, &c. The Branches ariſing from the Trunk of the Artery.

G. A Proportion of the Trunk of the Artery of the Arm above mention'd.

H. The Sides of the Artery very much thickned, whereby the *Diameter* of its *Canalis* was ſo much diminiſhed that the Probe

I. Would not paſs it.

The *Oſſifications* in the Coats of *Arteries* have been frequently obſerv'd, eſpecially in their large Trunks within the Cavities of the *Thorax* and *Abdomen*; but I don't remember the like has been ta-

ken notice of in the Limbs; or that ſuch Impediments in their Canals have been found the Cauſe of Mortifications of particular Parts, as in the Inſtance above-mentioned; tho' I doubt not, but the like has often happen'd in aged People, eſpecially where we find the Progreſs of the Gangreen not very ſwift, and its Beginning from no external *Cauſe*; the Conſequences of which are commonly found fatal. When the Arteries of one Leg (or of any other Limb) are ſo affected, we may well ſuſpect the like in *thoſe* of other Parts; which probably happened in the Inſtance I now mention'd; for tho' no Gangreen came on the Stump, yet the other Foot and Toes began to mortify about ſix Weeks after the Amputation, as did the Parts about the Hips, which were compreſs'd in lying or ſitting before he expired.

## FIG. 4.

REpreſents the Extremities of the Blood Veſſels, as they appear while the Blood is paſſing them in the *Omentum* of a live Dog, view'd with a *Microſcope*.

A, A, The Branches of Arteries, and B. B. the Veins which aſſociate, C C their leſſer Branches where they paſs from each other, and are united at their Extremities.

## FIG. 5.

THE like appearing in the *Meſentery* of a Dog when living.

D, D, The *Areæ* that are here viewed with the Microſcope, as they appear to the naked Eye.

## FIG. 6.

THE Trunks of the *Vena Cava*, with their Branches diſſected from an adult human Body, done from the original Scheme in the *Repoſitory* of the *Royal Society*.

A, A, The Orifice of the *Vena Cava*, as it appears when cut from the right Auricle of the Heart.

a, The Orifice of the coronary Vein of the Heart.

B, A, The *ſuperior*, or *deſcending Trunk* of the *Vena Cava*.

C, C, A, The *inferior* or *aſcending Trunk*: ſo diſtinguiſhed from the Motion of the Blood in their Trunks, which is contrary to their Poſition:

D, D, The Subclavian Veins.

† That Part of the left Subclavian Vein, where the *Thoracick Duct* enters it, and diſcharges it ſelf of its *Chyle* and *Lympha*.

b, The *Vena Azygos* with its Branches going to the Ribs, e, e.

c, The ſuperior Intercoſtal Veins.

d, d, The internal mammary Veins.

E, E, The right and left Iliack Branches.

F, F, The internal jugular Veins.

G, G, The external Jugulars.

H, H, The Veins which bring Blood from the lower Jaw and its Muſcles.

I, I, The Trunks of the internal Jugulars cut off at the *Baſis* of the Skull.

f, The Veins of the *Thymus* and *Mediaſtinum*.

g, g, The Veins of the Thyroid Glands.

h, The *Vena Sacra*.

i, The internal Iliack Branch.

k, The external——

K, K, The occiputal Veins.

L, The right axillary Vein.

M, The Cephalick.

N, The Baſilick.

O, The Median Vein.

P, The Trunk of the Veins of the Liver.

Q, The Phrenick Vein of the left Side.

R, The right Phrenick Vein.

r, A large Vein from the left *Glandula Renalis* and Parts adjacent.

S, The left emulgent Vein.

T, The right emulgent, in this Subject very much lower than the left, which is not uſual.

V, V, The two Spermatick Veins.

X, X, Two communicant Branches between the aſcending Trunk of the *Vena Cava* and *Vena Azygos*, by which the Wind paſſes into the deſcending Trunk of the *Cava*, when we blow into the aſcending at A. P. C. tho' the Trunk at A. A. and C. is firmly tyed on the Blow-pipe.

* An uncommon Branch between the lower Trunk of the *Vena Cava* and the left emulgent Vein.

y, A Vein which brings Blood from the Muſcles of the *Abdomen* into the external Iliack Branch.

z, The Epigaſtrick Vein of the right Side.

I, The *Vena Saphena*.

The reſt of the Branches here diſplayed commonly differ ſo much in various Subjects, that the particular Deſcriptions of them (which none but the *Operator* who diſſected them could pretend to be Maſter of) would be perhaps as uſeleſs, as tedious to repeat: Wherefore I paſs to thoſe conſiderable venous Trunks *which* are wanting in this *Scheme*.

## FIG. 7.

SOme of the large Trunks of the Veins and their *Sinus*'s within the Skull, with the Beginnings of the internal Jugular Veins, filled with Wax, and dried together with the *Falx*, &c.

A, The Extremity of the *Falx* cut from the *Criſta Galli*.

a, Its lower *Limbus* that touched the *Corpus Calloſum*, as it divides the right Hemiſphere of the

the Brain from the left; where the fifth *Sinus* paſſes, which are here dried and diſappears.

B, B, The ſecond *Proceſs* of the *Dura Mater*, which ſupported the hindermoſt Parts of the Lobes of the Brain, and defended the *Cerebellum* from being preſs'd by thoſe Parts of the *Cerebrum*.

C, A Portion of the *Dura Mater* remaining to the Longitudinal *Sinus*.

D, D, Several Trunks of the Veins of the Brain cut off before they enter the Longitudinal *Sinus*.

E, E, The Longitudinal *Sinus's*.

F, F, the two lateral *Sinus's*.

G, The fourth *Sinus*.

g, The Veins from the *Plexus Choroides*.

H, H, The *Bulbi* or *Diverticuli* at the Beginnings of the internal Jugular Veins.

I, I, The internal Jugular Veins.

K, K, The Trunks of Veins, which bring Blood from the lower Jaw and Parts adjacent.

## FIG. 8.

THE Trunks of the *Vena Portæ* diſſected and diſplayed; done from the Original Scheme in the *Repoſitory* of the *Royal Society*.

A, A, The Branches of the *Vena Portæ* freed from the Liver.

a, The Umbilical Vein.

B, The Splenick Branch.

C, C, The Meſenterick Branches which are continued from the Inteſtines.

b, The Trunk of the *Vena Pancreatica*, which receives Branches alſo from the *Duodenum*.

c, c, The *Vena Gaſtrica dextra Coronaria Superior*.

D, The Superior Coronary Vein of the Stomach of the left Side.

E, The inferior Coronary Branch of the Stomach of the right Side, and

F, The ſame Coronary Vein of the left Side removed from their proper Situations; from theſe two laſt are continued the *Vena Epiplocia ſuperior dextra* 1, and the *ſiniſtra* 2, with the *Media* 3.

G, The Vein call'd *Vas Breve*.

d, The *Vena duodeni*.

H, The *Vena Hæmorrhoidalis* ariſing from the *Rectum* and *Anus*, in this Subject emptying it ſelf into the left Meſenterick Branch; but in other Bodies (and particularly in a Preparation of theſe Veins, which I have now by me) I find this Trunk of the *Hæmorrhoid* Veins ending in the *Ramus Splenicus*.

The Length of the Trunk of this Hæmorrhoid Vein, and its Progreſs under the *Inteſtines*, renders it liable to be compreſs'd, and its refluent Blood retarded; whence its Branches in the *Inteſtinum Rectum* and *Anus*, become diſtended with Blood, and cauſe the *Hæmorrhoides Cæcæ* and *Apertæ*; *which* are frequently attended with *Apoſthumations* in the *Anus* and Parts adjacent; which Diſorders are the more incident, not only becauſe theſe Hæmorrhoid Veins (like the reſt of the Branches of the *Vena Portæ*) are without *Valves*, and the Blood has an aſcending Progreſs in *them*, as alſo that the long Trunk (H) is not only expo ed to the Compreſſions made by the *Inteſtines* in both Sexes: But particularly the *Uterus* in *Women* in time of *Geſtation*, eſpecially near the Birth, ſo compreſſes this *Trunk*, that 'tis no wonder we find Women more afflicted with the *Hæmorrhoids* at that *time*, than at any other. Nor are the *Iliack* Veins and the *Lympheduct* that accompany *them*, without being expoſed to the like Incumbrance in Women with Child, whence the Veins of Legs and Thighs become *Varicoſe*, and thoſe Limbs are ſo frequently ſwoln, which in a late Inſtance I was acquainted with, when the Intumeſcence proved ſo great, that at Length the Abdominal Teguments were vaſtly extended; but the *Gentlewoman* recovered (beyond the Expectation of ſome) on the happy *Delivery* of two large Children.

ARTHROSIS, or Articulation; amongſt the Writers of Anatomy is divided into (1) *Diarthroſis* or De-articulation, which is a more looſe Articulation of the Bones where there is a manifeſt natural Motion of one Bone on the other; in which it differs from the (2) *Synarthroſis* or Co-articulation, which is a much cloſer Junc ture, and where there is no ſuch natural apparent Motion of one Joint on the other. (3) *Ginglymus*, where each Bone receives into its *Sinus* the *Proceſſus* of the other; as in the Articulation of the *Ulna*, *Tibia*, *Humerus*, *& Oſſa Femorum*.

ARYTÆNOIDÆUS *Minor*, is a Muſcle which runs on the Surface of the *Arytænoidus Major*, ariſing from that Part of one of the *Cartilagines Arytænidæi*, next the *Cricoides* on one Side, and terminating in that Part of the other *Arytænoideal Cartilage*, which is fartheſt from the *Cricoides* on the other Side. Its Uſe is to aſſiſt the other Muſcle of this Name in its Action, which is much ſtrengthen'd by this manifeſt Decuſſation of the Fibres.

ASAPHATUM, is a Kind of *Impetigo*, *Serpigo*, or running Itch.

ASHLAR, is the Work-Men's Term for common or free Stone, as it comes out of the Quarry.

ASPECT *Double*, is a Term in painting, us'd for a ſingle Figure repreſenting two or more different Objects; which is cauſed either by a Change of the Poſition of the Eye, or by angular Glaſſes, *&c.*

ASSEMBLY, in the Military Art, is the ſecond Beat of a Drum before a March; on hearing this, the Soldiers ſtrike their Tents, and roll them up; and then ſtand to their Arms. The third beating is called the *March*, as the firſt is called the *General*.

ASSISA *magna*, was a more ſolemn Trial by a Jury of 12 or more Knights, to give their Verdict in a Cauſe proſecuted *per Breve de Recto*; i. e. where the Diſpute lies not about the bare Poſſeſſion, but of the *Right* and *Property*; in this diſtinguiſhed from the *Aſſiſa parva* or *minor*, where the Queſtion is only of Poſſeſſion, in which the Jury were 12 ordinary Legal or Freemen return'd by the Sheriff.

ASSISÆ *Judicium*, is the Judgment of the Court given againſt the Plaintiff or Defendant for Default.

ASTROLABE, this *Planiſphere* conſidered as a Projection of the Sphere is of two Kinds. The firſt is a Projection of the Sphere on the Plane of the

the Equinoctial in the Stereographick Way, the Eye being ſuppoſed to be placed in the Pole of the World. The other *Aſtrolabe* is of *Gemma Friſius*; which ſuppoſes the Eye in the Point of the Interjection of the Equator and Horizon, projecting the Sphere on the Plane of the oppoſite Meridian.

ASTRONOMICAL *Hours*, are ſuch as are accounted from the Noon of one natural Day, or as ſome will have it from Midnight, to the Noon or Midnight of the next natural Day.

## The former Equation of apparent Time.

*Substract from the apparent Time, if it be the Sun's mean Anamoly.*

| Sign. | 0 | 1 | 2 | 3 | 4 | 5 | — |
|---|---|---|---|---|---|---|---|
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | |
| 0 | 0 00 | 3 46 | 6 34 | 7 40 | 6 42 | 3 54 | 30 |
| 1 | 0 08 | 3 53 | 6 38 | 7 40 | 6 38 | 3 47 | 29 |
| 2 | 0 16 | 3 59 | 6 42 | 7 40 | 6 34 | 3 40 | 28 |
| 3 | 0 23 | 4 06 | 6 46 | 7 40 | 6 30 | 3 33 | 27 |
| 4 | 0 31 | 4 13 | 6 49 | 7 39 | 6 26 | 3 25 | 26 |
| 5 | 0 39 | 4 19 | 6 53 | 7 39 | 6 21 | 3 18 | 25 |
| 6 | 0 47 | 4 26 | 6 57 | 7 38 | 6 17 | 3 11 | 24 |
| 7 | 0 55 | 4 32 | 7 00 | 7 38 | 6 12 | 3 03 | 23 |
| 8 | 1 03 | 4 38 | 7 03 | 7 37 | 6 07 | 2 56 | 22 |
| 9 | 1 10 | 4 45 | 7 06 | 7 36 | 6 02 | 2 48 | 21 |
| 10 | 1 18 | 4 51 | 7 09 | 7 34 | 5 57 | 2 40 | 20 |
| 11 | 1 26 | 4 57 | 7 12 | 7 33 | 5 52 | 2 33 | 19 |
| 12 | 1 34 | 5 03 | 7 1 | 7 32 | 5 46 | 2 25 | 18 |
| 13 | 1 41 | 5 09 | 7 1 | 7 30 | 5 41 | 2 17 | 17 |
| 14 | 1 49 | 5 15 | 7 19 | 7 28 | 5 36 | 2 09 | 16 |
| 15 | 1 57 | 5 20 | 7 22 | 7 26 | 5 30 | 2 01 | 15 |
| 16 | 2 04 | 5 26 | 7 24 | 7 24 | 5 24 | 1 53 | 14 |
| 17 | 2 12 | 5 32 | 7 26 | 7 22 | 5 18 | 1 45 | 13 |
| 18 | 2 19 | 5 37 | 7 28 | 7 20 | 5 12 | 1 37 | 12 |
| 19 | 2 27 | 5 42 | 7 30 | 7 18 | 5 06 | 1 29 | 11 |
| 20 | 2 34 | 5 48 | 7 31 | 7 15 | 5 00 | 1 21 | 10 |
| 21 | 2 42 | 5 53 | 7 33 | 7 12 | 4 54 | 1 13 | 9 |
| 22 | 2 49 | 5 58 | 7 34 | 7 10 | 4 48 | 1 05 | 8 |
| 23 | 2 56 | 6 03 | 7 35 | 7 07 | 4 41 | 0 57 | 7 |
| 24 | 3 03 | 6 07 | 7 36 | 7 04 | 4 35 | 0 49 | 6 |
| 25 | 3 11 | 6 12 | 7 37 | 7 00 | 4 28 | 0 41 | 5 |
| 26 | 3 18 | 6 17 | 7 38 | 6 57 | 4 22 | 0 33 | 4 |
| 27 | 3 25 | 6 21 | 7 39 | 6 54 | 4 15 | 0 24 | 3 |
| 28 | 3 32 | 6 26 | 7 40 | 6 50 | 4 08 | 0 16 | 2 |
| 29 | 3 39 | 6 30 | 7 40 | 6 46 | 4 01 | 0 08 | 1 |
| 30 | 3 46 | 6 34 | 7 40 | 6 42 | 3 54 | 0 00 | 0 |
| | 11 | 10 | 9 | 8 | 7 | 6 | |

*Add to the apparent Time, if it be the Sun's mean Anamoly.*



## The latter Equation of the apparent Time.

*Substract from the apparent Time, if it be the Sun's Place.*

| — | ♈ ♎ | ♉ ♍ | ♊ ♐ | — |
|---|---|---|---|---|
| | ′ ″ | ′ ″ | ′ ″ | |
| 0 | 0 00 | 8 24 | 8 46 | 30 |
| 1 | 0 20 | 8 35 | 8 36 | 29 |
| 2 | 0 40 | 8 45 | 8 25 | 28 |
| 3 | 1 00 | 8 54 | 8 14 | 27 |
| 4 | 1 19 | 9 03 | 8 01 | 26 |
| 5 | 1 39 | 9 11 | 7 49 | 25 |
| 6 | 1 59 | 9 18 | 7 35 | 24 |
| 7 | 2 18 | 9 25 | 7 21 | 23 |
| 8 | 2 37 | 9 31 | 7 05 | 22 |
| 9 | 2 57 | 9 36 | 6 51 | 21 |
| 10 | 3 16 | 9 41 | 6 35 | 20 |
| 11 | 3 34 | 9 45 | 6 19 | 19 |
| 12 | 3 53 | 9 49 | 6 02 | 18 |
| 13 | 4 11 | 9 51 | 5 45 | 17 |
| 14 | 4 29 | 9 53 | 5 27 | 16 |
| 15 | 4 47 | 9 55 | 5 09 | 15 |
| 16 | 5 04 | 9 55 | 4 50 | 14 |
| 17 | 5 21 | 9 55 | 4 31 | 13 |
| 18 | 5 38 | 9 54 | 4 12 | 12 |
| 19 | 5 54 | 9 52 | 3 52 | 11 |
| 20 | 6 10 | 9 50 | 3 32 | 10 |
| 21 | 6 26 | 9 47 | 3 12 | 9 |
| 22 | 6 41 | 9 43 | 2 51 | 8 |
| 23 | 6 55 | 9 38 | 2 30 | 7 |
| 24 | 7 10 | 9 33 | 2 09 | 6 |
| 25 | 7 23 | 9 27 | 1 48 | 5 |
| 26 | 7 36 | 9 20 | 1 27 | 4 |
| 27 | 7 49 | 9 13 | 1 05 | 3 |
| 28 | 8 01 | 9 05 | 0 43 | 2 |
| 29 | 8 13 | 8 56 | 0 22 | 1 |
| 30 | 8 24 | 8 46 | 0 00 | 0 |
| | ♓ ♑ | ♋ ♌ | ♍ ♎ | |

*Add to the apparent Time, if it be the Sun's Place.*

*A Table of the Equation of Days made from the two preceding ones.*

| G. | ♈ S " | ♉ A " | ♊ A " | ♋ S " | ♌ S " | ♍ S " |
|---|---|---|---|---|---|---|
| 0 | 7 45 | 1 11 | 4 3 | 0 59 | 5 43 | 2 8 |
| 1 | 7 26 | 1 24 | 4 0 | 1 15 | 5 45 | 1 53 |
| 2 | 7 7 | 1 37 | 3 56 | 1 29 | 5 46 | 1 37 |
| 3 | 6 48 | 1 49 | 3 51 | 1 42 | 5 47 | 1 21 |
| 4 | 6 29 | 2 1 | 3 45 | 1 54 | 5 48 | 1 5 |
| 5 | 6 10 | 2 12 | 3 39 | 2 6 | 5 48 | 0 48 |
| 6 | 5 51 | 2 23 | 3 32 | 2 19 | 5 48 | 0 30 |
| 7 | 5 31 | 2 33 | 3 25 | 2 32 | 5 46 | 0 12 |
| 8 | 5 11 | 2 43 | 3 17 | 2 44 | 5 44 | 0 A 7 |
| 9 | 4 51 | 2 53 | 3 9 | 2 56 | 5 40 | 0 26 |
| 10 | 4 31 | 3 3 | 3 0 | 3 8 | 5 36 | 0 45 |
| 11 | 4 11 | 3 13 | 2 51 | 3 20 | 5 31 | 1 3 |
| 12 | 3 52 | 3 22 | 2 41 | 3 32 | 5 25 | 1 21 |
| 13 | 3 33 | 3 30 | 2 31 | 3 43 | 5 19 | 1 40 |
| 14 | 3 14 | 3 37 | 2 21 | 3 54 | 5 13 | 1 59 |
| 15 | 2 55 | 3 43 | 2 10 | 4 4 | 5 6 | 2 19 |
| 16 | 2 37 | 3 48 | 2 0 | 4 14 | 4 58 | 2 40 |
| 17 | 2 19 | 3 53 | 1 49 | 4 24 | 4 49 | 3 1 |
| 18 | 2 1 | 3 57 | 1 37 | 4 34 | 4 39 | 3 22 |
| 19 | 1 43 | 4 1 | 1 25 | 4 43 | 4 30 | 3 44 |
| 20 | 1 26 | 4 5 | 1 13 | 4 51 | 4 20 | 4 6 |
| 21 | 1 9 | 4 8 | 1 1 | 4 59 | 4 9 | 4 29 |
| 22 | 0 52 | 4 10 | 0 49 | 5 6 | 3 57 | 4 51 |
| 23 | 0 35 | 4 12 | 0 37 | 5 13 | 3 45 | 5 13 |
| 24 | 0 19 | 4 13 | 0 24 | 5 19 | 3 32 | 5 35 |
| 25 | 0 3 | 4 11 | 0 10 | 5 24 | 3 19 | 5 57 |
| 26 | 0 A 12 | 4 9 | 0 S 3 | 5 29 | 3 5 | 6 19 |
| 27 | 0 27 | 4 8 | 0 16 | 5 33 | 2 51 | 6 41 |
| 28 | 0 42 | 4 6 | 0 29 | 5 37 | 2 37 | 7 2 |
| 29 | 0 57 | 4 5 | 0 44 | 5 40 | 2 23 | 7 23 |
| 30 | 1 11 | 4 3 | 0 59 | 5 43 | 2 8 | 7 44 |



*A Table of the Equation of Days made from the two preceding ones.*

| G. | ♎ A " | ♏ A " | ♐ A " | ♑ A " | ♒ S " | ♓ S " |
|---|---|---|---|---|---|---|
| 0 | 7 44 | 15 34 | 13 25 | 0 59 | 11 48 | 14 36 |
| 1 | 8 5 | 15 42 | 13 7 | 0 27 | 12 4 | 14 29 |
| 2 | 8 25 | 15 48 | 12 48 | 0 S 5 | 12 19 | 14 21 |
| 3 | 8 45 | 15 53 | 12 29 | 0 35 | 12 35 | 14 13 |
| 4 | 9 5 | 15 57 | 12 10 | 1 4 | 12 50 | 14 4 |
| 5 | 9 25 | 16 1 | 11 50 | 1 33 | 13 5 | 13 55 |
| 6 | 9 44 | 16 5 | 11 30 | 2 3 | 13 19 | 13 46 |
| 7 | 10 3 | 16 7 | 11 10 | 2 32 | 13 32 | 13 37 |
| 8 | 10 22 | 16 8 | 10 49 | 3 1 | 13 44 | 13 27 |
| 9 | 10 41 | 16 9 | 10 28 | 3 29 | 13 55 | 13 17 |
| 10 | 11 0 | 16 9 | 10 6 | 3 57 | 14 5 | 13 7 |
| 11 | 11 19 | 16 9 | 9 42 | 4 25 | 14 14 | 12 56 |
| 12 | 11 38 | 16 8 | 9 17 | 4 53 | 14 22 | 12 44 |
| 13 | 11 57 | 16 7 | 8 51 | 5 20 | 14 29 | 12 32 |
| 14 | 12 15 | 16 5 | 8 25 | 5 48 | 14 35 | 12 19 |
| 15 | 12 33 | 16 1 | 7 58 | 6 15 | 14 40 | 12 6 |
| 16 | 12 50 | 15 56 | 7 31 | 6 42 | 14 45 | 11 52 |
| 17 | 13 7 | 15 50 | 7 5 | 7 9 | 14 50 | 11 37 |
| 18 | 13 22 | 15 44 | 6 38 | 7 34 | 14 54 | 11 21 |
| 19 | 13 36 | 15 37 | 6 12 | 7 58 | 14 56 | 11 4 |
| 20 | 13 49 | 15 30 | 5 45 | 8 21 | 14 58 | 10 46 |
| 21 | 14 2 | 15 22 | 5 19 | 8 45 | 14 59 | 10 28 |
| 22 | 14 14 | 15 13 | 4 52 | 9 8 | 15 0 | 10 10 |
| 23 | 14 26 | 15 3 | 4 26 | 9 31 | 15 0 | 9 52 |
| 24 | 14 37 | 14 52 | 3 58 | 9 53 | 15 0 | 9 34 |
| 25 | 14 47 | 14 40 | 3 30 | 10 13 | 14 58 | 9 16 |
| 26 | 14 57 | 14 27 | 3 1 | 10 32 | 14 55 | 8 58 |
| 27 | 15 7 | 14 13 | 2 31 | 10 51 | 14 51 | 8 40 |
| 28 | 15 16 | 13 58 | 2 1 | 11 10 | 14 47 | 8 22 |
| 29 | 15 25 | 13 42 | 1 30 | 11 29 | 14 42 | 8 4 |
| 30 | 15 34 | 13 25 | 0 59 | 11 48 | 14 36 | 7 45 |

## A Table of the Earth's mean Motions; of the Place of its Perihelion, and of the Preceſſion of the Equinoxes from the firſt Star in *Aries*.

| *Years from Chriſt* | *The Earth's mean Motion from the Vernal Equinox.* | | | | *The Motion of the Earth's Perihelion from the Vernal Equinox.* | | | |
|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | s | o | ' | " |
| 1 | 9 | 07 | 53 | 3 | 2 | 14 | 3 | 30 |
| 1501 | 9 | 19 | 13 | 9 | 3 | 4 | 53 | 30 |
| 1581 | 9 | 19 | 49 | 26 | 3 | 6 | 0 | 10 |
| 1601 | 9 | 19 | 58 | 30 | 3 | 6 | 16 | 50 |
| 1621 | 9 | 20 | 07 | 34 | 3 | 6 | 33 | 30 |
| 1641 | 9 | 20 | 16 | 38 | 3 | 6 | 50 | 10 |
| 1661 | 9 | 20 | 25 | 42 | 3 | 7 | 6 | 50 |
| 1681 | 9 | 20 | 34 | 46 | 3 | 7 | 23 | 30 |
| 1701 | 9 | 20 | 43 | 50 | 3 | 7 | 40 | 10 |
| 1721 | 9 | 20 | 52 | 54 | 3 | 7 | 56 | 50 |
| 1741 | 9 | 21 | 01 | 58 | 3 | 8 | 13 | 30 |
| 1761 | 9 | 21 | 11 | 2 | 3 | 8 | 30 | 10 |
| 1781 | 9 | 21 | 20 | 6 | 3 | 8 | 46 | 50 |
| 1801 | 9 | 21 | 29 | 11 | 3 | 9 | 3 | 30 |



A Table of the Earth's mean Motion, and of the Motion of its Perihelion, and of the Fix'd Stars for the intermediate Years not mention'd in the preceding Table.

| *Years.* | *The mean Motions for the intermediate Years.* | | | | *The Motions of the Perihelii, and of the fix'd Stars for intermed. Years.* | | | |
|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | s | o | ' | " |
| 1 | 11 | 29 | 45 | 40 | 0 | 00 | 00 | 50 |
| 2 | 11 | 29 | 31 | 20 | 0 | 00 | 01 | 40 |
| 3 | 11 | 29 | 17 | 00 | 0 | 00 | 02 | 30 |
| 4 | 00 | 00 | 01 | 48 | 0 | 00 | 03 | 20 |
| 5 | 11 | 29 | 47 | 28 | 0 | 00 | 04 | 10 |
| 6 | 11 | 29 | 33 | 08 | 0 | 00 | 05 | 00 |
| 7 | 11 | 29 | 18 | 48 | 0 | 00 | 05 | 50 |
| 8 | 00 | 00 | 03 | 36 | 0 | 00 | 06 | 40 |
| 9 | 11 | 29 | 49 | 16 | 0 | 00 | 07 | 30 |
| 10 | 11 | 29 | 34 | 57 | 0 | 00 | 08 | 20 |
| 11 | 11 | 29 | 20 | 37 | 0 | 00 | 09 | 10 |
| 12 | 00 | 00 | 05 | 26 | 0 | 00 | 10 | 00 |
| 13 | 11 | 29 | 51 | 6 | 0 | 00 | 10 | 50 |
| 14 | 11 | 29 | 36 | 46 | 0 | 00 | 11 | 40 |
| 15 | 11 | 29 | 22 | 26 | 0 | 00 | 12 | 30 |
| 16 | 00 | 00 | 07 | 14 | 0 | 00 | 13 | 20 |
| 17 | 11 | 29 | 52 | 54 | 0 | 00 | 14 | 10 |
| 18 | 11 | 29 | 38 | 34 | 0 | 00 | 15 | 00 |
| 19 | 11 | 29 | 24 | 14 | 0 | 00 | 15 | 50 |
| 20 | 00 | 00 | 09 | 4 | 0 | 00 | 16 | 40 |
| 40 | 00 | 00 | 18 | 8 | 0 | 00 | 33 | 20 |
| 60 | 00 | 00 | 27 | 12 | 0 | 00 | 50 | 00 |
| 80 | 00 | 00 | 36 | 16 | 0 | 01 | 06 | 40 |
| 100 | 00 | 00 | 45 | 20 | 0 | 01 | 23 | 20 |
| 200 | 00 | 01 | 30 | 41 | 0 | 02 | 46 | 40 |
| 300 | 00 | 02 | 16 | 1 | 0 | 04 | 10 | 00 |
| 400 | 00 | 03 | 1 | 22 | 0 | 05 | 33 | 20 |
| 500 | 00 | 03 | 46 | 42 | 0 | 06 | 56 | 40 |
| 600 | 00 | 04 | 32 | 3 | 0 | 08 | 20 | 00 |
| 700 | 00 | 05 | 17 | 23 | 0 | 09 | 43 | 20 |
| 800 | 00 | 06 | 2 | 44 | 0 | 11 | 06 | 40 |
| 900 | 00 | 06 | 48 | 4 | 0 | 12 | 29 | 00 |
| 1000 | 00 | 07 | 33 | 25 | 0 | 13 | 53 | 20 |
| 2000 | 00 | 15 | 6 | 50 | 0 | 27 | 46 | 40 |
| 3000 | 00 | 22 | 40 | 15 | 1 | 11 | 40 | 40 |
| 4000 | 01 | 00 | 13 | 41 | 1 | 25 | 33 | 20 |
| 5000 | 01 | 07 | 47 | 6 | 1 | 09 | 26 | 40 |

| Days | Jan. The Earth's mean Motion. | M. P. | Feb. The Earth's mean Motion. | M. P. | March. The Earth's mean Motion. | M. P. |
|---|---|---|---|---|---|---|
| | s o ' " | " | s o ' " | " | s o ' " | " |
| 1 | 0 00 59 08 | 00 | 1 01 32 27 | 04 | 1 29 08 20 | 08 |
| 2 | 0 01 58 17 | 00 | 1 02 31 25 | 05 | 2 00 07 28 | 08 |
| 3 | 0 02 57 25 | 00 | 1 03 30 43 | 05 | 2 01 06 36 | 08 |
| 4 | 0 03 56 33 | 01 | 1 04 29 52 | 05 | 2 02 05 45 | 09 |
| 5 | 0 04 55 42 | 01 | 1 05 29 00 | 05 | 2 03 04 53 | 09 |
| 6 | 0 05 54 50 | 01 | 1 06 28 08 | 05 | 2 04 04 01 | 09 |
| 7 | 0 06 53 58 | 01 | 1 07 27 16 | 05 | 2 05 03 10 | 09 |
| 8 | 0 07 53 07 | 01 | 1 08 26 25 | 05 | 2 06 02 18 | 09 |
| 9 | 0 08 52 15 | 01 | 1 09 25 33 | 06 | 2 07 01 26 | 09 |
| 10 | 0 09 51 23 | 01 | 1 10 24 41 | 06 | 2 08 00 35 | 09 |
| 11 | 0 10 50 32 | 02 | 1 11 23 50 | 06 | 2 08 59 43 | 10 |
| 12 | 0 11 49 40 | 02 | 1 12 22 58 | 06 | 2 09 58 51 | 10 |
| 13 | 0 12 48 48 | 02 | 1 13 22 06 | 06 | 2 10 58 00 | 10 |
| 14 | 0 13 47 57 | 02 | 1 14 21 15 | 06 | 2 11 57 08 | 10 |
| 15 | 0 14 47 05 | 02 | 1 15 20 23 | 06 | 2 12 56 16 | 10 |
| 16 | 0 15 46 13 | 02 | 1 16 19 31 | 06 | 2 13 55 25 | 10 |
| 17 | 0 16 45 22 | 02 | 1 17 18 40 | 07 | 2 14 54 33 | 10 |
| 18 | 0 17 44 30 | 02 | 1 18 17 48 | 07 | 2 15 53 41 | 11 |
| 19 | 0 18 43 38 | 03 | 1 19 16 56 | 07 | 2 16 52 50 | 11 |
| 20 | 0 19 42 47 | 03 | 1 20 16 04 | 07 | 2 17 51 58 | 11 |
| 21 | 0 20 41 55 | 03 | 1 21 15 13 | 07 | 2 18 51 06 | 11 |
| 22 | 0 21 41 03 | 03 | 1 22 14 21 | 07 | 2 19 50 15 | 11 |
| 23 | 0 22 40 12 | 03 | 1 23 13 30 | 07 | 2 20 49 23 | 11 |
| 24 | 0 23 39 20 | 03 | 1 24 12 38 | 08 | 2 21 48 31 | 11 |
| 25 | 0 24 38 28 | 03 | 1 25 11 46 | 08 | 2 22 47 40 | 11 |
| 26 | 0 25 37 37 | 04 | 1 26 10 55 | 08 | 2 23 46 48 | 12 |
| 27 | 0 26 36 45 | 04 | 1 27 10 03 | 08 | 2 24 45 56 | 12 |
| 28 | 0 27 35 53 | 04 | 1 28 09 11 | 08 | 2 25 45 05 | 12 |
| 29 | 0 28 35 02 | 04 | | | 2 26 44 13 | 12 |
| 30 | 0 29 34 10 | 04 | | | 2 27 43 21 | 12 |
| 31 | 1 00 33 18 | 04 | | | 2 28 42 30 | 12 |



| Days | April. The Earth's mean Motion. | M. P. | May. The Earth's mean Motion. | M. P. | June. The Earth's mean Motion. | M. P. |
|---|---|---|---|---|---|---|
| | s o ' " | " | s o ' " | " | s o ' " | " |
| 1 | 2 29 41 38 | 12 | 3 29 15 48 | 17 | 4 29 49 06 | 21 |
| 2 | 3 00 40 46 | 13 | 4 00 14 56 | 17 | 5 00 48 14 | 21 |
| 3 | 3 01 39 55 | 13 | 4 01 14 04 | 17 | 5 01 47 23 | 21 |
| 4 | 3 02 39 03 | 13 | 4 02 13 13 | 17 | 5 02 46 31 | 21 |
| 5 | 3 03 38 11 | 13 | 4 03 12 21 | 17 | 5 03 45 39 | 21 |
| 6 | 3 04 37 20 | 13 | 4 04 11 29 | 17 | 5 04 44 48 | 21 |
| 7 | 3 05 36 27 | 13 | 4 05 10 38 | 17 | 5 05 43 56 | 22 |
| 8 | 3 06 35 36 | 13 | 4 06 09 46 | 17 | 5 06 43 04 | 22 |
| 9 | 3 07 34 45 | 13 | 4 07 08 54 | 18 | 5 07 42 13 | 22 |
| 10 | 3 08 33 53 | 14 | 4 08 08 03 | 18 | 5 08 41 21 | 22 |
| 11 | 3 09 33 01 | 14 | 4 09 07 11 | 18 | 5 09 40 29 | 22 |
| 12 | 3 10 32 10 | 14 | 4 10 06 19 | 18 | 5 10 39 38 | 22 |
| 13 | 3 11 31 18 | 14 | 4 11 05 28 | 18 | 5 11 38 46 | 22 |
| 14 | 3 12 30 26 | 14 | 4 12 04 36 | 18 | 5 12 37 54 | 23 |
| 15 | 3 13 29 34 | 14 | 4 13 03 44 | 18 | 5 13 37 03 | 23 |
| 16 | 3 14 28 43 | 14 | 4 14 02 53 | 19 | 5 14 36 11 | 23 |
| 17 | 3 15 27 51 | 15 | 4 15 02 01 | 19 | 5 15 35 19 | 23 |
| 18 | 3 16 27 00 | 15 | 4 16 01 09 | 19 | 5 16 34 28 | 23 |
| 19 | 3 17 26 08 | 15 | 4 17 00 18 | 19 | 5 17 33 36 | 23 |
| 20 | 3 18 25 16 | 15 | 4 17 59 26 | 19 | 5 18 32 44 | 23 |
| 21 | 3 19 24 24 | 15 | 4 18 58 34 | 19 | 5 19 31 53 | 24 |
| 22 | 3 20 23 33 | 15 | 4 19 57 42 | 19 | 5 20 31 01 | 24 |
| 23 | 3 21 22 41 | 15 | 4 20 56 51 | 20 | 5 21 30 09 | 24 |
| 24 | 3 22 21 49 | 16 | 4 21 55 59 | 20 | 5 22 29 18 | 24 |
| 25 | 3 23 20 58 | 16 | 4 22 55 08 | 20 | 5 23 28 26 | 24 |
| 26 | 3 24 20 06 | 16 | 4 23 54 16 | 20 | 5 24 27 34 | 24 |
| 27 | 3 25 19 14 | 16 | 4 24 53 24 | 20 | 5 25 26 43 | 24 |
| 28 | 3 26 18 23 | 16 | 4 25 52 33 | 20 | 5 26 25 51 | 24 |
| 29 | 3 27 17 31 | 16 | 4 26 51 41 | 20 | 5 27 24 59 | 25 |
| 30 | 3 28 16 39 | 16 | 4 27 50 49 | 21 | 5 28 24 08 | 25 |
| 31 | | | 4 28 49 58 | 21 | | |

## A Table of the Earth's mean Motion for every Day in the Year.

| Days | July. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ | Aug. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ | Septemb. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 29 | 23 | 16 | 25 | 6 | 29 | 56 | 34 | 29 | 8 | 00 | 29 | 52 | 33 |
| 2 | 6 | 00 | 22 | 24 | 25 | 7 | 00 | 55 | 42 | 29 | 8 | 01 | 29 | 01 | 34 |
| 3 | 6 | 01 | 21 | 32 | 25 | 7 | 01 | 54 | 51 | 29 | 8 | 02 | 28 | 09 | 34 |
| 4 | 6 | 02 | 20 | 40 | 25 | 7 | 02 | 33 | 59 | 30 | 8 | 03 | 27 | 17 | 34 |
| 5 | 6 | 03 | 19 | 49 | 25 | 7 | 03 | 53 | 07 | 30 | 8 | 04 | 26 | 36 | 34 |
| 6 | 6 | 04 | 18 | 57 | 26 | 7 | 04 | 52 | 16 | 30 | 8 | 05 | 25 | 34 | 34 |
| 7 | 6 | 05 | 18 | 06 | 26 | 7 | 05 | 51 | 24 | 30 | 8 | 06 | 24 | 42 | 34 |
| 8 | 6 | 06 | 17 | 14 | 26 | 7 | 06 | 50 | 32 | 30 | 8 | 07 | 23 | 51 | 34 |
| 9 | 6 | 07 | 16 | 22 | 26 | 7 | 07 | 49 | 41 | 30 | 8 | 08 | 22 | 59 | 35 |
| 10 | 6 | 08 | 15 | 31 | 26 | 7 | 08 | 48 | 49 | 30 | 8 | 09 | 22 | 07 | 35 |
| 11 | 6 | 09 | 14 | 39 | 26 | 7 | 09 | 47 | 57 | 31 | 8 | 10 | 21 | 16 | 35 |
| 12 | 6 | 10 | 13 | 47 | 26 | 7 | 10 | 47 | 06 | 31 | 8 | 11 | 20 | 24 | 35 |
| 13 | 6 | 11 | 12 | 56 | 27 | 7 | 11 | 46 | 14 | 31 | 8 | 12 | 19 | 32 | 35 |
| 14 | 6 | 12 | 12 | 04 | 27 | 7 | 12 | 45 | 22 | 31 | 8 | 13 | 18 | 41 | 35 |
| 15 | 6 | 13 | 11 | 12 | 27 | 7 | 13 | 44 | 31 | 31 | 8 | 14 | 17 | 49 | 35 |
| 16 | 6 | 14 | 10 | 21 | 27 | 7 | 14 | 43 | 39 | 31 | 8 | 15 | 16 | 57 | 36 |
| 17 | 6 | 15 | 09 | 29 | 27 | 7 | 15 | 42 | 47 | 31 | 8 | 16 | 16 | 05 | 36 |
| 18 | 6 | 16 | 08 | 37 | 27 | 7 | 16 | 41 | 56 | 31 | 8 | 17 | 15 | 14 | 36 |
| 19 | 6 | 17 | 07 | 46 | 27 | 7 | 17 | 41 | 04 | 32 | 8 | 18 | 14 | 22 | 36 |
| 20 | 6 | 18 | 06 | 54 | 28 | 7 | 18 | 40 | 12 | 32 | 8 | 19 | 13 | 30 | 36 |
| 21 | 6 | 19 | 06 | 02 | 28 | 7 | 19 | 39 | 21 | 32 | 8 | 20 | 12 | 39 | 36 |
| 22 | 6 | 20 | 05 | 11 | 28 | 7 | 20 | 38 | 25 | 32 | 8 | 21 | 11 | 47 | 36 |
| 23 | 6 | 21 | 04 | 19 | 28 | 7 | 21 | 37 | 37 | 32 | 8 | 22 | 10 | 55 | 36 |
| 24 | 6 | 22 | 03 | 27 | 28 | 7 | 22 | 36 | 46 | 32 | 8 | 23 | 10 | 04 | 37 |
| 25 | 6 | 23 | 02 | 36 | 28 | 7 | 23 | 35 | 54 | 32 | 8 | 24 | 09 | 12 | 37 |
| 26 | 6 | 24 | 01 | 44 | 28 | 7 | 24 | 35 | 02 | 33 | 8 | 25 | 08 | 20 | 37 |
| 27 | 6 | 25 | 00 | 52 | 28 | 7 | 25 | 34 | 11 | 33 | 8 | 26 | 07 | 29 | 37 |
| 28 | 6 | 26 | 00 | 01 | 29 | 7 | 26 | 33 | 19 | 33 | 8 | 27 | 06 | 37 | 37 |
| 29 | 6 | 26 | 59 | 09 | 29 | 7 | 27 | 32 | 27 | 33 | 8 | 28 | 05 | 45 | 37 |
| 30 | 6 | 27 | 58 | 17 | 29 | 7 | 28 | 31 | 36 | 33 | 8 | 29 | 04 | 54 | 37 |
| 31 | 6 | 28 | 57 | 26 | 29 | 7 | 29 | 30 | 44 | 33 | | | | | |

## A Table of the Earth's mean Motion for every Day in the Year.

| Days | Octob. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ | Novemb. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ | Decemb. The Earth's mean Motion. s | ° | ′ | ″ | M. P. ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | 00 | 04 | 02 | 38 | 10 | 00 | 37 | 20 | 42 | 11 | 00 | 11 | 30 | 46 |
| 2 | 9 | 01 | 03 | 10 | 38 | 10 | 01 | 36 | 29 | 42 | 11 | 01 | 10 | 38 | 46 |
| 3 | 9 | 02 | 02 | 19 | 38 | 10 | 02 | 35 | 37 | 42 | 11 | 02 | 09 | 47 | 46 |
| 4 | 9 | 03 | 01 | 27 | 38 | 10 | 03 | 34 | 45 | 42 | 11 | 03 | 08 | 55 | 46 |
| 5 | 9 | 04 | 00 | 35 | 38 | 10 | 04 | 33 | 54 | 42 | 11 | 04 | 08 | 03 | 46 |
| 6 | 9 | 04 | 59 | 44 | 38 | 10 | 05 | 33 | 02 | 42 | 11 | 05 | 07 | 12 | 47 |
| 7 | 9 | 05 | 58 | 52 | 38 | 10 | 06 | 32 | 10 | 43 | 11 | 06 | 06 | 20 | 47 |
| 8 | 9 | 06 | 58 | 00 | 38 | 10 | 07 | 31 | 19 | 43 | 11 | 07 | 05 | 28 | 47 |
| 9 | 9 | 07 | 57 | 08 | 39 | 10 | 08 | 30 | 27 | 43 | 11 | 08 | 04 | 37 | 47 |
| 10 | 9 | 08 | 56 | 17 | 39 | 10 | 09 | 29 | 35 | 43 | 11 | 09 | 03 | 45 | 47 |
| 11 | 9 | 09 | 55 | 25 | 39 | 10 | 10 | 28 | 44 | 43 | 11 | 10 | 02 | 53 | 47 |
| 12 | 9 | 10 | 54 | 34 | 39 | 10 | 11 | 27 | 52 | 43 | 11 | 11 | 02 | 02 | 47 |
| 13 | 9 | 11 | 53 | 42 | 39 | 10 | 12 | 27 | 00 | 43 | 11 | 12 | 01 | 10 | 48 |
| 14 | 9 | 12 | 52 | 50 | 39 | 10 | 13 | 26 | 09 | 44 | 11 | 13 | 00 | 18 | 48 |
| 15 | 9 | 13 | 51 | 59 | 39 | 10 | 14 | 25 | 17 | 44 | 11 | 13 | 59 | 27 | 48 |
| 16 | 9 | 14 | 51 | 07 | 40 | 10 | 15 | 24 | 25 | 44 | 11 | 14 | 58 | 35 | 48 |
| 17 | 9 | 15 | 50 | 15 | 40 | 10 | 16 | 23 | 34 | 44 | 11 | 15 | 57 | 43 | 48 |
| 18 | 9 | 16 | 49 | 24 | 40 | 10 | 17 | 22 | 42 | 44 | 11 | 16 | 56 | 52 | 48 |
| 19 | 9 | 17 | 48 | 32 | 40 | 10 | 18 | 21 | 50 | 44 | 11 | 17 | 56 | 00 | 48 |
| 20 | 9 | 18 | 47 | 40 | 40 | 10 | 19 | 20 | 59 | 44 | 11 | 18 | 55 | 08 | 48 |
| 21 | 9 | 19 | 46 | 49 | 40 | 10 | 20 | 20 | 07 | 44 | 11 | 19 | 54 | 17 | 49 |
| 22 | 9 | 20 | 45 | 57 | 40 | 10 | 21 | 19 | 15 | 45 | 11 | 20 | 53 | 25 | 49 |
| 23 | 9 | 21 | 45 | 05 | 41 | 10 | 22 | 18 | 24 | 45 | 11 | 21 | 52 | 33 | 49 |
| 24 | 9 | 22 | 44 | 14 | 41 | 10 | 23 | 17 | 32 | 45 | 11 | 22 | 51 | 42 | 49 |
| 25 | 9 | 23 | 43 | 22 | 41 | 10 | 24 | 16 | 40 | 45 | 11 | 23 | 50 | 50 | 49 |
| 26 | 9 | 24 | 42 | 30 | 41 | 10 | 25 | 15 | 49 | 45 | 11 | 24 | 49 | 58 | 49 |
| 27 | 9 | 25 | 41 | 39 | 41 | 10 | 26 | 14 | 57 | 45 | 11 | 25 | 49 | 07 | 49 |
| 28 | 9 | 26 | 40 | 47 | 41 | 10 | 27 | 14 | 05 | 45 | 11 | 26 | 48 | 15 | 49 |
| 29 | 9 | 27 | 39 | 55 | 41 | 10 | 28 | 13 | 13 | 46 | 11 | 27 | 47 | 23 | 50 |
| 30 | 9 | 28 | 39 | 04 | 41 | 10 | 29 | 12 | 22 | 46 | 11 | 28 | 46 | 32 | 50 |
| 31 | 9 | 29 | 38 | 12 | 42 | | | | | | 11 | 29 | 45 | 40 | 50 |

## A Table of the Horary mean Motion of the Earth.

In Leap Years after *February*, add a Day and the Motion of one Day to the Time.

| H. | ° | ′ | ″ | ‴ | H. | ° | ′ | ″ | ‴ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 00 | 00 | | 30 | 1 | 13 | 55 | |
| 1 | 0 | 02 | 28 | | 31 | 1 | 16 | 23 | |
| 2 | 0 | 04 | 56 | | 32 | 1 | 18 | 51 | |
| 3 | 0 | 07 | 24 | | 33 | 1 | 21 | 19 | |
| 4 | 0 | 09 | 51 | | 34 | 1 | 23 | 47 | |
| 5 | 0 | 12 | 19 | | 35 | 1 | 26 | 14 | |
| 6 | 0 | 14 | 47 | | 36 | 1 | 28 | 42 | |
| 7 | 0 | 17 | 15 | | 37 | 1 | 31 | 10 | |
| 8 | 0 | 19 | 43 | | 38 | 1 | 33 | 38 | |
| 9 | 0 | 22 | 11 | | 39 | 1 | 36 | 06 | |
| 10 | 0 | 24 | 38 | | 40 | 1 | 38 | 34 | |
| 11 | 0 | 27 | 06 | | 41 | 1 | 41 | 02 | |
| 12 | 0 | 29 | 34 | | 42 | 1 | 43 | 29 | |
| 13 | 0 | 32 | 02 | | 43 | 1 | 45 | 57 | |
| 14 | 0 | 34 | 30 | | 44 | 1 | 48 | 25 | |
| 15 | 0 | 36 | 58 | | 45 | 1 | 50 | 53 | |
| 16 | 0 | 39 | 25 | | 46 | 1 | 53 | 21 | |
| 17 | 0 | 41 | 53 | | 47 | 1 | 55 | 49 | |
| 18 | 0 | 44 | 21 | | 48 | 1 | 58 | 16 | |
| 19 | 0 | 46 | 49 | | 49 | 2 | 00 | 44 | |
| 20 | 0 | 49 | 17 | | 50 | 2 | 03 | 12 | |
| 21 | 0 | 51 | 45 | | 51 | 2 | 05 | 40 | |
| 22 | 0 | 54 | 13 | | 52 | 2 | 08 | 08 | |
| 23 | 0 | 56 | 40 | | 53 | 2 | 10 | 36 | |
| 24 | 0 | 59 | 08 | | 54 | 2 | 13 | 03 | |
| 25 | 1 | 01 | 36 | | 55 | 2 | 15 | 31 | |
| 26 | 1 | 04 | 04 | | 56 | 2 | 17 | 59 | |
| 27 | 1 | 06 | 32 | | 57 | 2 | 20 | 27 | |
| 28 | 1 | 09 | 00 | | 58 | 2 | 25 | 55 | |
| 29 | 1 | 11 | 27 | | 59 | 2 | 22 | 23 | |
| 30 | 1 | 13 | 55 | | 60 | 2 | 25 | 50 | |



## A Table of the Equation of the Earth's Orbit.

*Substract.*

| | Sign. 0 | | | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | ″ | ° | ′ | ″ | |
| 0 | 0 | 00 | 00 | 0 | 56 | 56 | 1 | 39 | 28 | 1 | 56 | 20 | 1 | 41 | 34 | 0 | 59 | 2 | 30 |
| 1 | 0 | 01 | 58 | 0 | 58 | 39 | 1 | 40 | 28 | 1 | 56 | 20 | 1 | 40 | 33 | 0 | 57 | 14 | 29 |
| 2 | 0 | 03 | 57 | 1 | 0 | 21 | 1 | 41 | 27 | 1 | 56 | 20 | 1 | 39 | 30 | 0 | 55 | 26 | 28 |
| 3 | 0 | 05 | 56 | 1 | 2 | 3 | 1 | 42 | 24 | 1 | 56 | 17 | 1 | 38 | 26 | 0 | 53 | 37 | 27 |
| 4 | 0 | 07 | 55 | 1 | 03 | 43 | 1 | 43 | 21 | 1 | 56 | 13 | 1 | 37 | 20 | 0 | 51 | 47 | 26 |
| 5 | 0 | 09 | 54 | 1 | 5 | 22 | 1 | 44 | 15 | 1 | 56 | 4 | 1 | 36 | 11 | 0 | 49 | 55 | 25 |
| 6 | 0 | 11 | 53 | 1 | 7 | 0 | 1 | 45 | 8 | 1 | 55 | 54 | 1 | 35 | 1 | 0 | 48 | 3 | 24 |
| 7 | 0 | 13 | 51 | 1 | 08 | 37 | 1 | 45 | 58 | 1 | 55 | 42 | 1 | 33 | 49 | 0 | 46 | 10 | 23 |
| 8 | 0 | 15 | 48 | 1 | 10 | 13 | 1 | 46 | 47 | 1 | 55 | 28 | 1 | 32 | 36 | 0 | 44 | 16 | 22 |
| 9 | 0 | 17 | 46 | 1 | 11 | 48 | 1 | 47 | 33 | 1 | 55 | 12 | 1 | 31 | 20 | 0 | 42 | 21 | 21 |
| 10 | 0 | 19 | 44 | 1 | 13 | 22 | 1 | 48 | 19 | 1 | 55 | 53 | 1 | 30 | 3 | 0 | 40 | 26 | 20 |
| 11 | 0 | 21 | 40 | 1 | 14 | 53 | 1 | 49 | 1 | 1 | 54 | 32 | 1 | 28 | 45 | 0 | 38 | 30 | 19 |
| 12 | 0 | 23 | 36 | 1 | 16 | 24 | 1 | 49 | 42 | 1 | 54 | 10 | 1 | 27 | 25 | 0 | 36 | 32 | 18 |
| 13 | 0 | 25 | 33 | 1 | 17 | 53 | 1 | 50 | 22 | 1 | 53 | 46 | 1 | 26 | 3 | 0 | 34 | 34 | 17 |
| 14 | 0 | 27 | 29 | 1 | 19 | 22 | 1 | 50 | 59 | 1 | 53 | 19 | 1 | 24 | 39 | 0 | 32 | 36 | 16 |
| 15 | 0 | 29 | 24 | 1 | 20 | 49 | 1 | 51 | 34 | 1 | 52 | 50 | 1 | 23 | 14 | 0 | 30 | 36 | 15 |
| 16 | 0 | 31 | 19 | 1 | 22 | 14 | 1 | 52 | 7 | 1 | 52 | 19 | 1 | 21 | 47 | 0 | 28 | 37 | 14 |
| 17 | 0 | 33 | 13 | 1 | 23 | 38 | 1 | 52 | 38 | 1 | 51 | 46 | 1 | 20 | 19 | 0 | 26 | 37 | 13 |
| 18 | 0 | 35 | 7 | 1 | 25 | 0 | 1 | 53 | 8 | 1 | 51 | 11 | 1 | 18 | 48 | 0 | 24 | 36 | 12 |
| 19 | 0 | 37 | 1 | 1 | 26 | 22 | 1 | 53 | 35 | 1 | 50 | 35 | 1 | 17 | 17 | 0 | 22 | 34 | 11 |
| 20 | 0 | 38 | 54 | 1 | 27 | 42 | 1 | 54 | 0 | 1 | 49 | 56 | 1 | 15 | 44 | 0 | 20 | 32 | 10 |
| 21 | 0 | 40 | 44 | 1 | 28 | 58 | 1 | 54 | 23 | 1 | 49 | 14 | 1 | 14 | 10 | 0 | 18 | 30 | 9 |
| 22 | 0 | 42 | 35 | 1 | 30 | 4 | 1 | 54 | 44 | 1 | 48 | 32 | 1 | 12 | 34 | 0 | 16 | 28 | 8 |
| 23 | 0 | 44 | 26 | 1 | 31 | 29 | 1 | 55 | 3 | 1 | 47 | 47 | 1 | 10 | 57 | 0 | 14 | 26 | 7 |
| 24 | 0 | 46 | 16 | 1 | 32 | 42 | 1 | 55 | 21 | 1 | 46 | 59 | 1 | 9 | 19 | 0 | 12 | 22 | 6 |
| 25 | 0 | 48 | 5 | 1 | 33 | 54 | 1 | 55 | 35 | 1 | 46 | 10 | 1 | 07 | 39 | 0 | 10 | 19 | 5 |
| 26 | 0 | 49 | 52 | 1 | 35 | 03 | 1 | 55 | 48 | 1 | 45 | 20 | 1 | 05 | 58 | 0 | 08 | 16 | 4 |
| 27 | 0 | 51 | 40 | 1 | 36 | 12 | 1 | 55 | 59 | 1 | 44 | 26 | 1 | 04 | 16 | 0 | 06 | 12 | 3 |
| 28 | 0 | 53 | 26 | 1 | 37 | 19 | 1 | 56 | 9 | 1 | 43 | 31 | 1 | 2 | 32 | 0 | 04 | 8 | 2 |
| 29 | 0 | 55 | 11 | 1 | 38 | 24 | 1 | 56 | 15 | 1 | 42 | 34 | 1 | 00 | 48 | 0 | 02 | 4 | 1 |
| 30 | 0 | 56 | 56 | 1 | 39 | 28 | 1 | 56 | 20 | 1 | 41 | 35 | 0 | 59 | 3 | 0 | 00 | 00 | 0 |
| | *Sign* 11 | | | 10 | | | 9 | | | 8 | | | 7 | | | 6 | | | |

# A Table of the Moon's mean Motion, and of her Apogæum and Node.

| *Years from Christ* | *The Moon's Motion from the Vernal Equinox.* | | | | *The Apogæum's Motion from the Vernal Equinox.* | | | | *The Motion of the Node from the Vernal Equinox.* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | s | o | ' | " | s | o | ' | " |
| 1 | 4 | 2 | 2 | 45 | 9 | 12 | 7 | 5 | 08 | 28 | 36 | 04 |
| 1501 | 1 | 29 | 39 | 8 | 3 | 29 | 55 | 50 | 01 | 25 | 46 | 43 |
| 1581 | 7 | 23 | 55 | 20 | 4 | 15 | 16 | 50 | 10 | 08 | 25 | 47 |
| 1601 | 0 | 7 | 29 | 25 | 7 | 19 | 7 | 5 | 09 | 11 | 35 | 31 |
| 21 | 4 | 21 | 03 | 30 | 10 | 22 | 57 | 20 | 08 | 14 | 45 | 19 |
| 41 | 9 | 4 | 37 | 35 | 1 | 26 | 47 | 35 | 07 | 17 | 55 | 03 |
| 61 | 1 | 18 | 11 | 40 | 5 | 0 | 37 | 50 | 06 | 21 | 04 | 47 |
| 81 | 6 | 1 | 45 | 45 | 8 | 4 | 28 | 5 | 05 | 24 | 14 | 35 |
| 1701 | 10 | 15 | 19 | 50 | 11 | 8 | 18 | 20 | 04 | 27 | 24 | 20 |
| 1721 | 02 | 28 | 53 | 55 | 02 | 12 | 8 | 6 | 04 | 00 | 34 | 6 |
| 1741 | 7 | 12 | 28 | 0 | 05 | 15 | 59 | 21 | 03 | 03 | 43 | 51 |
| 1761 | 11 | 26 | 02 | 05 | 08 | 19 | 42 | 36 | 02 | 06 | 53 | 35 |
| 1781 | 04 | 09 | 36 | 10 | 11 | 23 | 39 | 51 | 01 | 10 | 03 | 20 |
| 1801 | 08 | 23 | 10 | 15 | 02 | 27 | 30 | 6 | 00 | 13 | 13 | 4 |



A Table of the Moon's mean Motion, of her Apogæum and Node for the intermediate Years, not mentioned in the preceding Table.

| *Years* | *The Moon's mean Motion.* | | | | *The Apogæ's mean Motion.* | | | | *The Node's mean Motion.* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | s | o | ' | " | s | o | ' | " |
| 1 | 04 | 09 | 23 | 4 | 01 | 10 | 39 | 51 | 00 | 19 | 59 | 43 |
| 2 | 08 | 18 | 46 | 7 | 02 | 21 | 19 | 41 | 01 | 08 | 39 | 26 |
| 3 | 00 | 28 | 09 | 10 | 04 | 01 | 59 | 32 | 01 | 27 | 59 | 09 |
| 4 | 05 | 20 | 42 | 49 | 05 | 12 | 46 | 4 | 02 | 17 | 22 | 03 |
| 5 | 10 | 00 | 05 | 52 | 06 | 23 | 25 | 54 | 03 | 06 | 41 | 46 |
| 6 | 02 | 09 | 28 | 55 | 08 | 04 | 05 | 44 | 03 | 26 | 01 | 29 |
| 7 | 06 | 18 | 51 | 59 | 09 | 14 | 45 | 35 | 04 | 15 | 21 | 12 |
| 8 | 11 | 11 | 25 | 37 | 10 | 25 | 32 | 7 | 05 | 04 | 44 | 05 |
| 9 | 03 | 20 | 48 | 41 | 00 | 06 | 11 | 57 | 05 | 24 | 03 | 49 |
| 10 | 08 | 00 | 11 | 44 | 01 | 16 | 51 | 47 | 06 | 13 | 23 | 33 |
| 11 | 00 | 09 | 34 | 48 | 02 | 27 | 31 | 38 | 07 | 02 | 43 | 16 |
| 12 | 05 | 02 | 18 | 27 | 04 | 08 | 18 | 10 | 07 | 22 | 06 | 9 |
| 13 | 09 | 11 | 31 | 30 | 05 | 18 | 58 | 0 | 08 | 11 | 25 | 52 |
| 14 | 01 | 20 | 54 | 34 | 06 | 29 | 37 | 50 | 09 | 00 | 45 | 35 |
| 15 | 06 | 00 | 17 | 37 | 08 | 10 | 17 | 41 | 09 | 20 | 05 | 18 |
| 16 | 10 | 22 | 51 | 16 | 09 | 21 | 04 | 13 | 10 | 09 | 28 | 12 |
| 17 | 03 | 02 | 14 | 19 | 11 | 01 | 44 | 3 | 10 | 28 | 47 | 56 |
| 18 | 07 | 11 | 37 | 22 | 00 | 12 | 23 | 53 | 11 | 18 | 07 | 39 |
| 19 | 11 | 21 | 00 | 25 | 01 | 23 | 03 | 44 | 00 | 07 | 27 | 22 |
| 20 | 4 | 13 | 34 | 5 | 03 | 3 | 50 | 15 | 00 | 26 | 50 | 15 |
| 40 | 08 | 27 | 8 | 10 | 06 | 07 | 40 | 30 | 01 | 23 | 40 | 31 |
| 60 | 01 | 10 | 42 | 15 | 09 | 11 | 30 | 45 | 02 | 20 | 30 | 46 |
| 80 | 05 | 24 | 16 | 20 | 00 | 15 | 21 | 0 | 03 | 17 | 21 | 2 |
| 100 | 10 | 07 | 50 | 25 | 03 | 19 | 11 | 15 | 04 | 14 | 11 | 17 |
| 200 | 08 | 15 | 40 | 50 | 07 | 08 | 22 | 30 | 08 | 28 | 22 | 33 |
| 300 | 06 | 23 | 31 | 15 | 10 | 27 | 33 | 45 | 01 | 12 | 33 | 50 |
| 400 | 05 | 01 | 21 | 40 | 02 | 16 | 45 | 00 | 05 | 26 | 45 | 7 |
| 500 | 03 | 09 | 12 | 5 | 06 | 05 | 56 | 15 | 10 | 10 | 56 | 23 |
| 600 | 01 | 17 | 2 | 30 | 09 | 25 | 7 | 30 | 02 | 25 | 7 | 40 |
| 700 | 11 | 24 | 52 | 55 | 01 | 14 | 18 | 45 | 07 | 09 | 18 | 57 |
| 800 | 10 | 02 | 43 | 20 | 05 | 03 | 30 | 0 | 11 | 23 | 30 | 13 |
| 900 | 08 | 10 | 33 | 45 | 08 | 22 | 41 | 15 | 04 | 07 | 41 | 30 |
| 1000 | 06 | 18 | 24 | 10 | 00 | 11 | 52 | 30 | 08 | 21 | 52 | 47 |
| 2000 | 01 | 06 | 48 | 20 | 00 | 23 | 45 | 0 | 05 | 13 | 45 | 44 |
| 3000 | 7 | 25 | 12 | 30 | 01 | 05 | 37 | 30 | 02 | 05 | 38 | 30 |
| 4000 | 2 | 13 | 36 | 40 | 01 | 17 | 30 | 0 | 10 | 27 | 31 | 27 |
| 5000 | 09 | 2 | 00 | 50 | 01 | 29 | 22 | 30 | 07 | 20 | 24 | 14 |

## A Table of the mean Motion of the Moon, of her Apogæum, and the Retrogradation of her Nodes, for every Day in the Year.

*January.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | o | ′ | ″ |
| 1 | 00 | 3 | 10 | 35 | 0 | 06 | 41 | 0 | 03 | 11 |
| 2 | 00 | 26 | 21 | 10 | 0 | 13 | 22 | 0 | 06 | 21 |
| 3 | 01 | 09 | 31 | 45 | 0 | 20 | 03 | 0 | 09 | 32 |
| 4 | 01 | 22 | 42 | 20 | 0 | 26 | 44 | 0 | 12 | 43 |
| 5 | 02 | 05 | 52 | 55 | 0 | 33 | 25 | 0 | 15 | 53 |
| 6 | 02 | 19 | 03 | 30 | 0 | 40 | 06 | 0 | 19 | 04 |
| 7 | 03 | 02 | 14 | 05 | 0 | 46 | 48 | 0 | 22 | 14 |
| 8 | 03 | 15 | 24 | 40 | 0 | 53 | 29 | 0 | 25 | 25 |
| 9 | 03 | 28 | 35 | 15 | 1 | 00 | 10 | 0 | 28 | 36 |
| 10 | 04 | 11 | 45 | 50 | 1 | 06 | 51 | 0 | 31 | 46 |
| 11 | 04 | 24 | 56 | 25 | 1 | 13 | 32 | 0 | 34 | 57 |
| 12 | 05 | 08 | 07 | 00 | 1 | 20 | 13 | 0 | 38 | 08 |
| 13 | 05 | 21 | 17 | 35 | 1 | 26 | 54 | 0 | 41 | 18 |
| 14 | 06 | 04 | 28 | 10 | 1 | 33 | 35 | 0 | 44 | 29 |
| 15 | 06 | 17 | 38 | 45 | 1 | 40 | 16 | 0 | 47 | 40 |
| 16 | 07 | 00 | 49 | 20 | 1 | 46 | 57 | 0 | 50 | 50 |
| 17 | 07 | 13 | 59 | 55 | 1 | 53 | 38 | 0 | 54 | 01 |
| 18 | 07 | 27 | 10 | 30 | 2 | 00 | 19 | 0 | 57 | 11 |
| 19 | 08 | 10 | 21 | 05 | 2 | 07 | 00 | 1 | 00 | 22 |
| 20 | 08 | 23 | 31 | 40 | 2 | 13 | 41 | 1 | 03 | 33 |
| 21 | 09 | 06 | 42 | 15 | 2 | 20 | 23 | 1 | 06 | 43 |
| 22 | 09 | 19 | 52 | 50 | 2 | 27 | 04 | 1 | 09 | 54 |
| 23 | 10 | 03 | 03 | 25 | 2 | 33 | 45 | 1 | 13 | 05 |
| 24 | 10 | 16 | 14 | 00 | 2 | 40 | 26 | 1 | 16 | 15 |
| 25 | 10 | 29 | 24 | 35 | 2 | 47 | 07 | 1 | 19 | 26 |
| 26 | 11 | 12 | 35 | 10 | 2 | 53 | 48 | 1 | 22 | 37 |
| 27 | 11 | 25 | 45 | 45 | 3 | 00 | 29 | 1 | 25 | 47 |
| 28 | 00 | 08 | 56 | 20 | 3 | 07 | 10 | 1 | 28 | 58 |
| 29 | 00 | 22 | 06 | 55 | 3 | 13 | 51 | 1 | 32 | 09 |
| 30 | 01 | 05 | 17 | 31 | 3 | 20 | 32 | 1 | 35 | 19 |
| 31 | 01 | 18 | 28 | 06 | 3 | 27 | 13 | 1 | 38 | 30 |

## A Table of the mean Motion of the Moon, of her Apogæum, and the Retrogradation of her Nodes, for every Day in the Year.

*February.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | s | o | ′ | o | ′ | ″ |
| 1 | 02 | 01 | 38 | 41 | 3 | 33 | 54 | 1 | 41 | 40 |
| 2 | 02 | 14 | 49 | 16 | 3 | 40 | 35 | 1 | 44 | 50 |
| 3 | 02 | 27 | 59 | 51 | 3 | 47 | 16 | 1 | 48 | 01 |
| 4 | 03 | 11 | 10 | 26 | 3 | 53 | 57 | 1 | 51 | 12 |
| 5 | 03 | 24 | 21 | 01 | 4 | 00 | 38 | 1 | 54 | 23 |
| 6 | 04 | 07 | 31 | 36 | 4 | 07 | 19 | 1 | 57 | 33 |
| 7 | 04 | 20 | 42 | 11 | 4 | 14 | 00 | 2 | 00 | 44 |
| 8 | 05 | 03 | 52 | 46 | 4 | 20 | 41 | 2 | 03 | 54 |
| 9 | 05 | 17 | 03 | 21 | 4 | 27 | 22 | 2 | 07 | 06 |
| 10 | 06 | 00 | 13 | 56 | 4 | 34 | 04 | 2 | 10 | 16 |
| 11 | 06 | 13 | 24 | 31 | 4 | 40 | 45 | 2 | 13 | 27 |
| 12 | 06 | 26 | 35 | 06 | 4 | 47 | 26 | 2 | 16 | 37 |
| 13 | 07 | 09 | 45 | 41 | 4 | 54 | 07 | 2 | 19 | 48 |
| 14 | 07 | 22 | 56 | 15 | 5 | 00 | 48 | 2 | 22 | 59 |
| 15 | 08 | 06 | 06 | 50 | 5 | 07 | 29 | 2 | 26 | 09 |
| 16 | 08 | 19 | 17 | 26 | 5 | 14 | 10 | 2 | 29 | 20 |
| 17 | 09 | 02 | 28 | 01 | 5 | 20 | 51 | 2 | 32 | 30 |
| 18 | 09 | 15 | 38 | 36 | 5 | 27 | 32 | 2 | 35 | 41 |
| 19 | 09 | 28 | 49 | 11 | 5 | 34 | 13 | 2 | 38 | 52 |
| 20 | 10 | 11 | 59 | 46 | 5 | 40 | 54 | 2 | 42 | 02 |
| 21 | 10 | 25 | 10 | 21 | 5 | 47 | 36 | 2 | 45 | 13 |
| 22 | 11 | 08 | 20 | 56 | 5 | 54 | 17 | 2 | 48 | 23 |
| 23 | 11 | 21 | 31 | 31 | 6 | 00 | 58 | 2 | 51 | 34 |
| 24 | 00 | 04 | 42 | 06 | 6 | 07 | 39 | 2 | 54 | 45 |
| 25 | 00 | 17 | 52 | 41 | 6 | 14 | 20 | 2 | 57 | 55 |
| 26 | 01 | 01 | 03 | 16 | 6 | 21 | 01 | 3 | 01 | 06 |
| 27 | 01 | 14 | 13 | 51 | 6 | 27 | 42 | 3 | 04 | 16 |
| 28 | 01 | 27 | 24 | 26 | 6 | 34 | 23 | 3 | 07 | 27 |

## A Table of the mean Motion of the Moon, &c.

*March.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | o | ′ | ″ |
| 1 | 02 | 10 | 35 | 01 | 06 | 41 | 04 | 03 | 10 | 38 |
| 2 | 02 | 23 | 45 | 36 | 06 | 47 | 45 | 03 | 13 | 49 |
| 3 | 03 | 06 | 56 | 11 | 06 | 54 | 26 | 03 | 16 | 59 |
| 4 | 03 | 20 | 06 | 46 | 07 | 01 | 07 | 03 | 20 | 10 |
| 5 | 04 | 03 | 17 | 21 | 07 | 07 | 48 | 03 | 23 | 20 |
| 6 | 04 | 16 | 27 | 56 | 07 | 14 | 29 | 03 | 26 | 31 |
| 7 | 04 | 29 | 38 | 31 | 07 | 21 | 11 | 03 | 29 | 42 |
| 8 | 05 | 12 | 49 | 06 | 07 | 27 | 52 | 03 | 32 | 52 |
| 9 | 05 | 25 | 59 | 41 | 07 | 34 | 33 | 03 | 36 | 03 |
| 10 | 06 | 09 | 10 | 16 | 07 | 41 | 14 | 03 | 39 | 14 |
| 11 | 06 | 22 | 20 | 51 | 07 | 47 | 55 | 03 | 42 | 25 |
| 12 | 07 | 05 | 31 | 26 | 07 | 54 | 36 | 03 | 45 | 36 |
| 13 | 07 | 18 | 42 | 01 | 08 | 01 | 17 | 03 | 48 | 46 |
| 14 | 08 | 01 | 52 | 36 | 08 | 07 | 58 | 03 | 51 | 56 |
| 15 | 08 | 15 | 03 | 11 | 08 | 14 | 39 | 03 | 55 | 07 |
| 16 | 08 | 28 | 13 | 46 | 08 | 21 | 20 | 03 | 58 | 18 |
| 17 | 09 | 11 | 24 | 21 | 08 | 28 | 01 | 04 | 01 | 28 |
| 18 | 09 | 24 | 34 | 56 | 08 | 34 | 42 | 04 | 04 | 39 |
| 19 | 10 | 07 | 45 | 31 | 08 | 41 | 23 | 04 | 07 | 96 |
| 20 | 10 | 20 | 56 | 07 | 08 | 48 | 04 | 04 | 11 | 00 |
| 21 | 11 | 04 | 06 | 42 | 08 | 54 | 45 | 04 | 14 | 11 |
| 22 | 11 | 17 | 17 | 17 | 09 | 01 | 27 | 04 | 17 | 22 |
| 23 | 00 | 00 | 27 | 52 | 09 | 08 | 08 | 04 | 20 | 32 |
| 24 | 00 | 13 | 38 | 27 | 09 | 14 | 49 | 04 | 23 | 43 |
| 25 | 00 | 26 | 49 | 02 | 09 | 21 | 30 | 04 | 26 | 53 |
| 26 | 01 | 09 | 59 | 37 | 09 | 28 | 11 | 04 | 30 | 04 |
| 27 | 01 | 23 | 10 | 12 | 09 | 34 | 52 | 04 | 33 | 15 |
| 28 | 02 | 06 | 20 | 47 | 09 | 41 | 33 | 04 | 36 | 25 |
| 29 | 02 | 19 | 31 | 22 | 09 | 48 | 14 | 04 | 39 | 36 |
| 30 | 03 | 02 | 41 | 57 | 09 | 54 | 55 | 04 | 42 | 47 |
| 31 | 03 | 15 | 52 | 32 | 10 | 01 | 36 | 04 | 45 | 58 |

## A Table of the mean Motion of the Moon, &c.

*April.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | o | ′ | ″ |
| 1 | 03 | 29 | 03 | 07 | 10 | 08 | 17 | 04 | 49 | 08 |
| 2 | 04 | 12 | 13 | 42 | 10 | 14 | 58 | 04 | 52 | 19 |
| 3 | 04 | 25 | 24 | 17 | 10 | 21 | 39 | 04 | 55 | 29 |
| 4 | 05 | 08 | 34 | 52 | 10 | 28 | 20 | 04 | 58 | 40 |
| 5 | 05 | 21 | 45 | 27 | 10 | 35 | 02 | 05 | 01 | 51 |
| 6 | 06 | 04 | 56 | 02 | 10 | 41 | 43 | 05 | 05 | 01 |
| 7 | 06 | 18 | 06 | 38 | 10 | 48 | 24 | 05 | 08 | 12 |
| 8 | 07 | 01 | 17 | 12 | 10 | 55 | 05 | 05 | 11 | 22 |
| 9 | 07 | 14 | 27 | 47 | 11 | 01 | 46 | 05 | 14 | 33 |
| 10 | 07 | 27 | 38 | 22 | 11 | 08 | 27 | 05 | 17 | 44 |
| 11 | 08 | 10 | 48 | 57 | 11 | 15 | 08 | 05 | 20 | 54 |
| 12 | 08 | 23 | 59 | 32 | 11 | 21 | 49 | 05 | 24 | 05 |
| 13 | 09 | 07 | 10 | 07 | 11 | 28 | 30 | 05 | 27 | 16 |
| 14 | 09 | 20 | 20 | 42 | 11 | 35 | 11 | 05 | 30 | 26 |
| 15 | 10 | 03 | 31 | 17 | 11 | 41 | 52 | 05 | 33 | 37 |
| 16 | 10 | 16 | 41 | 52 | 11 | 48 | 33 | 05 | 36 | 48 |
| 17 | 10 | 29 | 52 | 27 | 11 | 55 | 14 | 05 | 39 | 58 |
| 18 | 11 | 13 | 03 | 02 | 12 | 01 | 55 | 05 | 43 | 09 |
| 19 | 11 | 26 | 13 | 37 | 12 | 08 | 36 | 05 | 46 | 19 |
| 20 | 00 | 09 | 24 | 12 | 12 | 15 | 18 | 05 | 49 | 31 |
| 21 | 00 | 22 | 34 | 47 | 12 | 21 | 59 | 05 | 52 | 41 |
| 22 | 01 | 05 | 45 | 22 | 12 | 28 | 40 | 05 | 55 | 52 |
| 23 | 01 | 18 | 55 | 57 | 12 | 35 | 21 | 05 | 59 | 02 |
| 24 | 02 | 02 | 06 | 37 | 12 | 42 | 02 | 06 | 02 | 13 |
| 25 | 02 | 15 | 17 | 07 | 12 | 48 | 43 | 06 | 05 | 24 |
| 26 | 02 | 28 | 27 | 42 | 12 | 55 | 24 | 06 | 08 | 34 |
| 27 | 03 | 11 | 38 | 17 | 13 | 02 | 05 | 06 | 11 | 45 |
| 28 | 03 | 24 | 48 | 52 | 13 | 08 | 46 | 06 | 14 | 56 |
| 29 | 04 | 07 | 59 | 27 | 13 | 15 | 27 | 06 | 18 | 06 |
| 30 | 04 | 21 | 10 | 02 | 13 | 22 | 08 | 06 | 21 | 17 |

## A Table of the mean Motion of the Moon, &c.

*May.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | o | ' | " | o | ' | " |
| 1 | 05 | 04 | 20 | 37 | 13 | 28 | 49 | 06 | 24 | 27 |
| 2 | 05 | 17 | 31 | 12 | 13 | 35 | 30 | 06 | 27 | 38 |
| 3 | 06 | 00 | 41 | 47 | 13 | 42 | 11 | 06 | 30 | 48 |
| 4 | 06 | 13 | 52 | 22 | 13 | 48 | 52 | 06 | 33 | 59 |
| 5 | 06 | 27 | 02 | 57 | 13 | 55 | 34 | 06 | 37 | 10 |
| 6 | 07 | 10 | 13 | 32 | 14 | 02 | 15 | 06 | 40 | 20 |
| 7 | 07 | 23 | 24 | 07 | 14 | 08 | 56 | 06 | 43 | 31 |
| 8 | 08 | 06 | 34 | 42 | 14 | 15 | 37 | 06 | 46 | 41 |
| 9 | 08 | 19 | 45 | 17 | 14 | 22 | 18 | 06 | 49 | 52 |
| 10 | 09 | 02 | 55 | 53 | 14 | 28 | 59 | 06 | 53 | 03 |
| 11 | 09 | 16 | 06 | 27 | 14 | 35 | 40 | 06 | 56 | 14 |
| 12 | 09 | 29 | 17 | 03 | 14 | 42 | 21 | 06 | 59 | 24 |
| 13 | 10 | 12 | 27 | 38 | 14 | 49 | 02 | 07 | 02 | 34 |
| 14 | 10 | 25 | 38 | 13 | 14 | 55 | 43 | 07 | 05 | 45 |
| 15 | 11 | 08 | 48 | 48 | 15 | 02 | 24 | 07 | 08 | 56 |
| 16 | 11 | 21 | 59 | 23 | 15 | 09 | 05 | 07 | 12 | 06 |
| 17 | 00 | 05 | 09 | 58 | 15 | 15 | 46 | 07 | 15 | 17 |
| 18 | 00 | 18 | 20 | 33 | 15 | 22 | 28 | 07 | 18 | 27 |
| 19 | 01 | 01 | 31 | 08 | 15 | 29 | 09 | 07 | 21 | 38 |
| 20 | 01 | 14 | 41 | 43 | 15 | 35 | 50 | 07 | 24 | 49 |
| 21 | 01 | 27 | 52 | 18 | 15 | 42 | 31 | 07 | 28 | 00 |
| 22 | 02 | 11 | 02 | 53 | 15 | 49 | 12 | 07 | 31 | 10 |
| 23 | 02 | 24 | 13 | 28 | 15 | 55 | 53 | 07 | 34 | 21 |
| 24 | 03 | 07 | 24 | 03 | 16 | 02 | 34 | 07 | 37 | 32 |
| 25 | 03 | 20 | 34 | 38 | 16 | 09 | 15 | 07 | 40 | 43 |
| 26 | 04 | 03 | 45 | 13 | 16 | 15 | 56 | 07 | 43 | 53 |
| 27 | 04 | 16 | 55 | 48 | 16 | 22 | 37 | 07 | 47 | 04 |
| 28 | 05 | 00 | 06 | 23 | 16 | 29 | 18 | 07 | 50 | 14 |
| 29 | 05 | 13 | 16 | 58 | 16 | 35 | 59 | 07 | 53 | 25 |
| 30 | 05 | 26 | 27 | 33 | 16 | 42 | 40 | 07 | 56 | 36 |
| 31 | 06 | 09 | 38 | 08 | 16 | 49 | 21 | 07 | 59 | 46 |

## A Table of the mean Motion of the Moon, &c.

*June.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | s | o | ' | " | o | ' | " |
| 1 | 06 | 22 | 48 | 43 | 16 | 56 | 03 | 08 | 02 | 56 |
| 2 | 07 | 05 | 59 | 18 | 17 | 02 | 44 | 08 | 06 | 07 |
| 3 | 07 | 19 | 09 | 53 | 17 | 09 | 25 | 08 | 09 | 18 |
| 4 | 08 | 02 | 20 | 28 | 17 | 16 | 06 | 08 | 12 | 29 |
| 5 | 08 | 15 | 31 | 03 | 17 | 22 | 47 | 08 | 15 | 39 |
| 6 | 08 | 28 | 41 | 38 | 17 | 29 | 28 | 08 | 18 | 50 |
| 7 | 09 | 11 | 52 | 13 | 17 | 36 | 09 | 08 | 22 | 00 |
| 8 | 09 | 25 | 02 | 48 | 17 | 42 | 50 | 08 | 25 | 11 |
| 9 | 10 | 08 | 13 | 23 | 17 | 49 | 31 | 08 | 28 | 22 |
| 10 | 10 | 21 | 23 | 58 | 17 | 56 | 12 | 08 | 31 | 32 |
| 11 | 11 | 04 | 34 | 33 | 18 | 02 | 53 | 08 | 34 | 43 |
| 12 | 11 | 17 | 45 | 08 | 18 | 09 | 34 | 08 | 37 | 54 |
| 13 | 00 | 00 | 55 | 43 | 18 | 16 | 15 | 08 | 41 | 05 |
| 14 | 00 | 14 | 06 | 18 | 18 | 22 | 56 | 08 | 44 | 16 |
| 15 | 00 | 27 | 16 | 53 | 18 | 29 | 37 | 08 | 47 | 26 |
| 16 | 01 | 10 | 27 | 28 | 18 | 36 | 19 | 08 | 50 | 37 |
| 17 | 01 | 23 | 38 | 03 | 18 | 43 | 00 | 08 | 53 | 47 |
| 18 | 02 | 06 | 48 | 38 | 18 | 49 | 41 | 08 | 56 | 58 |
| 19 | 02 | 19 | 59 | 13 | 18 | 56 | 22 | 09 | 00 | 09 |
| 20 | 03 | 03 | 09 | 48 | 19 | 03 | 03 | 09 | 03 | 19 |
| 21 | 03 | 16 | 20 | 23 | 19 | 09 | 44 | 09 | 06 | 30 |
| 22 | 03 | 29 | 30 | 58 | 19 | 16 | 25 | 09 | 09 | 40 |
| 23 | 04 | 12 | 41 | 33 | 19 | 23 | 06 | 09 | 12 | 51 |
| 24 | 04 | 25 | 52 | 08 | 19 | 29 | 47 | 09 | 16 | 02 |
| 25 | 05 | 09 | 02 | 43 | 19 | 36 | 28 | 09 | 19 | 12 |
| 26 | 05 | 22 | 13 | 18 | 19 | 43 | 09 | 09 | 22 | 23 |
| 27 | 06 | 05 | 23 | 53 | 19 | 49 | 50 | 09 | 25 | 34 |
| 28 | 06 | 18 | 34 | 28 | 19 | 56 | 31 | 09 | 28 | 45 |
| 29 | 07 | 01 | 45 | 04 | 20 | 03 | 12 | 09 | 31 | 55 |
| 30 | 07 | 14 | 55 | 39 | 20 | 09 | 54 | 09 | 35 | 06 |

## A Table of the mean Motion of the Moon, &c.

*July.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | o | ' | " | o | ' | " |
| 1 | 07 | 28 | 06 | 14 | 20 | 16 | 35 | 09 | 38 | 16 |
| 2 | 08 | 11 | 16 | 49 | 20 | 23 | 16 | 09 | 41 | 27 |
| 3 | 08 | 24 | 27 | 24 | 20 | 29 | 57 | 09 | 44 | 37 |
| 4 | 09 | 07 | 37 | 59 | 20 | 36 | 38 | 09 | 47 | 48 |
| 5 | 09 | 20 | 48 | 34 | 20 | 43 | 19 | 09 | 50 | 59 |
| 6 | 10 | 03 | 59 | 09 | 20 | 50 | 00 | 09 | 54 | 09 |
| 7 | 10 | 17 | 09 | 44 | 20 | 56 | 41 | 09 | 57 | 20 |
| 8 | 11 | 00 | 20 | 19 | 21 | 03 | 22 | 10 | 00 | 30 |
| 9 | 11 | 13 | 30 | 54 | 21 | 10 | 03 | 10 | 03 | 41 |
| 10 | 11 | 26 | 41 | 29 | 21 | 16 | 44 | 10 | 06 | 51 |
| 11 | 00 | 09 | 52 | 04 | 21 | 23 | 25 | 10 | 10 | 02 |
| 12 | 00 | 23 | 02 | 39 | 21 | 30 | 06 | 10 | 13 | 13 |
| 13 | 01 | 06 | 13 | 14 | 21 | 36 | 47 | 10 | 16 | 24 |
| 14 | 01 | 19 | 22 | 49 | 21 | 43 | 28 | 10 | 19 | 35 |
| 15 | 02 | 02 | 34 | 24 | 21 | 50 | 09 | 10 | 22 | 45 |
| 16 | 02 | 15 | 44 | 59 | 21 | 56 | 52 | 10 | 25 | 56 |
| 17 | 02 | 28 | 55 | 34 | 22 | 03 | 32 | 10 | 29 | 06 |
| 18 | 03 | 12 | 06 | 09 | 22 | 10 | 13 | 10 | 32 | 17 |
| 19 | 03 | 25 | 16 | 44 | 22 | 16 | 54 | 10 | 35 | 28 |
| 20 | 04 | 08 | 27 | 19 | 22 | 23 | 35 | 10 | 38 | 39 |
| 21 | 04 | 21 | 37 | 54 | 22 | 30 | 15 | 10 | 41 | 49 |
| 22 | 05 | 04 | 48 | 29 | 22 | 36 | 56 | 10 | 45 | 00 |
| 23 | 05 | 17 | 59 | 04 | 22 | 43 | 37 | 10 | 48 | 11 |
| 24 | 06 | 01 | 09 | 39 | 22 | 50 | 19 | 10 | 51 | 21 |
| 25 | 06 | 14 | 20 | 14 | 22 | 57 | 00 | 10 | 54 | 32 |
| 26 | 06 | 27 | 30 | 49 | 23 | 03 | 41 | 10 | 57 | 42 |
| 27 | 07 | 10 | 41 | 20 | 23 | 10 | 22 | 11 | 00 | 53 |
| 28 | 07 | 23 | 15 | 59 | 23 | 17 | 03 | 11 | 04 | 03 |
| 29 | 08 | 07 | 02 | 34 | 23 | 23 | 44 | 11 | 07 | 14 |
| 30 | 08 | 20 | 13 | 09 | 23 | 30 | 25 | 11 | 10 | 25 |
| 31 | 09 | 03 | 23 | 44 | 23 | 37 | 06 | 11 | 13 | 36 |

## A Table of the mean Motion of the Moon, &c.

*Auguſt.*

| Days | The Moon's mean Motion. | | | | Apog. | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ' | " | o | ' | " | o | ' | " |
| 1 | 09 | 16 | 34 | 19 | 23 | 43 | 47 | 11 | 16 | 47 |
| 2 | 09 | 29 | 44 | 54 | 23 | 50 | 28 | 11 | 19 | 58 |
| 3 | 10 | 12 | 55 | 29 | 23 | 57 | 09 | 11 | 23 | 08 |
| 4 | 10 | 26 | 06 | 04 | 24 | 03 | 51 | 11 | 26 | 19 |
| 5 | 11 | 09 | 16 | 39 | 24 | 10 | 32 | 11 | 29 | 29 |
| 6 | 11 | 22 | 27 | 14 | 24 | 17 | 13 | 11 | 32 | 40 |
| 7 | 00 | 05 | 37 | 49 | 24 | 23 | 54 | 11 | 35 | 51 |
| 8 | 00 | 18 | 48 | 24 | 24 | 30 | 35 | 11 | 39 | 02 |
| 9 | 01 | 01 | 58 | 59 | 24 | 37 | 16 | 11 | 42 | 12 |
| 10 | 01 | 15 | 09 | 34 | 24 | 43 | 57 | 11 | 45 | 23 |
| 11 | 01 | 28 | 20 | 09 | 24 | 50 | 38 | 11 | 58 | 33 |
| 12 | 02 | 11 | 30 | 44 | 24 | 57 | 19 | 11 | 51 | 44 |
| 13 | 02 | 24 | 41 | 19 | 25 | 04 | 00 | 11 | 54 | 54 |
| 14 | 03 | 07 | 51 | 54 | 25 | 10 | 42 | 11 | 58 | 05 |
| 15 | 03 | 21 | 02 | 29 | 25 | 17 | 23 | 12 | 01 | 15 |
| 16 | 04 | 04 | 13 | 04 | 25 | 24 | 04 | 12 | 04 | 26 |
| 17 | 04 | 17 | 23 | 40 | 25 | 30 | 45 | 12 | 07 | 36 |
| 18 | 05 | 00 | 34 | 15 | 25 | 37 | 26 | 12 | 10 | 47 |
| 19 | 05 | 13 | 44 | 50 | 25 | 44 | 07 | 12 | 13 | 58 |
| 20 | 05 | 26 | 55 | 25 | 25 | 50 | 48 | 12 | 17 | 08 |
| 21 | 06 | 10 | 06 | 00 | 25 | 57 | 29 | 12 | 20 | 19 |
| 22 | 06 | 23 | 16 | 35 | 26 | 04 | 10 | 12 | 23 | 29 |
| 23 | 07 | 06 | 27 | 10 | 26 | 10 | 51 | 12 | 26 | 40 |
| 24 | 07 | 19 | 37 | 45 | 26 | 17 | 32 | 12 | 29 | 51 |
| 25 | 08 | 02 | 48 | 20 | 26 | 24 | 13 | 12 | 33 | 01 |
| 26 | 08 | 15 | 58 | 55 | 26 | 30 | 55 | 12 | 36 | 12 |
| 27 | 08 | 29 | 09 | 30 | 26 | 37 | 36 | 12 | 39 | 23 |
| 28 | 09 | 12 | 20 | 05 | 26 | 44 | 17 | 12 | 42 | 34 |
| 29 | 09 | 25 | 30 | 40 | 26 | 50 | 58 | 12 | 45 | 44 |
| 30 | 10 | 08 | 14 | 15 | 26 | 57 | 39 | 12 | 48 | 55 |
| 31 | 10 | 21 | 51 | 59 | 27 | 04 | 20 | 12 | 52 | 05 |

## A Table of the mean Motion of the Moon, &c.

*September.*

| Days | The Moon's mean Motion. | | | | Apog. | | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | s | o | ′ | ″ | o | ′ | ″ |
| 1 | 11 | 05 | 02 | 25 | 0 | 27 | 11 | 01 | 12 | 55 | 16 |
| 2 | 11 | 18 | 13 | 00 | 0 | 27 | 17 | 42 | 12 | 58 | 27 |
| 3 | 00 | 01 | 23 | 35 | 0 | 27 | 24 | 23 | 13 | 01 | 37 |
| 4 | 00 | 14 | 34 | 10 | 0 | 27 | 31 | 04 | 13 | 04 | 48 |
| 5 | 00 | 27 | 44 | 45 | 0 | 27 | 37 | 45 | 13 | 07 | 58 |
| 6 | 01 | 10 | 55 | 20 | 0 | 27 | 44 | 26 | 13 | 11 | 09 |
| 7 | 01 | 24 | 05 | 55 | 0 | 27 | 51 | 07 | 13 | 14 | 20 |
| 8 | 02 | 07 | 16 | 30 | 0 | 27 | 57 | 48 | 13 | 17 | 31 |
| 9 | 02 | 20 | 27 | 05 | 0 | 28 | 04 | 29 | 13 | 20 | 41 |
| 10 | 03 | 03 | 37 | 40 | 0 | 28 | 11 | 11 | 13 | 23 | 52 |
| 11 | 03 | 16 | 48 | 15 | 0 | 28 | 17 | 52 | 13 | 27 | 03 |
| 12 | 03 | 29 | 58 | 50 | 0 | 28 | 24 | 33 | 13 | 30 | 14 |
| 13 | 04 | 13 | 09 | 25 | 0 | 28 | 31 | 14 | 13 | 33 | 24 |
| 14 | 04 | 26 | 20 | 00 | 0 | 28 | 37 | 55 | 13 | 36 | 35 |
| 15 | 05 | 09 | 30 | 35 | 0 | 28 | 44 | 36 | 13 | 39 | 45 |
| 16 | 05 | 22 | 41 | 10 | 0 | 28 | 51 | 17 | 13 | 42 | 56 |
| 17 | 06 | 05 | 51 | 45 | 0 | 28 | 57 | 58 | 13 | 46 | 07 |
| 18 | 06 | 19 | 02 | 20 | 0 | 29 | 04 | 39 | 13 | 49 | 17 |
| 19 | 07 | 02 | 12 | 55 | 0 | 29 | 11 | 20 | 13 | 52 | 28 |
| 20 | 07 | 15 | 23 | 30 | 0 | 29 | 18 | 01 | 13 | 55 | 38 |
| 21 | 07 | 28 | 34 | 05 | 0 | 29 | 24 | 42 | 13 | 58 | 49 |
| 22 | 08 | 11 | 44 | 40 | 0 | 29 | 31 | 23 | 14 | 02 | 00 |
| 23 | 08 | 24 | 55 | 15 | 0 | 29 | 38 | 04 | 14 | 05 | 10 |
| 24 | 09 | 08 | 05 | 50 | 0 | 29 | 44 | 45 | 14 | 08 | 21 |
| 25 | 09 | 21 | 16 | 25 | 0 | 29 | 51 | 27 | 14 | 11 | 31 |
| 26 | 10 | 04 | 27 | 00 | 0 | 29 | 50 | 08 | 14 | 14 | 42 |
| 27 | 10 | 17 | 37 | 35 | 1 | 00 | 04 | 49 | 14 | 17 | 53 |
| 28 | 11 | 00 | 48 | 10 | 1 | 00 | 11 | 30 | 14 | 21 | 03 |
| 29 | 11 | 13 | 58 | 45 | 1 | 00 | 18 | 11 | 14 | 24 | 14 |
| 30 | 11 | 27 | 09 | 20 | 1 | 00 | 24 | 52 | 14 | 27 | 24 |

## A Table of the mean Motion of the Moon, &c.

*October.*

| Days | The Moon's mean Motion. | | | | Apog. | | | | Nod. Retrog. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | s | o | ′ | ″ | o | ′ | ″ |
| 1 | 00 | 10 | 19 | 55 | 1 | 00 | 31 | 33 | 14 | 30 | 35 |
| 2 | 00 | 23 | 30 | 30 | 1 | 00 | 38 | 14 | 14 | 33 | 46 |
| 3 | 01 | 06 | 41 | 05 | 1 | 00 | 44 | 55 | 14 | 36 | 56 |
| 4 | 01 | 19 | 51 | 40 | 1 | 00 | 51 | 36 | 14 | 40 | 07 |
| 5 | 02 | 03 | 02 | 15 | 1 | 00 | 58 | 17 | 14 | 43 | 17 |
| 6 | 02 | 16 | 12 | 50 | 1 | 01 | 04 | 58 | 14 | 46 | 28 |
| 7 | 02 | 29 | 23 | 26 | 1 | 01 | 11 | 39 | 14 | 49 | 39 |
| 8 | 03 | 12 | 34 | 01 | 1 | 01 | 18 | 20 | 14 | 52 | 50 |
| 9 | 03 | 25 | 44 | 36 | 1 | 01 | 25 | 02 | 14 | 56 | 00 |
| 10 | 04 | 08 | 55 | 11 | 1 | 01 | 31 | 43 | 14 | 59 | 11 |
| 11 | 04 | 22 | 05 | 46 | 1 | 01 | 38 | 24 | 15 | 02 | 21 |
| 12 | 05 | 05 | 16 | 21 | 1 | 01 | 45 | 05 | 15 | 05 | 32 |
| 13 | 05 | 18 | 26 | 56 | 1 | 01 | 51 | 46 | 15 | 08 | 43 |
| 14 | 06 | 01 | 37 | 31 | 1 | 01 | 58 | 27 | 15 | 11 | 53 |
| 15 | 06 | 14 | 48 | 06 | 1 | 02 | 05 | 08 | 15 | 15 | 04 |
| 16 | 06 | 27 | 58 | 41 | 1 | 02 | 11 | 49 | 15 | 18 | 15 |
| 17 | 07 | 11 | 09 | 16 | 1 | 02 | 18 | 30 | 15 | 21 | 26 |
| 18 | 07 | 24 | 19 | 51 | 1 | 02 | 25 | 11 | 15 | 24 | 36 |
| 19 | 08 | 07 | 30 | 26 | 1 | 02 | 31 | 52 | 15 | 27 | 47 |
| 20 | 08 | 20 | 41 | 01 | 1 | 02 | 38 | 33 | 15 | 30 | 57 |
| 21 | 09 | 03 | 51 | 36 | 1 | 02 | 45 | 14 | 15 | 34 | 08 |
| 22 | 09 | 17 | 02 | 11 | 1 | 02 | 51 | 55 | 15 | 37 | 19 |
| 23 | 10 | 00 | 12 | 46 | 1 | 02 | 58 | 36 | 15 | 40 | 29 |
| 24 | 10 | 13 | 23 | 21 | 1 | 03 | 05 | 17 | 15 | 43 | 40 |
| 25 | 10 | 26 | 33 | 56 | 1 | 03 | 11 | 58 | 15 | 46 | 50 |
| 26 | 11 | 09 | 44 | 31 | 1 | 03 | 18 | 39 | 15 | 50 | 01 |
| 27 | 11 | 22 | 55 | 06 | 1 | 03 | 25 | 21 | 15 | 53 | 12 |
| 28 | 00 | 06 | 05 | 41 | 1 | 03 | 32 | 02 | 15 | 56 | 22 |
| 29 | 00 | 19 | 16 | 16 | 1 | 03 | 38 | 43 | 15 | 59 | 33 |
| 30 | 01 | 02 | 26 | 51 | 1 | 03 | 45 | 24 | 16 | 02 | 43 |
| 31 | 01 | 15 | 37 | 26 | 1 | 03 | 52 | 05 | 16 | 05 | 54 |

## A Table of the mean Motion of the Moon, &c.

*November.*

| Days | The Moon's mean Motion. s | ° | ′ | ″ | Apog. s | ° | ′ | ″ | Nod. Retrog. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 01 | 28 | 48 | 01 | 1 | 03 | 58 | 46 | 16 | 09 | 05 |
| 2 | 02 | 11 | 58 | 36 | 1 | 04 | 05 | 27 | 16 | 12 | 16 |
| 3 | 02 | 25 | 09 | 11 | 1 | 04 | 12 | 08 | 16 | 15 | 26 |
| 4 | 03 | 08 | 19 | 46 | 1 | 04 | 18 | 49 | 16 | 18 | 37 |
| 5 | 03 | 21 | 30 | 21 | 1 | 04 | 25 | 30 | 16 | 21 | 48 |
| 6 | 04 | 04 | 40 | 56 | 1 | 04 | 32 | 11 | 16 | 24 | 59 |
| 7 | 04 | 17 | 51 | 31 | 1 | 04 | 38 | 53 | 16 | 28 | 09 |
| 8 | 05 | 01 | 02 | 06 | 1 | 04 | 45 | 34 | 16 | 31 | 20 |
| 9 | 05 | 14 | 12 | 41 | 1 | 04 | 52 | 15 | 16 | 34 | 30 |
| 10 | 05 | 27 | 23 | 16 | 1 | 04 | 58 | 56 | 16 | 37 | 41 |
| 11 | 06 | 10 | 33 | 51 | 1 | 05 | 05 | 37 | 16 | 40 | 52 |
| 12 | 06 | 23 | 44 | 26 | 1 | 05 | 12 | 10 | 16 | 44 | 02 |
| 13 | 07 | 06 | 55 | 01 | 1 | 05 | 18 | 59 | 16 | 47 | 13 |
| 14 | 07 | 20 | 05 | 36 | 1 | 05 | 25 | 40 | 16 | 50 | 23 |
| 15 | 08 | 03 | 16 | 11 | 1 | 05 | 32 | 21 | 16 | 53 | 34 |
| 16 | 08 | 16 | 26 | 46 | 1 | 05 | 39 | 02 | 16 | 56 | 45 |
| 17 | 08 | 29 | 37 | 21 | 1 | 05 | 45 | 43 | 16 | 59 | 55 |
| 18 | 09 | 12 | 47 | 56 | 1 | 05 | 52 | 24 | 17 | 03 | 06 |
| 19 | 09 | 25 | 58 | 31 | 1 | 05 | 59 | 05 | 17 | 06 | 16 |
| 20 | 10 | 09 | 09 | 06 | 1 | 06 | 05 | 46 | 17 | 09 | 27 |
| 21 | 10 | 22 | 19 | 41 | 1 | 06 | 12 | 27 | 17 | 12 | 38 |
| 22 | 11 | 05 | 30 | 16 | 1 | 06 | 19 | 09 | 17 | 15 | 49 |
| 23 | 11 | 18 | 40 | 51 | 1 | 06 | 25 | 50 | 17 | 18 | 59 |
| 24 | 00 | 01 | 51 | 26 | 1 | 06 | 32 | 31 | 17 | 22 | 10 |
| 25 | 00 | 15 | 02 | 02 | 1 | 06 | 39 | 12 | 17 | 25 | 21 |
| 26 | 00 | 28 | 12 | 37 | 1 | 06 | 45 | 53 | 17 | 28 | 32 |
| 27 | 01 | 11 | 23 | 12 | 1 | 06 | 52 | 34 | 17 | 31 | 42 |
| 28 | 01 | 24 | 33 | 47 | 1 | 06 | 59 | 15 | 17 | 34 | 53 |
| 29 | 02 | 07 | 44 | 22 | 1 | 07 | 05 | 56 | 17 | 38 | 03 |
| 30 | 02 | 20 | 54 | 57 | 1 | 07 | 12 | 37 | 17 | 41 | 14 |

## A Table of the mean Motion of the Moon, &c.

*December.*

| Days | The Moon's mean Motion. s | ° | ′ | ″ | Apog. s | ° | ′ | ″ | Nod. Retrog. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 03 | 04 | 05 | 32 | 1 | 07 | 19 | 18 | 17 | 44 | 25 |
| 2 | 03 | 17 | 16 | 07 | 1 | 07 | 25 | 59 | 17 | 47 | 35 |
| 3 | 04 | 00 | 26 | 42 | 1 | 07 | 32 | 40 | 17 | 50 | 46 |
| 4 | 04 | 13 | 37 | 17 | 1 | 07 | 39 | 21 | 17 | 53 | 56 |
| 5 | 04 | 26 | 47 | 52 | 1 | 07 | 46 | 02 | 17 | 57 | 07 |
| 6 | 05 | 09 | 58 | 27 | 1 | 07 | 52 | 43 | 18 | 00 | 18 |
| 7 | 05 | 23 | 09 | 02 | 1 | 07 | 59 | 24 | 18 | 03 | 28 |
| 8 | 06 | 06 | 19 | 37 | 1 | 08 | 06 | 06 | 18 | 06 | 39 |
| 9 | 06 | 19 | 30 | 12 | 1 | 08 | 12 | 47 | 18 | 09 | 49 |
| 10 | 07 | 02 | 40 | 47 | 1 | 08 | 19 | 28 | 18 | 13 | 00 |
| 11 | 07 | 15 | 51 | 22 | 1 | 08 | 26 | 09 | 18 | 16 | 11 |
| 12 | 07 | 29 | 01 | 57 | 1 | 08 | 32 | 50 | 18 | 19 | 21 |
| 13 | 08 | 12 | 12 | 32 | 1 | 08 | 39 | 31 | 18 | 22 | 32 |
| 14 | 08 | 25 | 23 | 07 | 1 | 08 | 46 | 12 | 18 | 25 | 42 |
| 15 | 09 | 08 | 33 | 42 | 1 | 08 | 52 | 53 | 18 | 28 | 53 |
| 16 | 09 | 21 | 44 | 17 | 1 | 08 | 59 | 34 | 18 | 32 | 04 |
| 17 | 10 | 04 | 54 | 52 | 1 | 09 | 06 | 15 | 18 | 35 | 15 |
| 18 | 10 | 18 | 05 | 27 | 1 | 09 | 12 | 56 | 18 | 38 | 25 |
| 19 | 11 | 01 | 16 | 02 | 1 | 09 | 19 | 38 | 18 | 41 | 36 |
| 20 | 11 | 14 | 26 | 37 | 1 | 09 | 26 | 19 | 18 | 44 | 47 |
| 21 | 11 | 27 | 37 | 12 | 1 | 09 | 33 | 00 | 18 | 47 | 58 |
| 22 | 00 | 10 | 47 | 47 | 1 | 09 | 39 | 41 | 18 | 51 | 09 |
| 23 | 00 | 23 | 58 | 22 | 1 | 09 | 46 | 22 | 18 | 54 | 19 |
| 24 | 01 | 07 | 08 | 57 | 1 | 09 | 53 | 03 | 18 | 57 | 30 |
| 25 | 01 | 20 | 19 | 32 | 1 | 09 | 59 | 44 | 19 | 00 | 41 |
| 26 | 02 | 03 | 30 | 07 | 1 | 10 | 06 | 25 | 19 | 03 | 51 |
| 27 | 02 | 16 | 40 | 42 | 1 | 10 | 13 | 06 | 19 | 07 | 02 |
| 28 | 02 | 29 | 51 | 17 | 1 | 10 | 19 | 47 | 19 | 10 | 12 |
| 29 | 03 | 13 | 01 | 52 | 1 | 10 | 26 | 28 | 19 | 13 | 23 |
| 30 | 03 | 26 | 12 | 27 | 1 | 10 | 33 | 09 | 19 | 16 | 34 |
| 31 | 04 | 09 | 23 | 02 | 1 | 10 | 39 | 50 | 19 | 19 | 45 |

## A Table of the Moon's mean Motion in Hours and Parts of an Hour.

| H. | ° ′ ″ | ′ ″ | ′ ″ | H. | ° ′ ″ | ° ″ | ′ ″ |
|---|---|---|---|---|---|---|---|
| 0 | 0 00 00 | 0 00 | 0 00 | 30 | 16 28 14 | 8 21 | 3 58 |
| 1 | 0 32 56 | 0 17 | 0 08 | 31 | 17 01 10 | 8 38 | 4 06 |
| 2 | 1 05 53 | 0 33 | 0 16 | 32 | 17 34 07 | 8 54 | 4 14 |
| 3 | 1 38 49 | 0 50 | 0 24 | 33 | 18 07 03 | 9 11 | 4 22 |
| 4 | 2 11 46 | 1 07 | 0 32 | 34 | 18 39 59 | 9 28 | 4 30 |
| 5 | 2 44 42 | 1 24 | 0 40 | 35 | 19 12 55 | 9 45 | 4 38 |
| 6 | 3 17 39 | 1 40 | 0 48 | 36 | 19 45 52 | 10 02 | 4 46 |
| 7 | 3 50 35 | 1 57 | 0 56 | 37 | 20 18 48 | 10 19 | 4 54 |
| 8 | 4 23 32 | 2 14 | 1 04 | 38 | 20 51 45 | 10 36 | 5 02 |
| 9 | 4 56 28 | 2 30 | 1 12 | 39 | 21 24 41 | 10 52 | 5 10 |
| 10 | 5 29 25 | 2 47 | 1 19 | 40 | 21 57 38 | 11 08 | 5 18 |
| 11 | 6 02 21 | 3 04 | 1 27 | 41 | 22 30 34 | 11 25 | 5 26 |
| 12 | 6 35 18 | 3 21 | 1 35 | 42 | 23 03 31 | 11 42 | 5 34 |
| 13 | 7 08 14 | 3 37 | 1 43 | 43 | 23 36 27 | 11 59 | 5 42 |
| 14 | 7 41 10 | 3 54 | 1 51 | 44 | 24 09 24 | 12 16 | 5 50 |
| 15 | 8 14 07 | 4 11 | 1 59 | 45 | 24 42 20 | 12 32 | 5 58 |
| 16 | 8 47 03 | 4 27 | 2 07 | 46 | 25 15 17 | 12 41 | 6 06 |
| 17 | 9 20 00 | 4 44 | 2 15 | 47 | 25 48 13 | 13 05 | 6 14 |
| 18 | 9 52 56 | 5 01 | 2 23 | 48 | 26 21 10 | 13 22 | 6 22 |
| 19 | 10 25 53 | 5 18 | 2 31 | 49 | 26 54 06 | 13 39 | 6 30 |
| 20 | 10 58 49 | 5 34 | 2 39 | 50 | 27 27 03 | 13 56 | 6 38 |
| 21 | 11 31 46 | 5 51 | 2 47 | 51 | 27 59 59 | 14 13 | 6 46 |
| 22 | 12 04 42 | 6 08 | 2 55 | 52 | 28 32 56 | 14 30 | 6 54 |
| 23 | 12 37 39 | 6 24 | 3 03 | 53 | 29 05 52 | 14 46 | 7 01 |
| 24 | 13 10 35 | 6 41 | 3 11 | 54 | 29 38 49 | 15 02 | 7 08 |
| 25 | 13 43 32 | 6 58 | 3 19 | 55 | 30 11 45 | 15 19 | 7 16 |
| 26 | 14 16 28 | 7 15 | 3 27 | 56 | 30 44 42 | 15 36 | 7 24 |
| 27 | 14 49 24 | 7 31 | 3 34 | 57 | 31 17 38 | 15 53 | 7 32 |
| 28 | 15 22 21 | 7 48 | 3 42 | 58 | 31 50 34 | 16 10 | 7 40 |
| 29 | 15 55 17 | 8 05 | 3 50 | 59 | 32 23 31 | 16 26 | 7 48 |
| 30 | 16 28 14 | 8 21 | 3 58 | 60 | 32 56 27 | 16 43 | 7 56 |

If it be Leap-Year, after *February*, you must to the Time given, add a Day, and to the collected Sums of her Motion.



## A Table of Physical Parts to be added to, or taken from the Moon's mean Motion, according to the Sun's mean Anomaly.

| Anomal. Sol. med. | Add. 0 | | 1 | | 2 | | 3 | | 4 | | 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | ′ | ″ | |
| 0 | 0 | 00 | 5 | 36 | 9 | 51 | 11 | 30 | 10 | 04 | 5 | 51 | 30 |
| 1 | 0 | 12 | 5 | 47 | 9 | 57 | 11 | 30 | 9 | 58 | 5 | 40 | 29 |
| 2 | 0 | 23 | 5 | 58 | 10 | 03 | 11 | 30 | 9 | 51 | 5 | 30 | 28 |
| 3 | 0 | 35 | 6 | 09 | 10 | 09 | 11 | 30 | 9 | 45 | 5 | 19 | 27 |
| 4 | 0 | 47 | 6 | 19 | 10 | 14 | 11 | 29 | 9 | 39 | 5 | 08 | 26 |
| 5 | 0 | 59 | 6 | 29 | 10 | 19 | 11 | 28 | 9 | 32 | 4 | 57 | 25 |
| 6 | 1 | 10 | 6 | 39 | 10 | 25 | 11 | 27 | 9 | 25 | 4 | 46 | 24 |
| 7 | 1 | 22 | 6 | 48 | 10 | 30 | 11 | 26 | 9 | 18 | 4 | 35 | 23 |
| 8 | 1 | 33 | 6 | 58 | 10 | 34 | 11 | 25 | 9 | 11 | 4 | 23 | 22 |
| 9 | 1 | 45 | 7 | 07 | 10 | 39 | 11 | 24 | 9 | 03 | 4 | 12 | 21 |
| 10 | 1 | 56 | 7 | 16 | 10 | 43 | 11 | 22 | 8 | 53 | 4 | 00 | 20 |
| 11 | 2 | 08 | 7 | 25 | 10 | 48 | 11 | 20 | 8 | 48 | 3 | 49 | 19 |
| 12 | 2 | 19 | 7 | 34 | 10 | 52 | 11 | 18 | 8 | 40 | 3 | 37 | 18 |
| 13 | 2 | 31 | 7 | 43 | 10 | 56 | 11 | 15 | 8 | 32 | 3 | 25 | 17 |
| 14 | 2 | 42 | 7 | 52 | 10 | 59 | 11 | 13 | 8 | 23 | 3 | 14 | 16 |
| 15 | 2 | 54 | 8 | 01 | 11 | 02 | 11 | 10 | 8 | 15 | 3 | 02 | 15 |
| 16 | 3 | 05 | 8 | 09 | 11 | 06 | 11 | 07 | 8 | 06 | 2 | 50 | 14 |
| 17 | 3 | 16 | 8 | 17 | 11 | 09 | 11 | 04 | 7 | 58 | 2 | 38 | 13 |
| 18 | 3 | 27 | 8 | 25 | 11 | 12 | 11 | 00 | 7 | 49 | 2 | 26 | 12 |
| 19 | 3 | 39 | 8 | 33 | 11 | 14 | 10 | 57 | 7 | 40 | 2 | 14 | 11 |
| 20 | 3 | 50 | 8 | 41 | 11 | 17 | 10 | 53 | 7 | 30 | 2 | 02 | 10 |
| 21 | 4 | 01 | 8 | 49 | 11 | 19 | 10 | 50 | 7 | 21 | 1 | 50 | 9 |
| 22 | 4 | 12 | 8 | 57 | 11 | 21 | 10 | 45 | 7 | 12 | 1 | 38 | 8 |
| 23 | 4 | 22 | 9 | 04 | 11 | 23 | 10 | 40 | 7 | 02 | 1 | 26 | 7 |
| 24 | 4 | 33 | 9 | 11 | 11 | 24 | 10 | 35 | 6 | 52 | 1 | 13 | 6 |
| 25 | 4 | 44 | 9 | 18 | 11 | 26 | 10 | 31 | 6 | 42 | 1 | 01 | 5 |
| 26 | 4 | 55 | 9 | 25 | 11 | 27 | 10 | 26 | 6 | 32 | 0 | 49 | 4 |
| 27 | 5 | 05 | 9 | 32 | 11 | 28 | 10 | 20 | 6 | 22 | 0 | 37 | 3 |
| 28 | 5 | 16 | 9 | 38 | 11 | 29 | 10 | 15 | 6 | 12 | 0 | 24 | 2 |
| 29 | 5 | 26 | 9 | 45 | 11 | 29 | 10 | 09 | 6 | 02 | 0 | 12 | 1 |
| 30 | 5 | 36 | 9 | 51 | 11 | 30 | 10 | 04 | 5 | 51 | 0 | 00 | 0 |
| | 11 | | 10 | | 9 | | 8 | | 7 | | 6 | | |

Subtr.

## A Table of the Equations of the Moon's Apogæum; with the Eccentricities of her Orbit in such Parts, as the Radius contains 1000000.

Add the Equation to the Apogæum.

| Argum. Ann. | Sign. 0, 6 | Eccentricity. Parts. | Sign. 1, 7. | Eccentricity. Parts. | Sign. 2, 8. | Eccentricity. Parts. | Argum. An. |
|---|---|---|---|---|---|---|---|
| | ° ′ ″ | | ° ′ ″ | | ° ′ ″ | | |
| | 0 00 00 | 66854 | 09 07 14 | 61045 | 11 08 55 | 49429 | 30 |
| 1 | 0 20 21 | 66847 | 09 20 52 | 60691 | 10 59 45 | 49082 | 29 |
| 2 | 0 40 42 | 66826 | 09 34 01 | 60330 | 10 49 35 | 48741 | 28 |
| 3 | 1 01 01 | 66791 | 09 46 40 | 59962 | 10 38 22 | 48408 | 27 |
| 4 | 1 21 17 | 66741 | 09 58 49 | 59589 | 10 26 07 | 48085 | 26 |
| 5 | 1 41 30 | 66678 | 10 10 24 | 59210 | 10 12 50 | 47769 | 25 |
| 6 | 2 01 40 | 66600 | 10 21 29 | 58827 | 09 58 45 | 47653 | 24 |
| 7 | 2 21 44 | 66509 | 10 31 58 | 58439 | 09 43 35 | 47167 | 23 |
| 8 | 2 41 42 | 66404 | 10 41 50 | 58047 | 09 26 22 | 46880 | 22 |
| 9 | 3 01 34 | 66286 | 10 51 08 | 57652 | 09 09 07 | 46604 | 21 |
| 10 | 3 21 18 | 66154 | 10 59 48 | 57254 | 08 51 50 | 46337 | 20 |
| 11 | 3 40 54 | 66008 | 11 07 47 | 56854 | 08 41 36 | 46082 | 19 |
| 12 | 4 00 12 | 65850 | 11 15 07 | 56451 | 08 11 14 | 45838 | 18 |
| 13 | 4 19 38 | 65679 | 11 21 45 | 56047 | 07 49 55 | 45606 | 17 |
| 14 | 4 38 44 | 65495 | 11 27 40 | 55642 | 07 27 40 | 45385 | 16 |
| 15 | 4 57 38 | 65298 | 11 32 51 | 55237 | 07 04 31 | 45176 | 15 |
| 16 | 5 16 20 | 65089 | 11 37 17 | 54832 | 06 40 30 | 44979 | 14 |
| 17 | 5 34 49 | 64868 | 11 30 55 | 54427 | 06 15 40 | 44794 | 13 |
| 18 | 5 53 02 | 64636 | 11 43 47 | 54023 | 05 50 02 | 44623 | 12 |
| 19 | 6 11 01 | 64392 | 11 45 49 | 53920 | 05 23 39 | 44466 | 11 |
| 20 | 6 28 43 | 64137 | 11 47 01 | 53220 | 04 56 34 | 44320 | 10 |
| 21 | 6 46 08 | 63870 | 11 47 22 | 52822 | 04 28 51 | 44188 | 9 |
| 22 | 7 03 15 | 63594 | 11 46 50 | 52427 | 04 00 32 | 44070 | 8 |
| 23 | 7 20 03 | 63307 | 11 45 24 | 52035 | 03 31 40 | 43965 | 7 |
| 24 | 7 36 30 | 63011 | 11 43 04 | 51647 | 03 02 20 | 43874 | 6 |
| 25 | 7 52 36 | 62705 | 11 39 47 | 51264 | 02 03 26 | 43796 | 5 |
| 26 | 8 08 20 | 62389 | 11 35 34 | 50885 | 02 02 30 | 43733 | 4 |
| 27 | 8 23 41 | 62066 | 11 30 23 | 50512 | 01 32 08 | 43683 | 3 |
| 28 | 8 38 38 | 61733 | 11 24 14 | 50144 | 01 01 30 | 43648 | 2 |
| 29 | 8 53 08 | 61392 | 11 17 05 | 49783 | 00 30 45 | 43627 | 1 |
| 30 | 9 07 14 | 61045 | 11 08 55 | 49429 | 00 00 00 | 43619 | 0 |
| | Sign. 5, 11 | | Sign. 4, 10. | | Sign. 3, 9. | | |

Subtract the Equations of the Apogæum.



## A Table of the Equations of the Centre of the Moon.

Subtract.

| Anom. Med. | Sign. 0. Ecc. least. 43610 | Mid. 55237 | Great. 66854 | Sign. 1. Ecc. least 43619 | Mid. 55237 | Great. 66854 | Anom. Med. |
|---|---|---|---|---|---|---|---|
| | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | |
| 0 | 0 00 00 | 0 00 00 | 0 00 00 | 2 23 08 | 2 59 04 | 3 34 08 | 30 |
| 1 | 0 04 58 | 0 06 12 | 0 07 24 | 2 27 32 | 3 04 33 | 3 40 43 | 29 |
| 2 | 0 09 56 | 0 12 24 | 0 14 48 | 2 31 50 | 3 10 00 | 3 47 15 | 28 |
| 3 | 0 14 53 | 0 18 35 | 0 22 12 | 2 36 07 | 3 15 23 | 3 53 43 | 27 |
| 4 | 0 19 50 | 0 24 47 | 0 29 36 | 2 40 22 | 3 20 44 | 4 00 08 | 26 |
| 5 | 0 24 48 | 0 30 58 | 0 36 58 | 2 44 35 | 3 26 01 | 4 06 30 | 25 |
| 6 | 0 29 44 | 0 37 09 | 0 44 20 | 2 48 48 | 3 31 16 | 4 12 47 | 24 |
| 7 | 0 34 39 | 0 43 19 | 0 51 42 | 2 52 53 | 3 36 27 | 4 19 01 | 23 |
| 8 | 0 39 34 | 0 49 27 | 0 59 04 | 2 56 54 | 3 41 35 | 4 25 12 | 22 |
| 9 | 0 44 30 | 0 55 36 | 1 06 25 | 3 00 58 | 3 46 39 | 4 31 18 | 21 |
| 10 | 0 49 25 | 1 01 43 | 1 13 45 | 3 04 55 | 3 51 39 | 4 37 20 | 20 |
| 11 | 0 54 19 | 1 07 51 | 1 21 02 | 3 08 53 | 3 56 36 | 4 43 18 | 19 |
| 12 | 0 59 13 | 1 13 57 | 1 28 18 | 3 12 46 | 4 01 30 | 4 49 12 | 18 |
| 13 | 1 04 04 | 1 20 02 | 1 35 34 | 3 16 35 | 4 06 20 | 4 55 01 | 17 |
| 14 | 1 08 56 | 1 26 05 | 1 42 49 | 3 20 22 | 4 11 06 | 5 00 46 | 16 |
| 15 | 1 13 45 | 1 32 07 | 1 50 02 | 3 24 05 | 4 15 47 | 5 06 26 | 15 |
| 16 | 1 18 33 | 1 38 08 | 1 57 13 | 3 27 44 | 4 20 24 | 5 12 01 | 14 |
| 17 | 1 23 20 | 1 44 08 | 2 04 23 | 3 31 20 | 4 24 58 | 5 17 32 | 13 |
| 18 | 1 28 06 | 1 50 06 | 2 11 31 | 3 34 53 | 4 29 28 | 5 22 59 | 12 |
| 19 | 1 32 50 | 1 56 02 | 2 18 37 | 3 38 22 | 4 33 53 | 5 28 20 | 11 |
| 20 | 1 37 32 | 2 01 56 | 2 25 41 | 3 41 47 | 4 38 14 | 5 33 36 | 10 |
| 21 | 1 42 13 | 2 07 49 | 2 32 43 | 3 45 09 | 4 42 31 | 5 38 47 | 9 |
| 22 | 1 46 53 | 2 13 39 | 2 39 43 | 3 48 28 | 4 46 43 | 5 43 53 | 8 |
| 23 | 1 51 33 | 2 19 27 | 2 46 40 | 3 51 43 | 4 50 50 | 5 48 53 | 7 |
| 24 | 1 56 09 | 2 25 14 | 2 53 35 | 3 54 55 | 4 54 53 | 5 53 48 | 6 |
| 25 | 2 00 45 | 2 30 58 | 3 00 28 | 3 58 03 | 4 58 55 | 5 58 38 | 5 |
| 26 | 2 05 18 | 2 36 41 | 3 07 18 | 4 01 06 | 5 02 43 | 6 03 21 | 4 |
| 27 | 2 09 49 | 2 42 21 | 3 14 05 | 4 04 05 | 5 06 32 | 6 07 59 | 3 |
| 28 | 2 14 18 | 2 47 58 | 3 20 49 | 4 07 00 | 5 10 15 | 6 12 31 | 2 |
| 29 | 2 18 44 | 2 53 32 | 3 27 30 | 4 09 51 | 5 13 54 | 6 16 58 | 1 |
| 30 | 2 23 08 | 2 59 04 | 3 34 08 | 4 12 40 | 5 17 27 | 6 21 18 | 0 |
| | Sign. 11. | | | Sign. 10. | | | |

Add.

## A Table of the Equations of the Centre of the Moon.

Subtract.

| Anom. Med. | Sign. 2. Ecc. least. 43619 | Sign. 2. Mid. 55237 | Sign. 2. Great. 66854 | Sign. 3. Ecc. least 43619 | Sign. 3. Mid. 55237 | Sign. 3. Great. 66854 | Anom. Med. |
|---|---|---|---|---|---|---|---|
| | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | |
| 0 | 4 12 40 | 5 17 27 | 6 21 18 | 4 59 30 | 6 18 59 | 7 38 17 | 30 |
| 1 | 4 15 18 | 5 20 54 | 6 25 32 | 4 59 48 | 6 19 23 | 7 38 52 | 29 |
| 2 | 4 17 56 | 5 24 17 | 6 29 39 | 4 59 56 | 6 19 40 | 7 39 20 | 28 |
| 3 | 4 20 28 | 5 27 35 | 6 33 40 | 4 59 59 | 6 19 50 | 7 39 40 | 27 |
| 4 | 4 23 00 | 5 30 47 | 6 37 36 | 4 59 58 | 6 19 54 | 7 39 51 | 26 |
| 5 | 4 25 24 | 5 33 53 | 6 41 25 | 4 59 49 | 6 19 51 | 7 39 53 | 25 |
| 6 | 4 27 44 | 5 36 54 | 6 45 08 | 4 59 36 | 6 19 40 | 7 39 47 | 24 |
| 7 | 4 30 00 | 5 39 49 | 6 48 44 | 4 59 20 | 6 19 23 | 7 39 33 | 23 |
| 8 | 4 32 12 | 5 42 39 | 6 52 14 | 4 58 53 | 6 18 57 | 7 39 09 | 22 |
| 9 | 4 34 19 | 5 45 24 | 6 55 36 | 4 58 24 | 6 18 25 | 7 38 37 | 21 |
| 10 | 4 36 21 | 5 48 02 | 6 58 52 | 4 57 48 | 6 17 46 | 7 37 58 | 20 |
| 11 | 4 38 18 | 5 50 35 | 7 02 01 | 4 57 06 | 6 17 00 | 7 37 09 | 19 |
| 12 | 4 40 12 | 5 53 02 | 7 05 03 | 4 56 19 | 6 16 08 | 7 36 12 | 18 |
| 13 | 4 41 58 | 5 55 22 | 7 07 57 | 4 55 27 | 6 15 08 | 7 35 06 | 17 |
| 14 | 4 43 41 | 5 57 36 | 7 10 45 | 4 54 30 | 6 14 00 | 7 33 52 | 16 |
| 15 | 4 45 19 | 5 59 44 | 7 13 25 | 4 53 27 | 6 12 46 | 7 32 29 | 15 |
| 16 | 4 46 53 | 6 01 46 | 7 15 58 | 4 52 19 | 6 11 25 | 7 30 57 | 14 |
| 17 | 4 48 22 | 6 03 42 | 7 18 24 | 4 51 03 | 6 09 56 | 7 29 17 | 13 |
| 18 | 4 49 44 | 6 05 31 | 7 20 42 | 4 49 45 | 6 08 20 | 7 27 28 | 12 |
| 19 | 4 51 02 | 6 07 15 | 7 22 53 | 4 48 21 | 6 06 37 | 7 25 30 | 11 |
| 20 | 4 52 15 | 6 08 52 | 7 24 56 | 4 46 51 | 6 04 48 | 7 23 23 | 10 |
| 21 | 4 53 22 | 6 10 23 | 7 26 52 | 4 45 16 | 6 02 51 | 7 21 08 | 9 |
| 22 | 4 54 23 | 6 11 46 | 7 28 39 | 4 43 34 | 6 00 48 | 7 18 44 | 8 |
| 23 | 4 55 20 | 6 13 03 | 7 30 20 | 4 41 44 | 5 58 37 | 7 16 12 | 7 |
| 24 | 4 56 12 | 6 14 14 | 7 31 52 | 4 39 56 | 5 56 19 | 7 13 30 | 6 |
| 25 | 4 56 59 | 6 15 19 | 7 33 16 | 4 37 58 | 5 53 54 | 7 10 40 | 5 |
| 26 | 4 57 38 | 6 16 17 | 7 34 32 | 4 35 56 | 5 51 23 | 7 07 42 | 4 |
| 27 | 4 58 14 | 6 17 08 | 7 35 40 | 4 33 47 | 5 48 43 | 7 04 35 | 3 |
| 28 | 4 58 45 | 6 17 52 | 7 36 41 | 4 31 33 | 5 45 57 | 7 01 19 | 2 |
| 29 | 4 59 10 | 6 18 29 | 7 37 34 | 4 29 13 | 5 43 04 | 6 57 55 | 1 |
| 30 | 4 59 30 | 6 18 59 | 7 38 17 | 4 26 49 | 5 40 05 | 6 54 23 | 0 |
| | Sign. 9. | | | Sign. 8. | | | |

Add.

## A Table of the Equations of the Centre of the Moon.

Subtract.

| Anom. Med. | Sign. 4. Ecc. least 43619 | Sign. 4. Mid. 55237 | Sign. 4. Great. 66854 | Sign. 5. Ecc. least 43619 | Sign. 5. Mid. 55237 | Sign. 5. Great. 66854 | Anom. Med. |
|---|---|---|---|---|---|---|---|
| | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | |
| 0 | 4 26 49 | 5 40 05 | 6 54 23 | 2 37 10 | 3 21 48 | 4 07 29 | 30 |
| 1 | 4 24 19 | 5 37 00 | 6 50 42 | 2 32 27 | 3 15 48 | 4 00 10 | 29 |
| 2 | 4 21 43 | 5 33 46 | 6 46 52 | 2 27 42 | 3 09 44 | 3 52 45 | 28 |
| 3 | 4 19 01 | 5 30 25 | 6 42 54 | 2 12 54 | 3 03 36 | 3 45 14 | 27 |
| 4 | 4 16 14 | 5 26 57 | 6 38 48 | 2 18 03 | 2 57 24 | 3 37 39 | 26 |
| 5 | 4 13 22 | 5 23 24 | 6 34 34 | 2 13 09 | 2 51 06 | 3 29 59 | 25 |
| 6 | 4 10 25 | 5 19 43 | 6 30 11 | 2 08 13 | 2 44 45 | 3 22 14 | 24 |
| 7 | 4 07 24 | 5 15 58 | 6 25 40 | 2 03 14 | 2 38 22 | 3 14 24 | 23 |
| 8 | 4 04 18 | 5 12 06 | 6 21 01 | 1 58 12 | 2 31 55 | 3 06 30 | 22 |
| 9 | 4 01 08 | 5 08 07 | 6 16 14 | 1 53 07 | 2 25 24 | 2 58 31 | 21 |
| 10 | 3 57 53 | 5 04 00 | 6 11 20 | 1 48 01 | 2 18 50 | 2 50 29 | 20 |
| 11 | 3 54 32 | 4 59 48 | 6 06 16 | 1 42 52 | 2 12 13 | 2 42 23 | 19 |
| 12 | 3 51 07 | 4 55 30 | 6 01 06 | 1 37 41 | 2 05 32 | 2 34 12 | 18 |
| 13 | 3 47 38 | 4 51 06 | 5 55 49 | 1 32 27 | 1 58 49 | 2 25 58 | 17 |
| 14 | 3 44 04 | 4 46 36 | 5 50 21 | 1 27 11 | 1 52 05 | 2 17 41 | 16 |
| 15 | 3 40 27 | 4 42 00 | 5 44 48 | 1 21 54 | 1 45 17 | 2 09 21 | 15 |
| 16 | 3 36 43 | 4 37 17 | 5 39 06 | 1 16 35 | 1 38 26 | 2 00 58 | 14 |
| 17 | 3 32 55 | 4 32 27 | 5 33 17 | 1 11 14 | 1 31 33 | 1 52 31 | 13 |
| 18 | 3 29 02 | 4 27 32 | 5 27 22 | 1 05 55 | 1 24 38 | 1 44 01 | 12 |
| 19 | 3 25 05 | 4 22 33 | 5 21 19 | 1 00 27 | 1 17 42 | 1 35 29 | 11 |
| 20 | 3 21 04 | 4 17 28 | 5 15 09 | 0 55 02 | 1 10 44 | 1 26 55 | 10 |
| 21 | 3 16 59 | 4 12 17 | 5 08 52 | 0 49 34 | 1 03 43 | 1 18 19 | 9 |
| 22 | 3 12 48 | 4 07 01 | 5 02 28 | 0 44 07 | 0 56 42 | 1 09 42 | 8 |
| 23 | 3 08 34 | 4 01 40 | 4 55 58 | 0 38 37 | 0 49 40 | 1 01 03 | 7 |
| 24 | 3 04 16 | 3 56 13 | 4 49 21 | 0 33 08 | 0 42 36 | 0 52 22 | 6 |
| 25 | 2 59 53 | 3 50 40 | 4 42 38 | 0 27 38 | 0 35 30 | 0 43 40 | 5 |
| 26 | 2 55 27 | 3 45 03 | 4 35 48 | 0 22 08 | 0 28 25 | 0 34 57 | 4 |
| 27 | 2 50 58 | 3 39 21 | 4 28 52 | 0 16 37 | 0 21 19 | 0 26 13 | 3 |
| 28 | 2 46 26 | 3 33 34 | 4 21 49 | 0 11 04 | 0 14 13 | 0 17 29 | 2 |
| 29 | 2 41 50 | 3 27 43 | 4 14 41 | 0 05 32 | 0 07 07 | 0 08 45 | 1 |
| 30 | 2 37 10 | 3 21 48 | 4 07 29 | 0 00 00 | 0 00 00 | 0 00 00 | 0 |
| | Sign. 7. | | | Sign. 6. | | | |

Add

## A Table of the Variation of the Moon.

| | Add. | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Sign.* 0, 6. | | *Sign.* 1, 7. | | *Sign.* 2, 8. | | |
| — | ′ | ″ | ′ | ″ | ′ | ″ | — |
| 0 | 00 | 00 | 32 | 54 | 32 | 54 | 30 |
| 1 | 01 | 20 | 33 | 33 | 32 | 13 | 29 |
| 2 | 02 | 39 | 34 | 09 | 31 | 30 | 28 |
| 3 | 03 | 59 | 34 | 42 | 30 | 45 | 27 |
| 4 | 05 | 18 | 35 | 13 | 29 | 57 | 26 |
| 5 | 06 | 36 | 35 | 42 | 29 | 07 | 25 |
| 6 | 07 | 54 | 36 | 09 | 28 | 14 | 24 |
| 7 | 09 | 11 | 36 | 32 | 27 | 20 | 23 |
| 8 | 10 | 28 | 36 | 52 | 26 | 24 | 22 |
| 9 | 11 | 44 | 37 | 10 | 25 | 26 | 21 |
| 10 | 13 | 00 | 37 | 25 | 24 | 25 | 20 |
| 11 | 14 | 14 | 37 | 38 | 23 | 23 | 19 |
| 12 | 15 | 27 | 37 | 48 | 22 | 20 | 18 |
| 13 | 16 | 40 | 37 | 55 | 21 | 15 | 17 |
| 14 | 17 | 51 | 37 | 59 | 20 | 08 | 16 |
| 15 | 19 | 00 | 38 | 00 | 19 | 00 | 15 |
| 16 | 20 | 08 | 37 | 59 | 17 | 51 | 14 |
| 17 | 21 | 15 | 37 | 55 | 16 | 40 | 13 |
| 18 | 22 | 20 | 37 | 48 | 15 | 27 | 12 |
| 19 | 23 | 23 | 37 | 38 | 14 | 14 | 11 |
| 20 | 24 | 25 | 37 | 25 | 13 | 00 | 10 |
| 21 | 25 | 26 | 37 | 10 | 11 | 44 | 9 |
| 22 | 26 | 24 | 36 | 52 | 10 | 28 | 8 |
| 23 | 27 | 20 | 36 | 32 | 09 | 11 | 7 |
| 24 | 28 | 14 | 36 | 09 | 07 | 54 | 6 |
| 25 | 29 | 07 | 35 | 42 | 06 | 36 | 5 |
| 26 | 29 | 57 | 35 | 13 | 05 | 18 | 4 |
| 27 | 30 | 45 | 34 | 42 | 03 | 59 | 3 |
| 28 | 31 | 30 | 34 | 09 | 02 | 39 | 2 |
| 29 | 32 | 13 | 33 | 33 | 01 | 20 | 1 |
| 30 | 32 | 54 | 32 | 54 | 00 | 00 | 0 |
| | *Sign.* 11, 5. | | *Sign.* 10, 4. | | *Sign.* 9, 3. | | |
| | Subtract. | | | | | | |

A Table



## A Table of the Equation of the Moon's Node, and of the Inclination of her Limit above five Degrees.

| | Add the Equations of the Node. | | | | | | |
|---|---|---|---|---|---|---|---|
| ☊ à ☊ diff. | *Sign.* 0, 6. | | *Sign.* 1, 7. | | *Sign.* 2, 8. | | ☊ à ☊ diff. |
| | Equat. ☊ | Inclin Lim. | Equat. ☊ | Inclin Lim. | Equat. ☊ | Inclin Lim. | |
| | ° ′ ″ | ′ ″ | ° ′ ″ | ′ ″ | ° ′ ″ | ′ ″ | |
| 0 | 0 00 00 | 18 00 | 1 25 12 | 13 30 | 1 26 50 | 04 30 | 30 |
| 1 | 0 03 28 | 18 00 | 1 27 00 | 13 14 | 1 25 01 | 04 14 | 29 |
| 2 | 0 06 56 | 17 59 | 1 28 37 | 12 57 | 1 23 06 | 03 59 | 28 |
| 3 | 0 10 23 | 17 59 | 1 30 04 | 12 40 | 1 21 06 | 03 43 | 27 |
| 4 | 0 13 49 | 17 55 | 1 31 22 | 12 23 | 1 19 03 | 03 28 | 26 |
| 5 | 0 17 11 | 17 52 | 1 32 30 | 12 05 | 1 46 56 | 03 13 | 25 |
| 6 | 0 20 31 | 17 48 | 1 33 34 | 11 47 | 1 14 44 | 02 59 | 24 |
| 7 | 0 23 48 | 17 43 | 1 34 34 | 11 29 | 1 12 26 | 02 45 | 23 |
| 8 | 0 27 02 | 17 38 | 1 35 31 | 11 11 | 1 10 02 | 02 32 | 22 |
| 9 | 0 30 13 | 17 34 | 1 36 25 | 10 53 | 1 07 31 | 02 19 | 21 |
| 10 | 0 33 22 | 17 28 | 1 37 15 | 10 34 | 1 04 53 | 02 06 | 20 |
| 11 | 0 36 29 | 17 21 | 1 37 59 | 10 14 | 1 02 09 | 01 54 | 19 |
| 12 | 0 39 34 | 17 13 | 1 38 37 | 09 55 | 0 59 19 | 01 43 | 18 |
| 13 | 0 42 37 | 17 05 | 1 39 09 | 09 37 | 0 56 23 | 01 32 | 17 |
| 14 | 0 45 38 | 16 57 | 1 39 33 | 09 18 | 0 53 21 | 01 22 | 16 |
| 15 | 0 48 37 | 16 48 | 1 39 46 | 09 00 | 0 50 15 | 01 12 | 15 |
| 16 | 0 51 33 | 16 38 | 1 39 34 | 08 42 | 0 47 06 | 01 03 | 14 |
| 17 | 0 54 27 | 16 28 | 1 39 11 | 08 23 | 0 43 56 | 00 55 | 13 |
| 18 | 0 57 17 | 16 17 | 1 38 41 | 08 05 | 0 40 44 | 00 47 | 12 |
| 19 | 1 00 06 | 16 05 | 1 38 05 | 07 46 | 0 37 29 | 00 39 | 11 |
| 20 | 1 02 51 | 15 54 | 1 37 23 | 07 26 | 0 44 12 | 00 32 | 10 |
| 21 | 1 05 31 | 15 41 | 1 36 34 | 07 07 | 0 30 53 | 00 26 | 9 |
| 22 | 1 08 04 | 15 28 | 1 35 46 | 06 49 | 0 27 32 | 00 22 | 8 |
| 23 | 1 10 29 | 15 15 | 1 34 56 | 06 31 | 0 24 09 | 00 17 | 7 |
| 24 | 1 12 48 | 15 01 | 1 34 03 | 06 13 | 0 20 44 | 00 12 | 6 |
| 25 | 1 15 01 | 14 47 | 1 33 06 | 05 55 | 0 17 18 | 00 08 | 5 |
| 26 | 1 17 08 | 14 32 | 1 32 05 | 05 37 | 0 13 51 | 00 05 | 4 |
| 27 | 1 19 12 | 14 17 | 1 31 00 | 05 20 | 0 10 24 | 00 03 | 3 |
| 28 | 1 21 14 | 14 01 | 1 29 47 | 05 03 | 0 06 57 | 00 01 | 2 |
| 29 | 1 23 14 | 13 46 | 1 28 24 | 04 46 | 0 03 29 | 00 00 | 1 |
| 30 | 1 25 12 | 13 30 | 1 26 50 | 04 30 | 0 00 00 | 00 00 | 0 |
| | *Sign.* 5, 11. | | *Sign.* 4, 10. | | *Sign.* 3, 9. | | |
| | Subtract the Equations of the Node. | | | | | | |

A Table of the Moon's simple Latitude, fitted to the leaſt Inclination of the Orbit, five Degrees, with the proper Increment of the greateſt Inclination, 5°. 18′.

| Argum. Lat. | North Sign. 0,6. South Lat. Lun | Parts added | Increm. or | North Sign. 1,7. South Lat. Lun | Parts added | Increm. or | North Sig. 2, 8. South Lat. Lun | Parts added | Increm. or | Argum. Lat. |
|---|---|---|---|---|---|---|---|---|---|---|
| | ° ′ ″ | ′ | ″ | ° ′ ″ | ′ | ″ | ° ′ ″ | ′ | ″ | |
| 0 | 0 00 00 | 0 | 00 | 2 29 51 | 9 | 00 | 4 19 44 | 15 | 36 | 30 |
| 1 | 0 05 14 | 0 | 19 | 2 34 22 | 9 | 16 | 4 22 18 | 15 | 45 | 29 |
| 2 | 0 10 28 | 0 | 37 | 2 38 50 | 9 | 32 | 4 24 49 | 15 | 54 | 28 |
| 3 | 0 15 42 | 0 | 56 | 2 43 15 | 9 | 48 | 4 27 14 | 16 | 02 | 27 |
| 4 | 0 20 55 | 1 | 15 | 2 47 37 | 10 | 03 | 4 29 34 | 16 | 11 | 26 |
| 5 | 0 26 08 | 1 | 34 | 2 51 56 | 10 | 19 | 4 31 50 | 16 | 19 | 25 |
| 6 | 0 31 20 | 1 | 53 | 2 56 11 | 10 | 34 | 4 34 00 | 16 | 27 | 24 |
| 7 | 0 36 32 | 2 | 11 | 3 00 24 | 10 | 49 | 4 36 06 | 16 | 34 | 23 |
| 8 | 0 41 43 | 2 | 30 | 3 04 33 | 11 | 04 | 4 38 06 | 16 | 42 | 22 |
| 9 | 0 46 53 | 2 | 49 | 3 08 39 | 11 | 19 | 4 40 02 | 16 | 49 | 21 |
| 10 | 0 52 02 | 3 | 08 | 3 12 42 | 11 | 34 | 4 41 52 | 16 | 55 | 20 |
| 11 | 0 57 10 | 3 | 26 | 3 16 41 | 11 | 48 | 4 43 37 | 17 | 01 | 19 |
| 12 | 1 02 18 | 3 | 45 | 3 20 36 | 12 | 02 | 4 45 17 | 17 | 07 | 18 |
| 13 | 1 07 24 | 4 | 03 | 3 24 38 | 12 | 16 | 4 46 52 | 17 | 12 | 17 |
| 14 | 1 12 29 | 4 | 21 | 3 28 16 | 12 | 30 | 4 48 21 | 17 | 18 | 16 |
| 15 | 1 17 33 | 4 | 39 | 3 32 00 | 12 | 44 | 4 49 45 | 17 | 23 | 15 |
| 16 | 1 22 36 | 4 | 57 | 3 35 40 | 12 | 56 | 4 51 04 | 17 | 28 | 14 |
| 17 | 1 27 37 | 5 | 15 | 3 39 17 | 13 | 09 | 4 52 18 | 17 | 33 | 13 |
| 18 | 1 32 36 | 5 | 33 | 3 42 49 | 13 | 22 | 4 53 26 | 17 | 37 | 12 |
| 19 | 1 37 34 | 5 | 51 | 3 46 17 | 13 | 35 | 4 54 28 | 17 | 40 | 11 |
| 20 | 1 42 29 | 6 | 09 | 3 49 42 | 13 | 47 | 4 55 26 | 17 | 44 | 10 |
| 21 | 1 47 23 | 6 | 27 | 3 53 02 | 13 | 59 | 4 56 18 | 17 | 47 | 9 |
| 22 | 1 52 16 | 6 | 45 | 3 56 17 | 14 | 11 | 4 57 04 | 17 | 50 | 8 |
| 23 | 1 57 06 | 7 | 02 | 3 59 29 | 14 | 23 | 4 57 45 | 17 | 52 | 7 |
| 24 | 2 01 54 | 7 | 19 | 4 02 36 | 14 | 34 | 4 58 21 | 17 | 54 | 6 |
| 25 | 2 06 39 | 7 | 36 | 4 05 39 | 14 | 45 | 4 58 51 | 17 | 56 | 5 |
| 26 | 2 11 23 | 7 | 53 | 4 08 37 | 14 | 56 | 4 59 16 | 17 | 58 | 4 |
| 27 | 2 16 04 | 8 | 09 | 4 11 30 | 15 | 06 | 4 59 35 | 17 | 59 | 3 |
| 28 | 2 20 42 | 8 | 26 | 4 14 19 | 15 | 17 | 4 59 49 | 17 | 59 | 2 |
| 29 | 2 25 18 | 8 | 43 | 4 17 04 | 15 | 26 | 4 59 57 | 18 | 00 | 1 |
| 30 | 2 29 51 | 9 | 00 | 4 19 44 | 15 | 36 | 5 00 00 | 18 | 00 | 0 |
| | North Sig. 5,11. South | | | North Sig. 4,10. South | | | North Sig. 3, 9. South | | | |



A Table of Reduction accommodated to the leaſt Inclination of the Moon's Orbit, five Degrees, with the Exceſs of the greateſt Declination, 5°. 18′.

| Argum. Lat. | Sig. 0,6. ſubt. Reduct. | Exceſs. | Sig. 1,7. ſubt. Reduct. | Exceſs. | Sig. 2,8. ſubt. Reduct. | Exceſs. | Argum. Lat. |
|---|---|---|---|---|---|---|---|
| | ′ ″ | ″ | ′ ″ | ″ | ′ ″ | ″ | |
| 0 | 0 00 | 00 | 5 40 | 42 | 5 41 | 42 | 30 |
| 1 | 0 14 | 02 | 5 47 | 43 | 5 34 | 41 | 29 |
| 2 | 0 27 | 04 | 5 53 | 44 | 5 26 | 40 | 28 |
| 3 | 0 41 | 06 | 5 59 | 45 | 5 18 | 39 | 27 |
| 4 | 0 55 | 08 | 6 04 | 46 | 5 10 | 38 | 26 |
| 5 | 1 08 | 09 | 6 09 | 46 | 5 02 | 37 | 25 |
| 6 | 1 22 | 11 | 6 14 | 46 | 4 53 | 36 | 24 |
| 7 | 1 35 | 12 | 6 18 | 47 | 4 43 | 35 | 23 |
| 8 | 1 48 | 13 | 6 21 | 47 | 4 34 | 34 | 22 |
| 9 | 2 01 | 15 | 6 24 | 47 | 4 23 | 33 | 21 |
| 10 | 2 14 | 17 | 6 27 | 48 | 4 13 | 30 | 20 |
| 11 | 2 27 | 19 | 6 29 | 48 | 4 02 | 30 | 19 |
| 12 | 2 40 | 20 | 6 31 | 48 | 3 51 | 29 | 18 |
| 13 | 2 52 | 22 | 6 32 | 48 | 3 40 | 28 | 17 |
| 14 | 3 04 | 23 | 6 33 | 49 | 3 29 | 26 | 16 |
| 15 | 3 16 | 24 | 6 33 | 49 | 3 17 | 24 | 15 |
| 16 | 3 28 | 26 | 6 33 | 49 | 3 05 | 23 | 14 |
| 17 | 3 40 | 28 | 6 32 | 49 | 2 53 | 22 | 13 |
| 18 | 3 51 | 29 | 6 31 | 49 | 2 40 | 20 | 12 |
| 19 | 4 02 | 30 | 6 29 | 48 | 2 28 | 19 | 11 |
| 20 | 4 12 | 31 | 6 27 | 48 | 2 15 | 17 | 10 |
| 21 | 4 23 | 33 | 6 25 | 47 | 2 02 | 15 | 9 |
| 22 | 4 33 | 34 | 6 22 | 47 | 1 49 | 13 | 8 |
| 23 | 4 44 | 35 | 6 18 | 47 | 1 35 | 12 | 7 |
| 24 | 4 52 | 36 | 6 14 | 46 | 1 22 | 11 | 6 |
| 25 | 5 01 | 37 | 6 10 | 46 | 1 08 | 9 | 5 |
| 26 | 5 09 | 38 | 6 05 | 46 | 0 55 | 8 | 4 |
| 27 | 5 18 | 39 | 6 00 | 45 | 0 41 | 6 | 3 |
| 28 | 5 26 | 40 | 5 54 | 44 | 0 27 | 4 | 2 |
| 29 | 5 33 | 41 | 5 47 | 43 | 0 14 | 2 | 1 |
| 30 | 5 40 | 42 | 5 41 | 42 | 0 00 | 0 | 0 |
| | Sig 5,11 | | Sig 4,10 | | Sig. 3,9 | | |

Add

## A Table of the true Horary Motion of the Moon in Eclipses, to the least and greatest Eccentricity; with the true Horary Motion of the Sun, and his Semidiameter.

| Mid. Anom | The true Horary Mot. of the Earth. | Semidiameter of the Sun. | The true Horary Mot. of the Moon. Eccentricity. 4362 | 6685 | Mid. Anom |
|---|---|---|---|---|---|
| s o | / // | / // | / // | / // | s o |
| 0 00 | 2 23 | 15 50 | 30 51 | 29 30 | 12 00 |
| 06 | 2 23 | 15 50 | 30 52 | 29 31 | 24 |
| 12 | 2 23 | 15 50 | 30 55 | 29 33 | 18 |
| 18 | 2 23 | 15 50 | 30 59 | 29 39 | 12 |
| 24 | 2 23 | 15 51 | 31 03 | 29 47 | 06 |
| 1 00 | 2 23 | 15 52 | 31 10 | 29 57 | 11 00 |
| 06 | 2 24 | 15 53 | 31 19 | 30 09 | 24 |
| 12 | 2 24 | 15 54 | 31 29 | 30 22 | 18 |
| 18 | 2 24 | 15 55 | 31 40 | 30 37 | 12 |
| 24 | 2 25 | 15 56 | 31 52 | 30 55 | 06 |
| 2 00 | 2 25 | 15 58 | 32 06 | 31 15 | 10 00 |
| 06 | 2 26 | 15 59 | 32 21 | 31 36 | 24 |
| 12 | 2 26 | 16 01 | 32 36 | 31 59 | 18 |
| 18 | 2 27 | 16 02 | 32 54 | 32 24 | 12 |
| 24 | 2 27 | 16 04 | 33 11 | 32 50 | 06 |
| 3 00 | 2 28 | 16 06 | 33 29 | 33 18 | 9 00 |
| 06 | 2 28 | 16 08 | 33 47 | 33 47 | 24 |
| 12 | 2 29 | 16 09 | 34 07 | 34 15 | 18 |
| 18 | 2 29 | 16 11 | 34 26 | 34 43 | 12 |
| 24 | 2 30 | 16 13 | 34 45 | 34 12 | 06 |
| 4 00 | 2 30 | 16 14 | 35 03 | 35 42 | 8 00 |
| 06 | 2 31 | 16 15 | 35 20 | 36 10 | 24 |
| 12 | 2 31 | 16 17 | 35 36 | 36 36 | 18 |
| 18 | 2 32 | 16 19 | 35 51 | 37 01 | 12 |
| 24 | 2 32 | 16 20 | 36 05 | 37 24 | 06 |
| 5 00 | 2 32 | 16 21 | 36 17 | 37 45 | 7 00 |
| 06 | 2 33 | 16 21 | 36 27 | 38 02 | 24 |
| 12 | 2 33 | 16 22 | 36 34 | 38 15 | 18 |
| 18 | 2 33 | 16 22 | 36 39 | 38 25 | 12 |
| 24 | 2 33 | 16 23 | 36 43 | 38 31 | 06 |
| 6 00 | 2 33 | 16 23½ | 36 44 | 38 32 | 6 00 |



## A Table of the Moon's Horizontal Parallaxes, and of her Horizontal Semidiameters.

| Mid. Anom | The Moon's Horizontal Parallax. Eccentricity. 4362 | 6685 | The Horizontal Semidiam. of the ☾. Eccentricity. 4362 | 6685 | Mid. Anom |
|---|---|---|---|---|---|
| s o | / // | / // | / // | / // | s o |
| 12 00 | 55 35 | 54 23 | 15 04 | 14 45 | 0 00 |
| 24 | 55 35 | 54 23 | 15 05 | 14 45 | 06 |
| 18 | 55 38 | 54 26 | 15 05 | 14 46 | 12 |
| 12 | 55 43 | 54 31 | 15 06 | 14 47 | 18 |
| 06 | 55 48 | 54 38 | 15 08 | 14 49 | 24 |
| 11 00 | 55 54 | 54 47 | 15 10 | 14 52 | 1 00 |
| 24 | 56 01 | 54 58 | 15 12 | 14 55 | 06 |
| 18 | 56 09 | 55 11 | 15 14 | 14 58 | 12 |
| 12 | 56 19 | 55 25 | 15 16 | 15 02 | 18 |
| 06 | 56 30 | 55 41 | 15 19 | 15 06 | 24 |
| 10 00 | 56 42 | 55 58 | 15 23 | 15 11 | 2 00 |
| 24 | 56 56 | 56 17 | 15 27 | 15 16 | 06 |
| 18 | 57 10 | 56 37 | 15 30 | 15 21 | 12 |
| 12 | 57 25 | 56 59 | 15 34 | 15 27 | 18 |
| 06 | 57 39 | 57 22 | 15 38 | 15 34 | 24 |
| 9 00 | 57 54 | 57 45 | 15 42 | 15 40 | 3 00 |
| 24 | 58 10 | 58 10 | 15 47 | 15 46 | 06 |
| 18 | 58 27 | 58 35 | 15 51 | 15 53 | 12 |
| 12 | 58 43 | 59 01 | 15 55 | 16 01 | 18 |
| 06 | 58 58 | 59 25 | 16 00 | 16 07 | 24 |
| 8 00 | 59 13 | 59 48 | 16 04 | 16 14 | 4 00 |
| 24 | 59 28 | 60 12 | 16 08 | 16 20 | 06 |
| 18 | 59 43 | 60 35 | 16 12 | 16 26 | 12 |
| 12 | 59 56 | 60 56 | 16 16 | 16 32 | 18 |
| 06 | 60 07 | 61 14 | 16 19 | 16 37 | 24 |
| 7 00 | 60 16 | 61 30 | 16 21 | 16 41 | 5 00 |
| 24 | 60 24 | 61 44 | 16 23 | 16 45 | 06 |
| 18 | 60 30 | 61 55 | 16 25 | 16 48 | 12 |
| 12 | 60 35 | 62 03 | 16 26 | 16 50 | 18 |
| 06 | 60 38 | 62 08 | 16 27 | 16 51 | 24 |
| 6 00 | 60 39 | 62 10 | 16 27 | 16 52 | 6 00 |

22

## A Table of the Angle, with the true Motion of the Moon from the Sun, makes with the Ecliptick, in the Syzygies.

| *Argum. Latitud.* | The true Horary Motion of the Moon from the Sun. | | | | | | | | | | *Argum. Latitud.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sig.* 0 | 27′ | 28′ | 29′ | 30′ | 31′ | 32′ | 33′ | 34′ | 35′ | 36′ | *Sig.* 5 |
| *Sig.* 6 | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | ° ′ | *Sig.* 11 |
| *gr.* 0 | 5 46 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | *gr.* 30 |
| 1 | 5 46 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 29 |
| 2 | 5 46 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 28 |
| 3 | 5 46 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 27 |
| 4 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 26 |
| 5 | 5 45 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 25 |
| 6 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 24 |
| 7 | 5 44 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 23 |
| 8 | 5 43 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 5 34 | 22 |
| 9 | 5 42 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 5 34 | 5 33 | 21 |
| 10 | 5 41 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 5 34 | 5 33 | 5 32 | 20 |
| 11 | 5 40 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 5 34 | 5 33 | 5 32 | 5 31 | 19 |
| 12 | 5 39 | 5 38 | 5 37 | 5 36 | 5 35 | 5 34 | 5 33 | 5 32 | 5 31 | 5 30 | 18 |

23

## A Table of the Temporary Reduction between the true Syzygies of the Luminaries, and the greateſt Approximation of their Centres.

| *Argum. Latitud.* | Subtract from the time of the true Syzygy in the Orbit. The true Horary Motion of the Moon from the Sun. | | | | | | | | | | *Argum. Latitud.* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sig.* 0 | 27′ | 28′ | 29′ | 30′ | 31′ | 32′ | 33′ | 34′ | 35′ | 36′ | *Sig.* 5 |
| *Sig.* 6 | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | *Sig.* 11 |
| *gr.* 0 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | *gr.* 30 |
| 1 | 0 35 | 0 34 | 0 33 | 0 31 | 0 30 | 0 29 | 0 28 | 0 27 | 0 26 | 0 26 | 29 |
| 2 | 1 10 | 1 07 | 1 05 | 1 05 | 1 00 | 0 58 | 0 56 | 0 55 | 0 53 | 0 51 | 28 |
| 3 | 2 45 | 1 41 | 1 37 | 1 34 | 1 30 | 1 27 | 1 25 | 1 22 | 1 19 | 1 17 | 27 |
| 4 | 2 20 | 2 15 | 2 10 | 2 05 | 2 00 | 1 56 | 1 53 | 1 49 | 1 45 | 1 42 | 26 |
| 5 | 2 55 | 2 48 | 2 41 | 2 36 | 2 30 | 2 25 | 2 21 | 2 16 | 2 12 | 2 08 | 25 |
| 6 | 3 29 | 3 21 | 3 14 | 3 07 | 3 00 | 2 54 | 2 48 | 2 43 | 3 38 | 2 33 | 24 |
| 7 | 4 04 | 3 54 | 3 46 | 3 38 | 3 30 | 3 23 | 3 16 | 3 10 | 3 04 | 2 58 | 23 |
| 8 | 4 38 | 4 27 | 4 17 | 4 08 | 3 59 | 3 51 | 3 43 | 3 36 | 3 09 | 3 23 | 22 |
| 9 | 5 11 | 4 59 | 4 48 | 4 38 | 4 28 | 4 19 | 4 10 | 4 02 | 3 54 | 3 47 | 21 |
| 10 | 5 44 | 5 31 | 5 19 | 5 07 | 4 56 | 4 46 | 4 37 | 4 28 | 4 19 | 4 21 | 20 |
| 11 | 6 17 | 6 03 | 5 49 | 5 37 | 5 25 | 5 14 | 5 03 | 4 53 | 4 44 | 4 35 | 19 |
| 12 | 6 50 | 6 34 | 6 19 | 6 06 | 5 53 | 5 41 | 5 29 | 5 19 | 5 09 | 4 59 | 18 |

Add to the time of the true Syzygy in the Orbit.

A Table

## A Table of the mean Motions of the Moon from the Sun.

| An. Æræ Christi Cu | Moon's mean Motion from the Sun. s | ° | ′ | ″ |
|---|---|---|---|---|
| 1 | 6 | 24 | 9 | 42 |
| 1501 | 4 | 10 | 25 | 59 |
| 1581 | 10 | 4 | 5 | 54 |
| 1601 | 2 | 17 | 30 | 55 |
| 1621 | 7 | 0 | 55 | 56 |
| 1641 | 11 | 14 | 20 | 57 |
| 1661 | 3 | 27 | 45 | 58 |
| 1681 | 8 | 11 | 10 | 59 |
| 1701 | 0 | 24 | 36 | 0 |
| 1721 | 5 | 8 | 1 | 1 |
| 1741 | 9 | 21 | 26 | 2 |
| 1761 | 2 | 4 | 51 | 3 |
| 1781 | 6 | 18 | 16 | 4 |
| 1801 | 11 | 1 | 41 | 4 |

| An. Jul. Expanſi | Moon's mean Motion from the Sun. s | ° | ′ | ″ |
|---|---|---|---|---|
| 20 | 4 | 13 | 25 | 13 |
| 40 | 8 | 26 | 50 | 26 |
| 60 | 1 | 10 | 15 | 39 |
| 80 | 5 | 23 | 40 | 52 |
| 100 | 10 | 7 | 6 | 5 |
| 200 | 8 | 14 | 12 | 10 |
| 300 | 6 | 21 | 18 | 15 |
| 400 | 4 | 28 | 24 | 20 |
| 500 | 3 | 5 | 30 | 25 |
| 600 | 1 | 12 | 36 | 30 |
| 700 | 11 | 19 | 42 | 35 |
| 800 | 9 | 26 | 48 | 40 |
| 900 | 8 | 3 | 54 | 45 |
| 1000 | 6 | 11 | 0 | 50 |
| 2000 | 0 | 22 | 1 | 40 |
| 3000 | 7 | 3 | 2 | 3 |
| 4000 | 1 | 14 | 2 | 53 |
| 5000 | 7 | 25 | 3 | 43 |

| An. Jul. Expanſi | Moon's mean Motion from the Sun. s | ° | ′ | ″ |
|---|---|---|---|---|
| 1 | 4 | 9 | 37 | 25 |
| 2 | 8 | 19 | 14 | 48 |
| 3 | 0 | 28 | 52 | 11 |
| 4 | 5 | 20 | 41 | 3 |
| 5 | 10 | 0 | 18 | 27 |
| 6 | 2 | 9 | 55 | 50 |
| 7 | 6 | 19 | 33 | 14 |
| 8 | 11 | 11 | 22 | 5 |
| 9 | 3 | 20 | 59 | 30 |
| 10 | 8 | 0 | 36 | 53 |
| 11 | 0 | 10 | 14 | 17 |
| 12 | 5 | 2 | 3 | 7 |
| 13 | 9 | 11 | 40 | 32 |
| 14 | 1 | 21 | 17 | 55 |
| 15 | 6 | 0 | 55 | 18 |
| 16 | 10 | 22 | 44 | 10 |
| 17 | 3 | 2 | 21 | 35 |
| 18 | 7 | 11 | 58 | 58 |
| 19 | 11 | 21 | 36 | 21 |
| 20 | 4 | 13 | 25 | 13 |

| Months. | Moon's mean Motion from the Sun. s | ° | ′ | ″ |
|---|---|---|---|---|
| *Jan.* | 0 | 0 | 0 | 0 |
| *Febr.* | 0 | 17 | 54 | 47 |
| *Mar.* | 11 | 29 | 15 | 14 |
| *Apr.* | 0 | 17 | 10 | 2 |
| *May* | 0 | 22 | 53 | 23 |
| *June* | 1 | 10 | 48 | 11 |
| *July* | 1 | 16 | 31 | 33 |
| *Aug.* | 2 | 4 | 26 | 19 |
| *Sept.* | 2 | 21 | 21 | 7 |
| *Octob.* | 2 | 28 | 4 | 28 |
| *Nov.* | 3 | 15 | 59 | 16 |
| *Dec.* | 3 | 21 | 42 | 36 |

In Leap-Year (after *February*) add a Day to the time given, and the Motion of a Day to the Motions before collected.

## A Table of the mean Motions of the Moon from the Sun.

| Days | Moon's mean Motion from the Sun. s | ° | ′ | ″ | H. | Mean Mot. ° | ′ | ″ | H. | Mean Mot. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ′ | ″ | ‴ | | ″ | ‴ | ⁗ |
| 1 | 00 | 12 | 11 | 27 | 1 | 00 | 30 | 29 | 31 | 15 | 44 | 47 |
| 2 | 00 | 24 | 22 | 53 | 2 | 01 | 00 | 57 | 32 | 16 | 15 | 16 |
| 3 | 01 | 06 | 34 | 20 | 3 | 01 | 31 | 26 | 33 | 16 | 45 | 44 |
| 4 | 01 | 18 | 45 | 47 | 4 | 02 | 01 | 54 | 34 | 17 | 16 | 13 |
| 5 | 02 | 00 | 57 | 13 | 5 | 02 | 32 | 23 | 35 | 17 | 46 | 42 |
| 6 | 02 | 13 | 08 | 40 | 6 | 03 | 02 | 54 | 36 | 18 | 17 | 10 |
| 7 | 02 | 25 | 20 | 07 | 7 | 03 | 33 | 20 | 37 | 10 | 47 | 39 |
| 8 | 03 | 07 | 31 | 33 | 8 | 04 | 03 | 49 | 38 | 19 | 18 | 07 |
| 9 | 03 | 19 | 43 | 00 | 9 | 04 | 34 | 18 | 39 | 19 | 48 | 36 |
| 10 | 04 | 01 | 54 | 27 | 10 | 05 | 04 | 46 | 40 | 20 | 19 | 05 |
| 11 | 04 | 14 | 05 | 53 | 11 | 05 | 35 | 15 | 41 | 20 | 49 | 33 |
| 12 | 04 | 26 | 17 | 20 | 12 | 06 | 05 | 43 | 42 | 21 | 20 | 02 |
| 13 | 05 | 08 | 28 | 47 | 13 | 06 | 36 | 12 | 43 | 21 | 50 | 31 |
| 14 | 05 | 20 | 40 | 13 | 14 | 07 | 06 | 41 | 44 | 22 | 20 | 59 |
| 15 | 06 | 02 | 51 | 40 | 15 | 07 | 37 | 09 | 45 | 22 | 51 | 28 |
| 16 | 06 | 15 | 03 | 07 | 16 | 08 | 07 | 38 | 46 | 23 | 21 | 56 |
| 17 | 06 | 27 | 14 | 33 | 17 | 08 | 38 | 06 | 47 | 23 | 52 | 25 |
| 18 | 07 | 09 | 26 | 00 | 18 | 09 | 08 | 35 | 48 | 24 | 22 | 54 |
| 19 | 07 | 21 | 37 | 27 | 19 | 09 | 39 | 04 | 49 | 24 | 53 | 22 |
| 20 | 08 | 03 | 48 | 53 | 20 | 10 | 09 | 32 | 50 | 25 | 23 | 51 |
| 21 | 08 | 16 | 00 | 20 | 21 | 10 | 40 | 01 | 51 | 25 | 54 | 19 |
| 22 | 08 | 28 | 11 | 47 | 22 | 11 | 10 | 30 | 52 | 26 | 24 | 48 |
| 23 | 09 | 10 | 23 | 13 | 23 | 11 | 40 | 58 | 53 | 26 | 55 | 17 |
| 24 | 09 | 22 | 34 | 40 | 24 | 12 | 11 | 27 | 54 | 27 | 25 | 45 |
| 25 | 10 | 04 | 46 | 07 | 25 | 12 | 41 | 55 | 55 | 27 | 56 | 13 |
| 26 | 10 | 16 | 57 | 33 | 26 | 13 | 12 | 24 | 56 | 28 | 26 | 43 |
| 27 | 10 | 29 | 09 | 00 | 27 | 12 | 42 | 53 | 57 | 28 | 57 | 11 |
| 28 | 11 | 11 | 20 | 27 | 28 | 14 | 13 | 21 | 58 | 29 | 27 | 40 |
| 29 | 11 | 23 | 31 | 53 | 29 | 14 | 43 | 50 | 59 | 29 | 58 | 08 |
| 30 | 00 | 05 | 43 | 20 | 30 | 15 | 14 | 19 | 60 | 30 | 28 | 37 |
| 31 | 00 | 17 | 54 | 47 | | | | | | | | |
| 32 | 01 | 00 | 06 | 13 | | | | | | | | |

In Leap-Year, add a Day to the time given, and the Motion of a Day to the Motions before collected.

Sir *Isaac Newton* augments the equation of P. 355. as 71. is to 69. and P. 356. as 22 to 21.
And he diminiſhes that of P. 360. as 224 is to 228. in the Sun's Perigee: and as 198 to 228. in the Apogæ; and that of P. 361. as 9 to 10.
The Ann. Equation of the Node to that of P. 355. as 95 to 118. of the ſame kind.
The Ann. Equation of the Apogæ to the ſame as 120 to 71. of the contrary kind.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Excentr. | P. 357 | Greateſt, | 66782 | 11731 | Greateſt Equat. | 7° | 40′ | 0″ |
| | 358 | Middle, | 55050 | 11731 | Leaſt Equat. | 4° | 57′ | 0″ |
| | 359 | Leaſt, | 43319 | | | | | |

## A Table of the mean Motion of the *Hugenian* Satellite of *Saturn*, from the first Star in *Aries*.

| Years from Christ. | Epochæ. s | o | ′ | Years. | MeanMo s | o | ′ | Days. | MeanMo s | o | ′ | H. M | M.Mo. o | ′ | ″ | H. M | Mean Mot. ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1641 | 8 | 29 | 17 | 1 | 10 | 29 | 36 | 1 | 0 | 22 | 35 | 1 | 0 | 56 | | 31 | 29 | 10 |
| 1661 | 10 | 14 | 10 | 2 | 9 | 11 | 12 | 2 | 1 | 15 | 09 | 2 | 1 | 53 | | 32 | 30 | 6 |
| 1681 | 11 | 29 | 3 | 3 | 8 | 1 | 48 | 3 | 2 | 7 | 44 | 3 | 2 | 49 | | 33 | 31 | 3 |
| 1701 | 1 | 13 | 56 | 4 | 7 | 14 | 59 | 4 | 3 | 0 | 18 | 4 | 3 | 46 | | 34 | 31 | 59 |
| 1721 | 2 | 28 | 49 | 5 | 6 | 5 | 35 | 5 | 3 | 22 | 53 | 5 | 4 | 42 | | 35 | 32 | 55 |
| 1741 | 4 | 13 | 42 | 6 | 4 | 26 | 11 | 6 | 4 | 15 | 28 | 6 | 5 | 39 | | 36 | 33 | 52 |
| 1761 | 5 | 28 | 37 | 7 | 3 | 16 | 47 | 7 | 5 | 8 | 2 | 7 | 6 | 35 | | 37 | 34 | 48 |
| 1781 | 7 | 13 | 28 | 8 | 2 | 26 | 57 | 8 | 6 | 0 | 37 | 8 | 7 | 32 | | 38 | 35 | 45 |
| 1801 | 8 | 28 | 21 | 9 | 1 | 20 | 23 | 9 | 6 | 23 | 12 | 9 | 8 | 28 | | 39 | 36 | 41 |
| *Months* | Mean | | Mot. | 10 | 0 | 11 | 9 | 10 | 7 | 15 | 46 | 10 | 9 | 24 | | 40 | 37 | 38 |
| *Jan.* | 0 | 0 | 0 | 11 | 11 | 1 | 45 | 11 | 8 | 8 | 21 | 11 | 10 | 21 | | 41 | 38 | 34 |
| *Feb.* | 11 | 9 | 53 | 12 | 10 | 14 | 56 | 12 | 9 | 0 | 55 | 12 | 11 | 17 | | 42 | 39 | 31 |
| *March* | 8 | 12 | 2 | 13 | 9 | 5 | 32 | 13 | 9 | 23 | 30 | 13 | 12 | 14 | | 43 | 40 | 27 |
| *April* | 7 | 21 | 56 | 14 | 7 | 26 | 8 | 14 | 10 | 16 | 5 | 14 | 13 | 10 | | 44 | 41 | 24 |
| *May* | 6 | 9 | 14 | 15 | 6 | 16 | 44 | 15 | 11 | 8 | 39 | 15 | 14 | 7 | | 45 | 42 | 20 |
| *June* | 5 | 19 | 7 | 16 | 5 | 29 | 54 | 16 | 0 | 1 | 14 | 16 | 15 | 3 | | 46 | 43 | 17 |
| *July* | 4 | 6 | 26 | 17 | 4 | 20 | 30 | 17 | 0 | 23 | 48 | 17 | 16 | 0 | | 47 | 44 | 13 |
| *August* | 3 | 16 | 19 | 18 | 3 | 11 | 6 | 18 | 1 | 16 | 23 | 18 | 16 | 56 | | 48 | 45 | 10 |
| *Sept.* | 2 | 26 | 12 | 19 | 2 | 1 | 42 | 19 | 2 | 8 | 58 | 19 | 17 | 52 | | 49 | 46 | 6 |
| *October* | 1 | 13 | 31 | 20 | 1 | 4 | 53 | 20 | 3 | 1 | 32 | 20 | 18 | 49 | | 50 | 47 | 3 |
| *Nov.* | 0 | 23 | 24 | | | | | 21 | 3 | 24 | 7 | 21 | 19 | 45 | | 51 | 47 | 59 |
| *Decemb.* | 11 | 10 | 43 | | | | | 22 | 4 | 16 | 42 | 22 | 20 | 42 | | 52 | 48 | 50 |
| | | | | | | | | 23 | 5 | 9 | 16 | 23 | 21 | 38 | | 53 | 49 | 52 |
| | | | | | | | | 24 | 6 | 1 | 51 | 24 | 22 | 35 | | 54 | 50 | 49 |
| | | | | | | | | 25 | 6 | 24 | 25 | 25 | 23 | 31 | | 55 | 51 | 45 |
| | | | | | | | | 26 | 7 | 17 | 00 | 26 | 24 | 25 | | 56 | 52 | 42 |
| | | | | | | | | 27 | 8 | 9 | 35 | 27 | 25 | 24 | | 57 | 53 | 38 |
| | | | | | | | | 28 | 9 | 2 | 9 | 28 | 26 | 20 | | 58 | 54 | 35 |
| | | | | | | | | 29 | 9 | 24 | 44 | 29 | 27 | 17 | | 59 | 55 | 31 |
| | | | | | | | | 30 | 10 | 17 | 18 | 30 | 28 | 13 | | 60 | 56 | 27 |
| | | | | | | | | 31 | 11 | 9 | 53 | | | | | | | |
| | | | | | | | | 32 | 0 | 2 | 28 | | | | | | | |

In Leap-Year, after *February*, add one Day, and the proper Motion belonging to it.



## A Table of the Declination of the Points of the Ecliptic of *Saturn*, from his Equator or Ring.

| Grad. Eclipt. | Declin. o | ′ | Grad. Eclipt. | Declin. o | ′ | Grad. Eclipt. | Declin. o | ′ |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 31 | 31 | 15 | 23 | 61 | 26 | 46 |
| 2 | 1 | 2 | 32 | 15 | 50 | 62 | 27 | 2 |
| 3 | 1 | 33 | 33 | 16 | 17 | 63 | 27 | 18 |
| 4 | 2 | 4 | 34 | 16 | 44 | 64 | 27 | 34 |
| 5 | 2 | 34 | 35 | 17 | 11 | 65 | 27 | 50 |
| 6 | 3 | 5 | 36 | 17 | 37 | 66 | 28 | 5 |
| 7 | 3 | 36 | 37 | 18 | 3 | 67 | 28 | 19 |
| 8 | 4 | 7 | 38 | 18 | 29 | 68 | 28 | 32 |
| 9 | 4 | 38 | 39 | 18 | 55 | 69 | 28 | 45 |
| 10 | 5 | 8 | 40 | 19 | 20 | 70 | 28 | 57 |
| 11 | 5 | 39 | 41 | 19 | 45 | 71 | 29 | 9 |
| 12 | 6 | 9 | 42 | 20 | 9 | 72 | 29 | 20 |
| 13 | 6 | 39 | 43 | 20 | 33 | 73 | 29 | 30 |
| 14 | 7 | 9 | 44 | 20 | 57 | 74 | 29 | 40 |
| 15 | 7 | 39 | 45 | 21 | 21 | 75 | 29 | 50 |
| 16 | 8 | 9 | 46 | 21 | 44 | 76 | 30 | 59 |
| 17 | 8 | 39 | 47 | 22 | 7 | 77 | 30 | 7 |
| 18 | 9 | 9 | 48 | 22 | 30 | 78 | 30 | 14 |
| 19 | 9 | 39 | 49 | 22 | 52 | 79 | 30 | 21 |
| 20 | 10 | 8 | 50 | 23 | 14 | 80 | 30 | 28 |
| 21 | 10 | 38 | 51 | 23 | 35 | 81 | 30 | 34 |
| 22 | 11 | 7 | 52 | 23 | 56 | 82 | 30 | 39 |
| 23 | 11 | 36 | 53 | 24 | 17 | 83 | 30 | 44 |
| 24 | 12 | 5 | 54 | 24 | 37 | 84 | 30 | 48 |
| 25 | 12 | 34 | 55 | 24 | 57 | 85 | 30 | 52 |
| 26 | 13 | 3 | 56 | 25 | 16 | 86 | 30 | 55 |
| 27 | 13 | 31 | 57 | 25 | 35 | 87 | 30 | 57 |
| 28 | 13 | 59 | 58 | 25 | 53 | 88 | 30 | 58 |
| 29 | 14 | 27 | 59 | 26 | 11 | 89 | 30 | 59 |
| 30 | 14 | 55 | 60 | 26 | 29 | 90 | 31 | 0 |

The *Epochæ* of the Revolutions of the first *Satellite* to the Shadow of *Jupiter*, under the Meridian of *London*.

| Jul. Years | D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|---|
| 1660 | 0 | 11 | 5 | 48 | 968 | 200,6 |
| 61 | 0 | 1 | 17 | 24 | 1174 | 181,2 |
| 62 | 1 | 9 | 57 | 36 | 1381 | 162,9 |
| 63 | 1 | 0 | 9 | 12 | 1587 | 143,5 |
| 1664 | 1 | 8 | 49 | 24 | 1794 | 125,1 |
| 65 | 0 | 23 | 1 | 0 | 2000 | 105,7 |
| 66 | 0 | 13 | 12 | 36 | 2206 | 86,4 |
| 67 | 0 | 3 | 24 | 12 | 2412 | 67,0 |
| 68 | 0 | 12 | 4 | 24 | 171 | 48,6 |
| 1669 | 0 | 2 | 16 | 0 | 377 | 29,2 |
| 70 | 1 | 10 | 56 | 12 | 584 | 10,9 |
| 71 | 1 | 1 | 7 | 48 | 790 | 216,9 |
| 72 | 1 | 9 | 48 | 0 | 997 | 198,5 |
| 73 | 0 | 23 | 59 | 36 | 1203 | 179,1 |
| 1674 | 0 | 14 | 11 | 12 | 1409 | 159,7 |
| 75 | 0 | 4 | 22 | 48 | 1615 | 140,3 |
| 76 | 0 | 13 | 3 | 0 | 1822 | 121,9 |
| 77 | 0 | 3 | 14 | 36 | 2028 | 102,5 |
| 78 | 1 | 11 | 54 | 48 | 2235 | 84,1 |
| 1679 | 1 | 2 | 6 | 24 | 2441 | 64,7 |
| 80 | 1 | 10 | 46 | 36 | 200 | 46,4 |
| 81 | 1 | 0 | 58 | 12 | 406 | 27,0 |
| 82 | 0 | 15 | 9 | 48 | 612 | 7,6 |
| 83 | 0 | 5 | 21 | 24 | 818 | 213,6 |
| 1684 | 0 | 14 | 1 | 36 | 1025 | 195,3 |
| 85 | 0 | 4 | 13 | 12 | 1231 | 175,9 |
| 86 | 1 | 12 | 53 | 24 | 1438 | 157,5 |
| 87 | 1 | 3 | 5 | 0 | 1644 | 138,1 |
| 88 | 1 | 11 | 45 | 12 | 1851 | 119,7 |
| 1689 | 1 | 1 | 56 | 48 | 2057 | 100,4 |

The *Epochæ* of the Revolutions of the first *Satellite* to the Shadow of *Jupiter* under the Meridian of *London*.

| Jul. Years | D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|---|
| 1690 | 0 | 16 | 8 | 24 | 2263 | 81,0 |
| 91 | 0 | 6 | 20 | 0 | 21 | 61,6 |
| 92 | 0 | 15 | 0 | 12 | 228 | 43,3 |
| 93 | 0 | 5 | 11 | 48 | 434 | 23,9 |
| 94 | 1 | 13 | 52 | 0 | 641 | 5,5 |
| 1695 | 1 | 4 | 3 | 36 | 847 | 211,5 |
| 96 | 1 | 12 | 43 | 48 | 1054 | 193,1 |
| 97 | 1 | 2 | 55 | 24 | 1260 | 173,7 |
| 98 | 0 | 17 | 7 | 0 | 1466 | 154,4 |
| 99 | 0 | 7 | 18 | 36 | 1672 | 136,0 |
| 1700 | 0 | 15 | 58 | 48 | 1879 | 116,6 |
| 01 | 0 | 6 | 10 | 24 | 2085 | 97,3 |
| 02 | 1 | 14 | 50 | 36 | 2292 | 78,9 |
| 03 | 1 | 5 | 2 | 12 | 50 | 59,5 |
| 04 | 1 | 13 | 42 | 24 | 257 | 41,1 |
| 1705 | 1 | 3 | 54 | 0 | 463 | 21,8 |
| 06 | 0 | 18 | 5 | 36 | 669 | 2,4 |
| 07 | 0 | 8 | 17 | 12 | 875 | 208,4 |
| 08 | 0 | 16 | 57 | 24 | 1082 | 190,0 |
| 09 | 0 | 7 | 9 | 0 | 1288 | 170,6 |
| 1710 | 1 | 15 | 49 | 12 | 1495 | 152,3 |
| 11 | 1 | 6 | 0 | 48 | 1701 | 132,9 |
| 12 | 1 | 14 | 41 | 0 | 1908 | 114,5 |
| 13 | 1 | 4 | 52 | 36 | 2114 | 95,1 |
| 14 | 0 | 19 | 4 | 12 | 2320 | 75,8 |
| 1715 | 0 | 9 | 15 | 48 | 78 | 56,4 |
| 16 | 0 | 17 | 56 | 0 | 285 | 38,0 |
| 17 | 0 | 8 | 7 | 36 | 491 | 18,6 |
| 18 | 1 | 16 | 47 | 48 | 698 | 0,3 |
| 19 | 1 | 6 | 59 | 24 | 904 | 206,3 |
| 1720 | 1 | 15 | 39 | 36 | 1111 | 187,9 |

## A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

| *January.* D. | h. | ′ | ″ | Num.I. | Num.II. |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0,0 |
| 1 | 18 | 28 | 36 | 1 | 1,0 |
| 3 | 12 | 57 | 12 | 2 | 2,1 |
| 5 | 7 | 25 | 48 | 3 | 3,1 |
| 7 | 1 | 54 | 24 | 4 | 4,1 |
| 8 | 20 | 23 | 0 | 5 | 5,2 |
| 10 | 14 | 51 | 36 | 6 | 6,2 |
| 12 | 9 | 20 | 12 | 7 | 7,2 |
| 14 | 3 | 48 | 48 | 8 | 8,2 |
| 15 | 22 | 17 | 24 | 9 | 9,3 |
| 17 | 16 | 46 | 0 | 10 | 10,3 |
| 19 | 11 | 14 | 36 | 11 | 11,3 |
| 21 | 5 | 43 | 12 | 12 | 12,3 |
| 23 | 0 | 11 | 48 | 13 | 13,4 |
| 24 | 18 | 40 | 24 | 14 | 14,4 |
| 26 | 13 | 9 | 0 | 15 | 15,4 |
| 28 | 7 | 37 | 36 | 16 | 16,5 |
| 30 | 2 | 6 | 12 | 17 | 17,5 |
| 31 | 20 | 34 | 48 | 18 | 18,5 |

| *February.* D. | h. | ′ | ″ | Num.I. | Num.II. |
|---|---|---|---|---|---|
| 0 | 20 | 34 | 48 | 18 | 18,5 |
| 2 | 15 | 3 | 24 | 19 | 19,6 |
| 4 | 9 | 32 | 0 | 20 | 20,6 |
| 6 | 4 | 0 | 36 | 21 | 21,6 |
| 7 | 22 | 29 | 12 | 22 | 22,6 |
| 9 | 16 | 57 | 48 | 23 | 23,7 |
| 11 | 11 | 26 | 24 | 24 | 24,7 |
| 13 | 5 | 55 | 0 | 25 | 25,7 |
| 13 | 5 | 55 | 0 | 25 | 25,7 |
| 15 | 0 | 23 | 36 | 26 | 26,7 |
| 16 | 18 | 52 | 12 | 27 | 27,7 |
| 18 | 13 | 20 | 48 | 28 | 28,7 |
| 20 | 7 | 49 | 24 | 29 | 29,7 |
| 22 | 2 | 18 | 0 | 30 | 30,8 |
| 23 | 20 | 46 | 36 | 31 | 31,8 |
| 25 | 15 | 15 | 12 | 32 | 32,8 |
| 27 | 9 | 43 | 48 | 33 | 33,8 |

| *March.* | | | | | |
|---|---|---|---|---|---|
| 1 | 4 | 12 | 24 | 34 | 34,8 |
| 2 | 22 | 41 | 0 | 35 | 35,8 |
| 4 | 17 | 9 | 36 | 36 | 36,8 |
| 6 | 11 | 38 | 12 | 37 | 37,9 |
| 8 | 6 | 6 | 48 | 38 | 38,9 |
| 10 | 0 | 35 | 24 | 39 | 39,9 |
| 11 | 19 | 4 | 0 | 40 | 40,9 |
| 13 | 13 | 32 | 36 | 41 | 41,9 |
| 15 | 8 | 1 | 12 | 42 | 42,9 |
| 17 | 2 | 29 | 48 | 43 | 43,9 |
| 18 | 20 | 58 | 24 | 44 | 44,9 |
| 20 | 15 | 27 | 0 | 45 | 45,9 |
| 22 | 9 | 55 | 36 | 46 | 46,9 |
| 24 | 4 | 24 | 12 | 47 | 47,9 |
| 25 | 22 | 52 | 48 | 48 | 48,9 |
| 27 | 17 | 21 | 24 | 49 | 49,9 |
| 29 | 11 | 50 | 0 | 50 | 50,9 |
| 31 | 6 | 18 | 36 | 51 | 51,9 |

## A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

| *April.* D. | h. | ′ | ″ | Num.I. | Num.II. |
|---|---|---|---|---|---|
| 0 | 6 | 18 | 36 | 51 | 51,9 |
| 2 | 0 | 47 | 12 | 52 | 52,9 |
| 3 | 19 | 15 | 48 | 53 | 53,9 |
| 5 | 13 | 44 | 24 | 54 | 54,9 |
| 7 | 8 | 13 | 0 | 55 | 55,9 |
| 9 | 2 | 41 | 36 | 56 | 56,9 |
| 10 | 21 | 10 | 12 | 57 | 57,9 |
| 12 | 15 | 38 | 48 | 58 | 58,9 |
| 14 | 10 | 7 | 24 | 59 | 59,9 |
| 16 | 4 | 36 | 0 | 60 | 60,8 |
| 17 | 23 | 4 | 36 | 61 | 61,8 |
| 19 | 17 | 33 | 12 | 62 | 62,8 |
| 21 | 12 | 1 | 48 | 63 | 63,8 |
| 23 | 6 | 30 | 24 | 64 | 64,8 |
| 25 | 0 | 59 | 0 | 65 | 65,7 |
| 26 | 19 | 27 | 36 | 66 | 66,7 |
| 28 | 13 | 56 | 12 | 67 | 67,7 |
| 30 | 8 | 24 | 48 | 68 | 68,6 |

| *May.* | | | | | |
|---|---|---|---|---|---|
| 0 | 8 | 24 | 48 | 68 | 68,6 |
| 2 | 2 | 53 | 24 | 69 | 69,6 |
| 3 | 21 | 22 | 0 | 70 | 70,6 |
| 5 | 15 | 50 | 36 | 71 | 71,6 |
| 7 | 10 | 19 | 12 | 72 | 72,5 |
| 9 | 4 | 47 | 48 | 73 | 73,5 |
| 10 | 23 | 16 | 24 | 74 | 74,5 |
| 12 | 17 | 45 | 0 | 75 | 75,5 |
| 14 | 12 | 13 | 36 | 76 | 76,4 |

| *May.* D. | h. | ′ | ″ | Num.I. | Num.II. |
|---|---|---|---|---|---|
| 14 | 12 | 13 | 36 | 76 | 76,4 |
| 16 | 6 | 42 | 12 | 77 | 77,4 |
| 18 | 1 | 10 | 48 | 78 | 78,4 |
| 19 | 19 | 39 | 24 | 79 | 79,3 |
| 21 | 14 | 8 | 0 | 80 | 80,3 |
| 23 | 8 | 36 | 36 | 81 | 81,3 |
| 25 | 3 | 5 | 12 | 82 | 82,3 |
| 26 | 21 | 33 | 48 | 83 | 83,3 |
| 28 | 16 | 2 | 24 | 84 | 84,2 |
| 30 | 10 | 31 | 0 | 85 | 85,2 |

| *June.* | | | | | |
|---|---|---|---|---|---|
| 1 | 4 | 59 | 36 | 86 | 86,1 |
| 2 | 23 | 28 | 12 | 87 | 87,1 |
| 4 | 17 | 56 | 48 | 88 | 88,0 |
| 6 | 12 | 25 | 24 | 89 | 89,0 |
| 8 | 6 | 54 | 0 | 90 | 90,0 |
| 10 | 1 | 22 | 36 | 91 | 90,9 |
| 11 | 19 | 51 | 12 | 92 | 91,9 |
| 13 | 14 | 19 | 48 | 93 | 92,9 |
| 15 | 8 | 48 | 24 | 94 | 93,8 |
| 17 | 3 | 17 | 0 | 95 | 94,8 |
| 18 | 21 | 45 | 36 | 96 | 95,7 |
| 20 | 16 | 14 | 12 | 97 | 96,7 |
| 22 | 10 | 42 | 48 | 98 | 97,7 |
| 24 | 5 | 11 | 24 | 99 | 98,6 |
| 27 | 23 | 40 | 0 | 100 | 99,6 |
| 29 | 18 | 8 | 36 | 101 | 100,6 |
| 29 | 12 | 37 | 12 | 102 | 101,5 |

## A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

| *June.* D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|
| 1 | 7 | 5 | 48 | 103 | 102,5 |
| 3 | 1 | 34 | 24 | 104 | 103,5 |
| 4 | 20 | 3 | 0 | 105 | 104,4 |
| 6 | 14 | 31 | 36 | 106 | 105,4 |
| 8 | 9 | 0 | 12 | 107 | 106,4 |
| 10 | 3 | 28 | 48 | 108 | 107,3 |
| 11 | 21 | 57 | 24 | 109 | 108,3 |
| 13 | 16 | 26 | 0 | 110 | 109,3 |
| 15 | 10 | 54 | 36 | 111 | 110,2 |
| 17 | 5 | 23 | 12 | 112 | 111,2 |
| 18 | 23 | 51 | 48 | 113 | 112,2 |
| 20 | 18 | 20 | 24 | 114 | 113,1 |
| 22 | 12 | 49 | 0 | 115 | 114,1 |
| 24 | 7 | 17 | 36 | 116 | 115,1 |
| 26 | 1 | 46 | 12 | 117 | 116,0 |
| 27 | 20 | 14 | 48 | 118 | 117,0 |
| 29 | 14 | 43 | 24 | 119 | 118,0 |
| 31 | 9 | 12 | 0 | 120 | 119,0 |
| *August.* | | | | | |
| 0 | 9 | 12 | 0 | 120 | 119,0 |
| 2 | 3 | 40 | 36 | 121 | 119,9 |
| 3 | 22 | 9 | 12 | 122 | 120,9 |
| 5 | 16 | 37 | 48 | 123 | 121,9 |
| 7 | 11 | 6 | 24 | 124 | 122,9 |
| 9 | 5 | 35 | 0 | 125 | 123,8 |
| 11 | 0 | 3 | 36 | 126 | 124,8 |
| 12 | 18 | 32 | 12 | 127 | 125,8 |
| 14 | 13 | 0 | 48 | 128 | 126,8 |

| *August.* D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|
| 14 | 13 | 0 | 48 | 128 | 126,8 |
| 16 | 7 | 29 | 24 | 129 | 127,7 |
| 18 | 1 | 58 | 0 | 130 | 128,7 |
| 19 | 20 | 26 | 36 | 131 | 129,7 |
| 21 | 14 | 55 | 12 | 132 | 130,7 |
| 23 | 9 | 23 | 48 | 133 | 131,7 |
| 25 | 3 | 52 | 24 | 134 | 132,7 |
| 26 | 22 | 21 | 0 | 135 | 133,6 |
| 28 | 16 | 49 | 36 | 136 | 134,6 |
| 30 | 11 | 18 | 12 | 137 | 135,6 |
| *September.* | | | | | |
| 1 | 5 | 46 | 48 | 138 | 136,6 |
| 3 | 0 | 15 | 24 | 139 | 137,6 |
| 4 | 48 | 44 | 0 | 140 | 138,6 |
| 6 | 13 | 12 | 36 | 141 | 139,6 |
| 8 | 7 | 41 | 12 | 142 | 140,6 |
| 10 | 2 | 9 | 48 | 143 | 141,5 |
| 11 | 20 | 38 | 24 | 144 | 142,5 |
| 13 | 15 | 7 | 0 | 145 | 143,5 |
| 15 | 9 | 35 | 36 | 146 | 144,5 |
| 17 | 4 | 4 | 12 | 147 | 145,5 |
| 18 | 22 | 32 | 48 | 148 | 146,5 |
| 20 | 17 | 1 | 24 | 149 | 147,5 |
| 22 | 11 | 30 | 0 | 150 | 148,5 |
| 24 | 5 | 58 | 36 | 151 | 149,5 |
| 26 | 0 | 27 | 12 | 152 | 150,5 |
| 27 | 18 | 55 | 48 | 153 | 151,5 |
| 29 | 13 | 24 | 24 | 154 | 152,5 |

## A Table of the Revolutions of the first *Satellite* of *Jupiter* in a Year.

| *October.* D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|
| 1 | 7 | 53 | 0 | 155 | 153,5 |
| 3 | 2 | 21 | 36 | 156 | 154,5 |
| 4 | 20 | 50 | 12 | 157 | 155,5 |
| 6 | 15 | 18 | 48 | 158 | 156,5 |
| 8 | 9 | 47 | 24 | 159 | 157,5 |
| 10 | 4 | 16 | 0 | 160 | 158,5 |
| 11 | 22 | 44 | 36 | 161 | 159,5 |
| 13 | 17 | 13 | 12 | 162 | 160,5 |
| 15 | 11 | 41 | 48 | 163 | 161,6 |
| 17 | 6 | 10 | 24 | 164 | 162,6 |
| 19 | 0 | 39 | 0 | 165 | 163,6 |
| 20 | 19 | 7 | 36 | 166 | 164,6 |
| 22 | 13 | 36 | 12 | 167 | 165,6 |
| 24 | 8 | 4 | 48 | 168 | 166,6 |
| 26 | 2 | 33 | 24 | 169 | 167,7 |
| 27 | 21 | 2 | 0 | 170 | 168,7 |
| 29 | 15 | 30 | 36 | 171 | 169,7 |
| 31 | 9 | 59 | 12 | 172 | 170,7 |
| *November.* | | | | | |
| 0 | 9 | 59 | 12 | 172 | 170,7 |
| 2 | 4 | 27 | 48 | 173 | 171,8 |
| 3 | 22 | 56 | 24 | 174 | 172,8 |
| 5 | 17 | 25 | 0 | 175 | 173,8 |
| 7 | 11 | 53 | 36 | 176 | 174,8 |
| 9 | 6 | 22 | 12 | 177 | 175,9 |
| 11 | 0 | 50 | 48 | 178 | 176,9 |
| 12 | 19 | 19 | 24 | 179 | 177,9 |
| 14 | 13 | 48 | 0 | 180 | 178,9 |
| 16 | 8 | 16 | 36 | 181 | 80 ,0 |

| *November.* D. | h. | ′ | ″ | Num.I. | NumII |
|---|---|---|---|---|---|
| 16 | 8 | 16 | 36 | 181 | 180,0 |
| 18 | 2 | 45 | 12 | 182 | 181,0 |
| 19 | 21 | 13 | 48 | 183 | 182,0 |
| 21 | 15 | 42 | 24 | 184 | 183,0 |
| 23 | 10 | 11 | 0 | 185 | 184,0 |
| 25 | 4 | 39 | 36 | 186 | 185,1 |
| 26 | 23 | 8 | 12 | 187 | 186,1 |
| 28 | 17 | 36 | 48 | 188 | 187,2 |
| 30 | 12 | 5 | 24 | 189 | 188,2 |
| *December.* | | | | | |
| 0 | 12 | 5 | 24 | 189 | 188,2 |
| 2 | 6 | 34 | 0 | 190 | 189,2 |
| 4 | 1 | 2 | 36 | 191 | 190,3 |
| 5 | 19 | 31 | 12 | 192 | 191,3 |
| 7 | 13 | 59 | 48 | 193 | 192,3 |
| 9 | 8 | 28 | 24 | 194 | 193,4 |
| 11 | 2 | 57 | 0 | 195 | 194,4 |
| 12 | 21 | 25 | 36 | 196 | 195,5 |
| 14 | 15 | 54 | 12 | 197 | 196,5 |
| 16 | 10 | 22 | 48 | 198 | 197,6 |
| 18 | 4 | 51 | 24 | 199 | 198,6 |
| 19 | 23 | 20 | 0 | 200 | 199,7 |
| 21 | 17 | 48 | 36 | 201 | 200,7 |
| 23 | 12 | 17 | 12 | 202 | 201,8 |
| 25 | 6 | 45 | 48 | 203 | 202,8 |
| 27 | 1 | 14 | 24 | 204 | 203,9 |
| 28 | 19 | 43 | 0 | 205 | 204,9 |
| 30 | 14 | 11 | 36 | 206 | 206,0 |

## A Table of the first Equation of the Conjunctions of the first *Satellite* with *Jupiter*.

| Num. I. | Equat. ′ | ″ | Num. I. | Equat. ′ | ″ | Num. I. | Equat. ′ | ″ | Num. I. | Equat. ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 300 | 28 | 9 | 610 | 39 | 5 | 920 | 26 | 37 |
| 10 | 1 | 3 | 310 | 28 | 54 | 620 | 39 | 3 | 930 | 25 | 53 |
| 20 | 2 | 5 | 320 | 29 | 35 | 630 | 38 | 58 | 940 | 25 | 8 |
| 30 | 3 | 8 | 330 | 30 | 11 | 640 | 38 | 51 | 950 | 24 | 23 |
| 40 | 4 | 12 | 340 | 30 | 45 | 650 | 38 | 44 | 960 | 23 | 37 |
| 50 | 5 | 15 | 350 | 31 | 28 | 660 | 38 | 34 | 970 | 22 | 50 |
| 60 | 6 | 16 | 360 | 32 | 10 | 670 | 38 | 24 | 980 | 22 | 3 |
| 70 | 7 | 19 | 370 | 32 | 44 | 680 | 38 | 10 | 990 | 21 | 15 |
| 80 | 8 | 20 | 380 | 33 | 15 | 690 | 37 | 56 | 1000 | 20 | 26 |
| 90 | 9 | 23 | 390 | 33 | 49 | 700 | 37 | 40 | 1010 | 19 | 37 |
| 100 | 10 | 25 | 400 | 34 | 20 | 710 | 37 | 24 | 1020 | 18 | 47 |
| 110 | 11 | 25 | 410 | 34 | 51 | 720 | 37 | 5 | 1030 | 17 | 56 |
| 120 | 12 | 25 | 420 | 35 | 21 | 730 | 36 | 45 | 1040 | 17 | 5 |
| 130 | 13 | 25 | 430 | 35 | 47 | 740 | 36 | 25 | 1050 | 16 | 13 |
| 140 | 14 | 25 | 440 | 36 | 6 | 750 | 36 | 4 | 1060 | 15 | 19 |
| 150 | 15 | 22 | 450 | 36 | 26 | 760 | 35 | 40 | 1070 | 14 | 25 |
| 160 | 16 | 18 | 460 | 36 | 47 | 770 | 45 | 15 | 1080 | 13 | 32 |
| 170 | 17 | 17 | 470 | 37 | 8 | 780 | 34 | 49 | 1090 | 12 | 37 |
| 180 | 18 | 11 | 480 | 37 | 29 | 790 | 34 | 19 | 1100 | 11 | 42 |
| 190 | 19 | 9 | 490 | 37 | 44 | 800 | 33 | 49 | 1110 | 10 | 47 |
| 200 | 20 | 5 | 500 | 37 | 59 | 810 | 33 | 21 | 1120 | 9 | 52 |
| 210 | 20 | 56 | 510 | 38 | 16 | 820 | 32 | 50 | 1130 | 8 | 57 |
| 220 | 21 | 49 | 520 | 38 | 29 | 830 | 32 | 17 | 1140 | 8 | 0 |
| 230 | 22 | 41 | 530 | 38 | 39 | 840 | 31 | 44 | 1150 | 7 | 3 |
| 240 | 23 | 32 | 540 | 38 | 49 | 850 | 31 | 10 | 1160 | 6 | 7 |
| 250 | 24 | 20 | 550 | 38 | 55 | 860 | 30 | 32 | 1170 | 5 | 10 |
| 260 | 25 | 7 | 560 | 38 | 59 | 870 | 29 | 56 | 1180 | 4 | 13 |
| 270 | 25 | 57 | 570 | 39 | 3 | 880 | 29 | 19 | 1190 | 3 | 15 |
| 280 | 26 | 43 | 580 | 39 | 6 | 890 | 28 | 40 | 1200 | 2 | 19 |
| 290 | 27 | 27 | 590 | 39 | 8 | 900 | 27 | 59 | 1210 | 1 | 21 |
| 300 | 28 | 9 | 600 | 39 | 7 | 910 | 27 | 19 | 1220 | 0 | 24 |
| | | | 610 | 39 | 5 | 920 | 26 | 37 | 1230 | 0 | 0 |



## A Table of the second Equation of the Conjunctions of the first *Satellite* with *Jupiter*.

| Num II. | Equat. add ′ | ″ | Num II. | Equat. add ′ | ″ | Num II. | Equat. add ′ | ″ | Num II. | Equat. add ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0′ | 0″ | 28 | 2′ | 4″ | 56 | 7′ | 0″ | 84 | 12′ | 0″ |
| 1 | 0 | 0 | 29 | 2 | 13 | 57 | 7 | 12 | 85 | 12 | 9 |
| 2 | 0 | 1 | 30 | 2 | 21 | 58 | 7 | 24 | 86 | 12 | 16 |
| 3 | 0 | 2 | 31 | 2 | 30 | 59 | 7 | 36 | 87 | 12 | 24 |
| 4 | 0 | 3 | 32 | 2 | 39 | 60 | 7 | 47 | 88 | 12 | 32 |
| 5 | 0 | 4 | 33 | 2 | 48 | 61 | 7 | 59 | 89 | 12 | 40 |
| 6 | 0 | 6 | 34 | 2 | 58 | 62 | 8 | 11 | 90 | 12 | 47 |
| 7 | 0 | 8 | 35 | 3 | 8 | 63 | 8 | 22 | 91 | 12 | 53 |
| 8 | 0 | 10 | 36 | 3 | 17 | 64 | 8 | 34 | 92 | 13 | 0 |
| 9 | 0 | 14 | 37 | 3 | 27 | 65 | 8 | 36 | 93 | 13 | 6 |
| 10 | 0 | 17 | 38 | 3 | 37 | 66 | 8 | 57 | 94 | 13 | 13 |
| 11 | 0 | 20 | 39 | 3 | 48 | 67 | 9 | 8 | 95 | 13 | 19 |
| 12 | 0 | 23 | 40 | 3 | 59 | 68 | 9 | 20 | 96 | 13 | 24 |
| 13 | 0 | 27 | 41 | 4 | 9 | 69 | 9 | 32 | 97 | 13 | 30 |
| 14 | 0 | 32 | 42 | 4 | 20 | 70 | 9 | 44 | 98 | 13 | 35 |
| 15 | 0 | 37 | 43 | 4 | 31 | 71 | 9 | 54 | 99 | 13 | 39 |
| 16 | 0 | 42 | 44 | 4 | 41 | 72 | 10 | 3 | 100 | 13 | 45 |
| 17 | 0 | 47 | 45 | 4 | 53 | 73 | 10 | 14 | 101 | 13 | 48 |
| 18 | 0 | 53 | 46 | 5 | 4 | 74 | 10 | 25 | 102 | 13 | 51 |
| 19 | 0 | 58 | 47 | 5 | 15 | 75 | 10 | 35 | 103 | 13 | 54 |
| 20 | 0 | 4 | 48 | 5 | 27 | 76 | 10 | 45 | 104 | 13 | 57 |
| 21 | 1 | 11 | 49 | 5 | 39 | 77 | 10 | 55 | 105 | 14 | 0 |
| 22 | 1 | 18 | 50 | 5 | 50 | 78 | 11 | 5 | 106 | 14 | 3 |
| 23 | 1 | 25 | 51 | 6 | 2 | 79 | 11 | 15 | 107 | 14 | 5 |
| 24 | 1 | 32 | 52 | 6 | 14 | 80 | 11 | 25 | 108 | 14 | 7 |
| 25 | 1 | 40 | 53 | 6 | 25 | 81 | 11 | 34 | 109 | 14 | 8 |
| 26 | 1 | 47 | 54 | 6 | 37 | 82 | 11 | 43 | 110 | 14 | 9 |
| 27 | 1 | 56 | 55 | 6 | 49 | 83 | 11 | 52 | 111 | 14 | 10 |
| 28 | 2 | 4 | 56 | 7 | 0 | 84 | 12 | 0 | 112 | 14 | 10 |

## A Table of the half Duration of the first *Satellite* in the Shadow of *Saturn*.

| Num.I. | H. | ′ | ″ | Num.I. | H. | ′ | ″ |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 4 | 56 | 1200 | 1 | 5 | 6 |
| 40 | 1 | 4 | 33 | 1240 | 1 | 4 | 48 |
| 80 | 1 | 4 | 12 | 1280 | 1 | 4 | 26 |
| 120 | 1 | 3 | 59 | 1320 | 1 | 4 | 7 |
| 160 | 1 | 3 | 48 | 1360 | 1 | 3 | 54 |
| 200 | 1 | 3 | 36 | 1400 | 1 | 3 | 38 |
| 240 | 1 | 3 | 38 | 1440 | 1 | 3 | 38 |
| 280 | 1 | 3 | 48 | 1480 | 1 | 3 | 44 |
| 320 | 1 | 4 | 1 | 1520 | 1 | 3 | 52 |
| 360 | 1 | 4 | 16 | 1560 | 1 | 4 | 7 |
| 400 | 1 | 4 | 36 | 1600 | 1 | 4 | 24 |
| 440 | 1 | 4 | 56 | 1640 | 1 | 4 | 42 |
| 480 | 1 | 5 | 18 | 1680 | 1 | 5 | 0 |
| 520 | 1 | 5 | 41 | 1720 | 1 | 5 | 22 |
| 560 | 1 | 6 | 1 | 1760 | 1 | 5 | 46 |
| 600 | 1 | 6 | 21 | 1800 | 1 | 6 | 10 |
| 640 | 1 | 6 | 39 | 1840 | 1 | 6 | 28 |
| 680 | 1 | 6 | 53 | 1880 | 1 | 6 | 45 |
| 720 | 1 | 7 | 3 | 1920 | 1 | 6 | 57 |
| 760 | 1 | 7 | 11 | 1960 | 1 | 7 | 7 |
| 800 | 1 | 7 | 15 | 2000 | 1 | 7 | 13 |
| 840 | 1 | 7 | 13 | 2040 | 1 | 7 | 14 |
| 880 | 1 | 7 | 9 | 2080 | 1 | 7 | 15 |
| 920 | 1 | 7 | 2 | 2120 | 1 | 7 | 15 |
| 960 | 1 | 6 | 54 | 2160 | 1 | 7 | 10 |
| 1000 | 1 | 6 | 39 | 2200 | 1 | 6 | 49 |
| 1040 | 1 | 6 | 22 | 2240 | 1 | 6 | 32 |
| 1080 | 1 | 6 | 5 | 2280 | 1 | 6 | 15 |
| 1120 | 1 | 5 | 45 | 2320 | 1 | 5 | 58 |
| 1160 | 1 | 5 | 26 | 2360 | 1 | 5 | 38 |
| 1200 | 1 | 5 | 6 | 2400 | 1 | 5 | 18 |
| | | | | 2440 | 1 | 5 | 2 |



| Year from Christ | Anomaly. s | o | ′ | ″ | Years. | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 8 | 34 | 18 | 1 | 0 | 12 | 12 | 46 |
| 1501 | 5 | 10 | 11 | 48 | 2 | 0 | 24 | 25 | 32 |
| 1581 | 1 | 27 | 53 | 0 | 3 | 1 | 6 | 38 | 17 |
| 1601 | 10 | 2 | 18 | 18 | 4 | 1 | 18 | 53 | 4 |
| 1621 | 6 | 6 | 43 | 36 | 5 | 2 | 1 | 5 | 49 |
| 1641 | 2 | 11 | 8 | 54 | 6 | 2 | 13 | 18 | 35 |
| 1661 | 10 | 15 | 34 | 12 | 7 | 2 | 25 | 31 | 21 |
| 1681 | 6 | 19 | 59 | 30 | 8 | 3 | 7 | 46 | 7 |
| 1701 | 2 | 24 | 24 | 48 | 9 | 3 | 19 | 58 | 53 |
| 1721 | 10 | 28 | 50 | 6 | 10 | 4 | 2 | 11 | 39 |
| 1741 | 7 | 3 | 15 | 24 | 11 | 4 | 14 | 24 | 25 |
| 1761 | 3 | 7 | 40 | 42 | 12 | 4 | 26 | 39 | 11 |
| 1781 | 11 | 12 | 6 | 0 | 13 | 5 | 8 | 51 | 57 |
| 1801 | 7 | 16 | 31 | 18 | 14 | 5 | 21 | 4 | 42 |
| 1901 | 0 | 8 | 37 | 48 | 15 | 6 | 3 | 17 | 28 |
| 2001 | 5 | 0 | 44 | 18 | 16 | 6 | 15 | 32 | 14 |
| Years | Anom. Mot. | | | | 17 | 6 | 27 | 45 | 0 |
| | | | | | 18 | 7 | 9 | 57 | 46 |
| 20 | 8 | 4 | 25 | 18 | 19 | 7 | 22 | 10 | 32 |
| 40 | 4 | 8 | 50 | 36 | 20 | 8 | 4 | 25 | 18 |
| 60 | 0 | 13 | 15 | 54 | Months | Anom. Mot. | | | |
| 80 | 8 | 17 | 41 | 12 | | o | ′ | ″ | |
| 100 | 4 | 22 | 6 | 30 | *January* | 0 | 0 | 0 | |
| 200 | 9 | 14 | 13 | 0 | *February* | 1 | 2 | 14 | |
| 300 | 2 | 6 | 19 | 30 | *March* | 1 | 58 | 27 | |
| 400 | 6 | 28 | 26 | 0 | *April* | 3 | 0 | 41 | |
| 500 | 11 | 20 | 32 | 30 | *May* | 4 | 0 | 55 | |
| 600 | 4 | 12 | 39 | 0 | *June* | 5 | 3 | 9 | |
| 700 | 9 | 4 | 45 | 30 | *July* | 6 | 3 | 22 | |
| 800 | 1 | 26 | 52 | 0 | *August* | 7 | 5 | 36 | |
| 900 | 6 | 18 | 58 | 30 | *September* | 8 | 7 | 50 | |
| 1000 | 11 | 11 | 5 | 0 | *October* | 9 | 8 | 4 | |
| 2000 | 10 | 22 | 10 | 0 | *November* | 10 | 10 | 18 | |
| 3000 | 10 | 3 | 15 | 0 | *December* | 11 | 10 | 32 | |
| 4000 | 9 | 14 | 20 | 0 | In Leap-Year (after *February*) add one Day, and the Motion of a Day. | | | | |
| 5000 | 8 | 25 | 25 | 0 | | | | | |
| 6000 | 8 | 6 | 30 | 0 | | | | | |

## A Table of the mean Motion of *Saturn* from the *Aphelion*.

| Days | Anom. Mot. ° | ′ | ″ | H. | Anom. Mot. ′ | ″ | H. | Anom. Mot. ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 2 | 0 | 1 | 0 | 5 | 31 | 2 | 36 |
| 2 | 0 | 4 | 1 | 2 | 0 | 10 | 32 | 2 | 41 |
| 3 | 0 | 6 | 1 | 3 | 0 | 15 | 33 | 2 | 46 |
| 4 | 0 | 8 | 2 | 4 | 0 | 20 | 34 | 2 | 51 |
| 5 | 0 | 10 | 2 | 5 | 0 | 25 | 35 | 2 | 56 |
| 6 | 0 | 12 | 3 | 6 | 0 | 30 | 36 | 3 | 1 |
| 7 | 0 | 14 | 3 | 7 | 0 | 35 | 37 | 3 | 6 |
| 8 | 0 | 16 | 4 | 8 | 0 | 40 | 38 | 3 | 11 |
| 9 | 0 | 18 | 4 | 9 | 0 | 45 | 39 | 3 | 16 |
| 10 | 0 | 20 | 5 | 10 | 0 | 50 | 40 | 3 | 21 |
| 11 | 0 | 22 | 5 | 11 | 0 | 55 | 41 | 3 | 16 |
| 12 | 0 | 24 | 5 | 12 | 0 | 0 | 42 | 3 | 21 |
| 13 | 0 | 26 | 6 | 13 | 1 | 5 | 43 | 3 | 26 |
| 14 | 0 | 28 | 6 | 14 | 1 | 10 | 44 | 3 | 31 |
| 15 | 0 | 30 | 7 | 15 | 1 | 15 | 45 | 3 | 46 |
| 16 | 0 | 32 | 7 | 16 | 1 | 20 | 46 | 3 | 51 |
| 17 | 0 | 34 | 8 | 17 | 1 | 25 | 47 | 3 | 56 |
| 18 | 0 | 36 | 8 | 18 | 1 | 30 | 48 | 4 | 1 |
| 19 | 0 | 38 | 9 | 19 | 1 | 35 | 49 | 4 | 6 |
| 20 | 0 | 40 | 9 | 20 | 1 | 40 | 50 | 4 | 11 |
| 21 | 0 | 42 | 10 | 21 | 1 | 45 | 51 | 4 | 16 |
| 22 | 0 | 44 | 10 | 22 | 1 | 50 | 52 | 4 | 21 |
| 23 | 0 | 46 | 10 | 23 | 1 | 55 | 53 | 4 | 26 |
| 24 | 0 | 48 | 11 | 24 | 2 | 0 | 54 | 4 | 31 |
| 25 | 0 | 50 | 11 | 25 | 2 | 5 | 55 | 4 | 36 |
| 26 | 0 | 52 | 12 | 26 | 2 | 10 | 56 | 4 | 41 |
| 27 | 0 | 54 | 12 | 27 | 2 | 16 | 57 | 4 | 46 |
| 28 | 0 | 56 | 13 | 28 | 2 | 21 | 58 | 4 | 51 |
| 29 | 0 | 58 | 13 | 29 | 2 | 26 | 59 | 4 | 56 |
| 30 | 1 | 0 | 14 | 30 | 2 | 31 | 60 | 5 | 1 |
| 31 | 1 | 2 | 14 | | | | | | |
| 32 | 1 | 4 | 15 | | | | | | |

| | ° | ′ | ″ |
|---|---|---|---|
| Long. Aph. ♄ à ☊ ✶ ♈ | 7 | 28 | 30 | 0 |
| Long. ☌ ♄ à ☊ ✶ ♈ | 2 | 22 | 30 | 0 |
| Inclin. Orb. ♄ | 2 | 30 | 0 |
| Dist. Mid. ♄ à ☉ | 953800 |
| Eccentricity | 54700 |



## A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | Sign. ☊ Long. ♄ à ☊ ✶ ♈ ° | ′ | ″ | Inc. North. ° | ′ | ″ | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|
| 0 | 7 | 28 | 31 | 13 | 1 | 1 | 0 | 6. 003608 |
| 1 | 7 | 29 | 24 | 46 | 0 | 58 | 51 | 6. 003609 |
| 2 | 8 | 0 | 18 | 19 | 0 | 56 | 42 | 6. 003605 |
| 3 | 8 | 1 | 11 | 52 | 0 | 54 | 31 | 6. 003593 |
| 4 | 8 | 2 | 5 | 24 | 0 | 52 | 20 | 6. 003575 |
| 5 | 8 | 2 | 58 | 58 | 0 | 50 | 9 | 6. 003550 |
| 6 | 8 | 3 | 52 | 32 | 0 | 47 | 56 | 6. 003519 |
| 7 | 8 | 4 | 46 | 6 | 0 | 45 | 43 | 6. 003481 |
| 8 | 8 | 5 | 39 | 41 | 0 | 43 | 29 | 6. 003435 |
| 9 | 8 | 6 | 33 | 16 | 0 | 41 | 14 | 6. 003386 |
| 10 | 8 | 7 | 26 | 52 | 0 | 38 | 59 | 6. 003328 |
| 11 | 8 | 8 | 20 | 30 | 0 | 36 | 43 | 6. 003263 |
| 12 | 8 | 9 | 14 | 8 | 0 | 34 | 26 | 6. 003193 |
| 13 | 8 | 10 | 7 | 48 | 0 | 32 | 9 | 6. 003115 |
| 14 | 8 | 11 | 1 | 28 | 0 | 29 | 52 | 6. 003032 |
| 15 | 8 | 11 | 55 | 10 | 0 | 27 | 34 | 6. 002942 |
| 16 | 8 | 12 | 48 | 53 | 0 | 25 | 15 | 6. 002845 |
| 17 | 8 | 13 | 42 | 37 | 0 | 22 | 56 | 6. 002743 |
| 18 | 8 | 14 | 36 | 24 | 0 | 20 | 37 | 6. 002633 |
| 19 | 8 | 15 | 30 | 13 | 0 | 18 | 17 | 6. 002517 |
| 20 | 8 | 16 | 24 | 2 | 0 | 15 | 57 | 6. 002395 |
| 21 | 8 | 17 | 17 | 53 | 0 | 13 | 37 | 6. 002267 |
| 22 | 8 | 18 | 11 | 47 | 0 | 11 | 16 | 6. 002131 |
| 23 | 8 | 19 | 5 | 43 | 0 | 8 | 55 | 6. 001990 |
| 24 | 8 | 19 | 59 | 40 | 0 | 6 | 34 | 6. 001842 |
| 25 | 8 | 20 | 53 | 40 | 0 | 4 | 12 | 6. 001688 |
| 26 | 8 | 21 | 47 | 42 | 0 | 1 | 51 | 6. 001527 |
| 27 | 8 | 22 | 41 | 47 | South | | 31 | 6. 001361 |
| 28 | 8 | 23 | 35 | 54 | 0 | 2 | 53 | 6. 001188 |
| 29 | 8 | 24 | 30 | 4 | 0 | 5 | 15 | 6. 001009 |
| 30 | 8 | 25 | 24 | 16 | 0 | 7 | 36 | 6. 000823 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 1.

| Mid. Anom. | Long. ♄ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 8 | 25 | 24 | 16 | 0 | 7 | 36 | 6. 000823 |
| 1 | 8 | 26 | 18 | 32 | 0 | 9 | 58 | 6. 000632 |
| 2 | 8 | 27 | 12 | 50 | 0 | 12 | 20 | 6. 000435 |
| 3 | 8 | 28 | 7 | 11 | 0 | 14 | 42 | 6. 000232 |
| 4 | 8 | 29 | 1 | 36 | 0 | 17 | 4 | 6. 000022 |
| 5 | 8 | 29 | 56 | 3 | 0 | 19 | 25 | 5. 999806 |
| 6 | 9 | 0 | 50 | 34 | 0 | 21 | 47 | 5. 999585 |
| 7 | 9 | 1 | 45 | 8 | 0 | 24 | 8 | 5. 999358 |
| 8 | 9 | 2 | 34 | 46 | 0 | 26 | 29 | 5. 999125 |
| 9 | 9 | 3 | 39 | 27 | 0 | 28 | 50 | 5. 998887 |
| 10 | 9 | 4 | 29 | 11 | 0 | 31 | 10 | 5. 998642 |
| 11 | 9 | 5 | 24 | 0 | 0 | 33 | 30 | 5. 998391 |
| 12 | 9 | 6 | 18 | 53 | 0 | 35 | 50 | 5. 998135 |
| 13 | 9 | 7 | 13 | 49 | 0 | 38 | 10 | 5. 997874 |
| 14 | 9 | 8 | 8 | 49 | 0 | 40 | 29 | 5. 997607 |
| 15 | 9 | 9 | 3 | 53 | 0 | 42 | 47 | 5. 997334 |
| 16 | 9 | 9 | 59 | 2 | 0 | 45 | 5 | 5. 997056 |
| 17 | 9 | 10 | 54 | 15 | 0 | 47 | 23 | 5. 996772 |
| 18 | 9 | 11 | 49 | 32 | 0 | 49 | 40 | 5. 996484 |
| 19 | 9 | 12 | 44 | 54 | 0 | 51 | 57 | 5. 996189 |
| 20 | 9 | 13 | 40 | 20 | 0 | 54 | 12 | 5. 995890 |
| 21 | 9 | 14 | 35 | 51 | 0 | 56 | 27 | 5. 995585 |
| 22 | 9 | 15 | 31 | 26 | 0 | 58 | 42 | 5. 995277 |
| 23 | 9 | 16 | 27 | 6 | 1 | 0 | 56 | 5. 994962 |
| 24 | 9 | 17 | 22 | 52 | 1 | 3 | 9 | 5. 994643 |
| 25 | 9 | 18 | 18 | 42 | 1 | 5 | 21 | 5. 994319 |
| 26 | 9 | 19 | 14 | 38 | 1 | 7 | 32 | 5. 993989 |
| 27 | 9 | 20 | 10 | 39 | 1 | 9 | 42 | 5. 993656 |
| 28 | 9 | 21 | 6 | 43 | 1 | 11 | 52 | 5. 993317 |
| 29 | 9 | 22 | 2 | 54 | 1 | 14 | 1 | 5. 992973 |
| 30 | 9 | 22 | 59 | 10 | 1 | 16 | 8 | 5. 992625 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 2.

| Mid. Anom. | Long. ♄ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 9 | 22 | 59 | 10 | 1 | 16 | 8 | 5. 992625 |
| 1 | 9 | 23 | 55 | 32 | 1 | 18 | 15 | 5. 992273 |
| 2 | 9 | 24 | 52 | 0 | 1 | 20 | 20 | 5. 991917 |
| 3 | 9 | 25 | 48 | 32 | 1 | 22 | 25 | 5. 991557 |
| 4 | 9 | 26 | 45 | 10 | 1 | 24 | 28 | 5. 991192 |
| 5 | 9 | 27 | 41 | 55 | 1 | 26 | 30 | 5. 990824 |
| 6 | 9 | 28 | 38 | 45 | 1 | 28 | 31 | 5. 990451 |
| 7 | 9 | 29 | 35 | 41 | 1 | 30 | 30 | 5. 990074 |
| 8 | 10 | 0 | 32 | 42 | 1 | 32 | 29 | 5. 989694 |
| 9 | 10 | 1 | 29 | 50 | 1 | 34 | 26 | 5. 989310 |
| 10 | 10 | 2 | 27 | 4 | 1 | 36 | 21 | 5. 988922 |
| 11 | 10 | 3 | 24 | 24 | 1 | 38 | 16 | 5. 988532 |
| 12 | 10 | 4 | 21 | 50 | 1 | 40 | 8 | 5. 988137 |
| 13 | 10 | 5 | 19 | 23 | 1 | 42 | 0 | 5. 987739 |
| 14 | 10 | 6 | 17 | 3 | 1 | 43 | 50 | 5. 987338 |
| 15 | 10 | 7 | 14 | 48 | 1 | 45 | 38 | 5. 986934 |
| 16 | 10 | 8 | 12 | 40 | 1 | 47 | 24 | 5. 986527 |
| 17 | 10 | 9 | 10 | 38 | 1 | 49 | 9 | 5. 986117 |
| 18 | 10 | 10 | 8 | 44 | 1 | 50 | 53 | 5. 985704 |
| 19 | 10 | 11 | 6 | 56 | 1 | 52 | 35 | 5. 985288 |
| 20 | 10 | 12 | 5 | 14 | 1 | 54 | 14 | 5. 984870 |
| 21 | 10 | 13 | 3 | 40 | 1 | 55 | 53 | 5. 984450 |
| 22 | 10 | 14 | 2 | 13 | 1 | 57 | 29 | 5. 984027 |
| 23 | 10 | 15 | 0 | 52 | 1 | 59 | 3 | 5. 983603 |
| 24 | 10 | 15 | 59 | 38 | 2 | 0 | 36 | 5. 983176 |
| 25 | 10 | 16 | 58 | 30 | 2 | 2 | 6 | 5. 982747 |
| 26 | 10 | 17 | 57 | 29 | 2 | 3 | 35 | 5. 982315 |
| 27 | 10 | 18 | 56 | 37 | 2 | 5 | 2 | 5. 981883 |
| 28 | 10 | 19 | 55 | 50 | 2 | 6 | 26 | 5. 981448 |
| 29 | 10 | 20 | 55 | 12 | 2 | 7 | 48 | 5. 981013 |
| 30 | 10 | 21 | 54 | 42 | 2 | 9 | 9 | 5. 980576 |

A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | Sign. 3. Long. ♄ à ☉ ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 10 | 21 | 54 | 42 | 2 | 9 | 9 | 5. 980576 |
| 1 | 10 | 22 | 54 | 18 | 2 | 10 | 27 | 5. 980139 |
| 2 | 10 | 23 | 54 | 1 | 2 | 11 | 43 | 5. 979700 |
| 3 | 10 | 24 | 53 | 51 | 2 | 12 | 57 | 5. 979260 |
| 4 | 10 | 25 | 53 | 49 | 2 | 14 | 8 | 5. 978819 |
| 5 | 10 | 26 | 53 | 54 | 2 | 15 | 17 | 5. 978378 |
| 6 | 10 | 27 | 54 | 6 | 2 | 16 | 24 | 5. 977936 |
| 7 | 10 | 28 | 54 | 25 | 2 | 17 | 29 | 5. 977494 |
| 8 | 10 | 29 | 54 | 52 | 2 | 18 | 31 | 5. 977051 |
| 9 | 11 | 0 | 55 | 27 | 2 | 19 | 30 | 5. 976609 |
| 10 | 11 | 1 | 56 | 8 | 2 | 20 | 27 | 5. 976166 |
| 11 | 11 | 2 | 56 | 58 | 2 | 21 | 22 | 5. 975724 |
| 12 | 11 | 3 | 57 | 54 | 2 | 22 | 14 | 5. 975282 |
| 13 | 11 | 4 | 58 | 59 | 2 | 23 | 3 | 5. 974841 |
| 14 | 11 | 6 | 0 | 12 | 2 | 23 | 50 | 5. 974400 |
| 15 | 11 | 7 | 1 | 31 | 2 | 24 | 34 | 5. 973960 |
| 16 | 11 | 8 | 2 | 58 | 2 | 25 | 16 | 5. 973520 |
| 17 | 11 | 9 | 4 | 32 | 2 | 25 | 54 | 5. 973083 |
| 18 | 11 | 10 | 6 | 13 | 2 | 26 | 30 | 5. 972647 |
| 19 | 11 | 11 | 8 | 2 | 2 | 27 | 4 | 5. 972211 |
| 20 | 11 | 12 | 10 | 0 | 2 | 27 | 34 | 5. 971777 |
| 21 | 11 | 13 | 12 | 3 | 2 | 28 | 2 | 5. 971345 |
| 22 | 11 | 14 | 14 | 15 | 2 | 28 | 27 | 5. 970915 |
| 23 | 11 | 15 | 16 | 33 | 2 | 28 | 49 | 5. 970487 |
| 24 | 11 | 16 | 18 | 59 | 2 | 29 | 8 | 5. 970060 |
| 25 | 11 | 17 | 21 | 34 | 2 | 29 | 24 | 5. 969637 |
| 26 | 11 | 18 | 24 | 14 | 2 | 29 | 37 | 5. 969216 |
| 27 | 11 | 19 | 27 | 3 | 2 | 29 | 47 | 5. 968798 |
| 28 | 11 | 20 | 29 | 57 | 2 | 29 | 55 | 5. 968382 |
| 29 | 11 | 21 | 33 | 1 | 2 | 29 | 59 | 5. 967970 |
| 30 | 11 | 22 | 36 | 10 | 2 | 30 | 0 | 5. 967559 |

A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | Sign. 4. Long. ♄ à ☉ ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 11 | 22 | 36 | 10 | 2 | 30 | 0 | 5. 967559 |
| 1 | 11 | 23 | 39 | 27 | 2 | 29 | 58 | 5. 967153 |
| 2 | 11 | 24 | 42 | 52 | 2 | 29 | 53 | 5. 966750 |
| 3 | 11 | 25 | 46 | 22 | 2 | 29 | 45 | 5. 966350 |
| 4 | 11 | 26 | 50 | 0 | 2 | 29 | 34 | 5. 965954 |
| 5 | 11 | 27 | 53 | 45 | 2 | 29 | 20 | 5. 965562 |
| 6 | 11 | 28 | 57 | 38 | 2 | 29 | 3 | 5. 965275 |
| 7 | 0 | 0 | 1 | 37 | 2 | 28 | 43 | 5. 964791 |
| 8 | 0 | 1 | 5 | 42 | 2 | 28 | 19 | 5. 964412 |
| 9 | 0 | 2 | 9 | 54 | 2 | 27 | 52 | 5. 964036 |
| 10 | 0 | 3 | 14 | 13 | 2 | 27 | 23 | 5. 963666 |
| 11 | 0 | 4 | 18 | 37 | 2 | 26 | 50 | 5. 963300 |
| 12 | 0 | 5 | 23 | 10 | 2 | 26 | 14 | 5. 962939 |
| 13 | 0 | 6 | 27 | 48 | 2 | 25 | 34 | 5. 962584 |
| 14 | 0 | 7 | 32 | 32 | 2 | 24 | 52 | 5. 962233 |
| 15 | 0 | 8 | 37 | 23 | 2 | 24 | 6 | 5. 961888 |
| 16 | 0 | 9 | 42 | 20 | 2 | 23 | 18 | 5. 961549 |
| 17 | 0 | 10 | 47 | 23 | 2 | 22 | 26 | 5. 961214 |
| 18 | 0 | 11 | 52 | 32 | 2 | 21 | 31 | 5. 960886 |
| 19 | 0 | 12 | 57 | 46 | 2 | 20 | 33 | 5. 960564 |
| 20 | 0 | 14 | 3 | 6 | 2 | 19 | 31 | 5. 960248 |
| 21 | 0 | 15 | 8 | 33 | 2 | 18 | 27 | 5. 959938 |
| 22 | 0 | 16 | 14 | 4 | 2 | 17 | 20 | 5. 959634 |
| 23 | 0 | 17 | 19 | 42 | 2 | 16 | 9 | 5. 959337 |
| 24 | 0 | 18 | 25 | 24 | 2 | 14 | 55 | 5. 959046 |
| 25 | 0 | 19 | 31 | 11 | 2 | 13 | 39 | 5. 958762 |
| 26 | 0 | 20 | 37 | 3 | 2 | 12 | 19 | 5. 958484 |
| 27 | 0 | 21 | 43 | 1 | 2 | 10 | 56 | 5. 958214 |
| 28 | 0 | 22 | 49 | 4 | 2 | 9 | 30 | 5. 957951 |
| 29 | 0 | 23 | 55 | 11 | 2 | 8 | 2 | 5. 957695 |
| 30 | 0 | 25 | 1 | 23 | 2 | 6 | 30 | 5. 957445 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 5.

| Mid. Auom. | Long. ♄ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 0 | 25 | 1 | 23 | 2 | 6 | 30 | 5. 957445 |
| 1 | 0 | 26 | 7 | 40 | 2 | 4 | 55 | 5. 957203 |
| 2 | 0 | 27 | 14 | 0 | 2 | 3 | 18 | 5. 956969 |
| 3 | 0 | 28 | 20 | 25 | 2 | 1 | 37 | 5. 956742 |
| 4 | 0 | 29 | 26 | 53 | 1 | 59 | 54 | 5. 956523 |
| 5 | 1 | 0 | 33 | 26 | 1 | 58 | 8 | 5. 956312 |
| 6 | 1 | 1 | 40 | 3 | 1 | 56 | 20 | 5. 956107 |
| 7 | 1 | 2 | 46 | 44 | 1 | 54 | 28 | 5. 955912 |
| 8 | 1 | 3 | 53 | 27 | 1 | 52 | 34 | 5. 955724 |
| 9 | 1 | 5 | 0 | 15 | 1 | 50 | 37 | 5. 955544 |
| 10 | 1 | 6 | 7 | 5 | 1 | 48 | 38 | 5. 955373 |
| 11 | 1 | 7 | 13 | 58 | 1 | 46 | 36 | 5. 955210 |
| 12 | 1 | 8 | 20 | 55 | 1 | 44 | 31 | 5. 955055 |
| 13 | 1 | 9 | 27 | 54 | 1 | 42 | 24 | 5. 954910 |
| 14 | 1 | 10 | 34 | 57 | 1 | 40 | 15 | 5. 954771 |
| 15 | 1 | 11 | 42 | 1 | 1 | 38 | 3 | 5. 254641 |
| 16 | 1 | 12 | 49 | 8 | 1 | 35 | 49 | 5. 954520 |
| 17 | 1 | 13 | 56 | 16 | 1 | 33 | 32 | 5. 954408 |
| 18 | 1 | 15 | 3 | 26 | 1 | 31 | 14 | 5. 954304 |
| 19 | 1 | 16 | 10 | 38 | 1 | 28 | 53 | 5. 954209 |
| 20 | 1 | 17 | 17 | 53 | 1 | 26 | 30 | 5. 954122 |
| 21 | 1 | 18 | 25 | 9 | 1 | 24 | 5 | 5. 954044 |
| 22 | 1 | 19 | 32 | 27 | 1 | 21 | 39 | 5. 953974 |
| 23 | 1 | 20 | 39 | 45 | 1 | 19 | 10 | 5. 953914 |
| 24 | 1 | 21 | 47 | 4 | 1 | 16 | 39 | 5. 953862 |
| 25 | 1 | 22 | 54 | 24 | 1 | 14 | 7 | 5. 953819 |
| 26 | 1 | 24 | 1 | 45 | 1 | 11 | 32 | 5. 953786 |
| 27 | 1 | 25 | 9 | 7 | 1 | 8 | 57 | 5. 953761 |
| 28 | 1 | 26 | 16 | 28 | 1 | 6 | 19 | 5. 953745 |
| 29 | 1 | 27 | 23 | 50 | 1 | 3 | 40 | 5. 953738 |
| 30 | 1 | 28 | 31 | 13 | 1 | 1 | 0 | 5. 953740 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 6.

| Mid. Auom. | Long. ♄ à ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 1 | 28 | 31 | 13 | 1 | 1 | 0 | 5. 953740 |
| 1 | 1 | 29 | 38 | 36 | 0 | 58 | 18 | 5. 953750 |
| 2 | 2 | 0 | 45 | 57 | 0 | 55 | 35 | 5. 953769 |
| 3 | 2 | 1 | 53 | 18 | 0 | 52 | 50 | 5. 953797 |
| 4 | 2 | 3 | 0 | 39 | 0 | 50 | 4 | 5. 953834 |
| 5 | 2 | 4 | 7 | 59 | 0 | 47 | 18 | 5. 953879 |
| 6 | 2 | 5 | 15 | 18 | 0 | 44 | 30 | 5. 953934 |
| 7 | 2 | 6 | 22 | 35 | 0 | 41 | 41 | 5. 953997 |
| 8 | 2 | 7 | 29 | 52 | 0 | 38 | 51 | 5. 954069 |
| 9 | 2 | 8 | 37 | 8 | 0 | 36 | 0 | 5. 954150 |
| 10 | 2 | 9 | 44 | 21 | 0 | 33 | 9 | 5. 954239 |
| 11 | 2 | 10 | 51 | 34 | 0 | 30 | 27 | 5. 954337 |
| 12 | 2 | 11 | 58 | 43 | 0 | 27 | 24 | 5. 954443 |
| 13 | 2 | 13 | 5 | 51 | 0 | 24 | 31 | 5. 954558 |
| 14 | 2 | 14 | 12 | 57 | 0 | 21 | 38 | 5. 954680 |
| 15 | 2 | 15 | 20 | 0 | 0 | 18 | 44 | 5. 954812 |
| 16 | 2 | 16 | 27 | 1 | 0 | 15 | 49 | 5. 954951 |
| 17 | 2 | 17 | 34 | 1 | 0 | 12 | 54 | 5. 955099 |
| 18 | 2 | 18 | 40 | 56 | 0 | 10 | 0 | 5. 955254 |
| 19 | 2 | 19 | 47 | 49 | 0 | 7 | 5 | 5. 955418 |
| 20 | 2 | 20 | 54 | 38 | 0 | 4 | 10 | 5. 955590 |
| 21 | 2 | 22 | 1 | 25 | 0 | 1 | 15 | 5. 955769 |
| 22 | 2 | 23 | 8 | 8 | *North* 1 | | 40 | 5. 955957 |
| 23 | 2 | 24 | 14 | 47 | 0 | 4 | 35 | 5. 956153 |
| 24 | 2 | 25 | 21 | 23 | 0 | 7 | 29 | 5. 956355 |
| 25 | 2 | 26 | 27 | 55 | 0 | 10 | 23 | 5. 956566 |
| 26 | 2 | 27 | 34 | 24 | 0 | 13 | 16 | 5. 956784 |
| 27 | 2 | 28 | 40 | 47 | 0 | 16 | 9 | 5. 957009 |
| 28 | 2 | 29 | 47 | 7 | 0 | 19 | 2 | 5. 957241 |
| 29 | 3 | 0 | 53 | 23 | 0 | 21 | 54 | 5. 957481 |
| 30 | 3 | 1 | 59 | 34 | 0 | 24 | 45 | 5. 957728 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 7.

| Mid. Anom. | Long. ♄ à ☉ ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 3 | 1 | 59 | 34 | 0 | 24 | 54 | 5. 957728 |
| 1 | 3 | 3 | 5 | 40 | 0 | 27 | 36 | 5. 957982 |
| 2 | 3 | 4 | 11 | 42 | 0 | 30 | 25 | 5. 958242 |
| 3 | 3 | 5 | 17 | 40 | 0 | 33 | 14 | 5. 958509 |
| 4 | 3 | 6 | 23 | 32 | 0 | 36 | 2 | 5. 958782 |
| 5 | 3 | 7 | 29 | 19 | 0 | 38 | 49 | 5. 959062 |
| 6 | 3 | 8 | 35 | 0 | 0 | 41 | 35 | 5. 959349 |
| 7 | 3 | 9 | 40 | 37 | 0 | 44 | 19 | 5. 959642 |
| 8 | 3 | 10 | 46 | 9 | 0 | 47 | 3 | 5. 959950 |
| 9 | 3 | 11 | 51 | 35 | 0 | 49 | 45 | 5. 960245 |
| 10 | 3 | 12 | 56 | 57 | 0 | 52 | 26 | 5. 960555 |
| 11 | 3 | 14 | 2 | 11 | 0 | 55 | 6 | 5. 960871 |
| 12 | 3 | 15 | 7 | 20 | 0 | 57 | 44 | 5. 961193 |
| 13 | 3 | 16 | 12 | 24 | 1 | 0 | 20 | 5. 961520 |
| 14 | 3 | 17 | 17 | 21 | 1 | 2 | 55 | 5. 961853 |
| 15 | 3 | 18 | 22 | 12 | 1 | 5 | 29 | 5. 962191 |
| 16 | 3 | 19 | 26 | 58 | 1 | 8 | 1 | 5. 962534 |
| 17 | 3 | 20 | 31 | 37 | 1 | 10 | 31 | 5. 962882 |
| 18 | 3 | 21 | 39 | 10 | 1 | 13 | 0 | 5. 963234 |
| 19 | 3 | 22 | 40 | 37 | 1 | 15 | 26 | 5. 963592 |
| 20 | 3 | 23 | 44 | 56 | 1 | 17 | 51 | 5. 963954 |
| 21 | 3 | 24 | 49 | 10 | 1 | 20 | 14 | 5. 964329 |
| 22 | 3 | 25 | 53 | 17 | 1 | 22 | 35 | 5. 964691 |
| 23 | 3 | 26 | 57 | 18 | 1 | 24 | 54 | 5. 965065 |
| 24 | 3 | 28 | 1 | 11 | 1 | 27 | 11 | 5. 965443 |
| 25 | 3 | 29 | 4 | 59 | 1 | 29 | 26 | 5. 965825 |
| 26 | 4 | 0 | 8 | 40 | 1 | 31 | 39 | 5. 966211 |
| 27 | 4 | 1 | 12 | 13 | 1 | 33 | 50 | 5. 966600 |
| 28 | 4 | 2 | 15 | 39 | 1 | 35 | 58 | 5. 966993 |
| 29 | 4 | 3 | 19 | 0 | 1 | 38 | 5 | 5. 967389 |
| 30 | 4 | 4 | 22 | 12 | 1 | 40 | 9 | 5. 967789 |

## A Table of the Heliocentrick Place of *Saturn*.

*Sign.* 8.

| Mid. Anom. | Long. ♄ à ☉ ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 4 | 4 | 22 | 12 | 1 | 46 | 9 | 5. 967789 |
| 1 | 4 | 5 | 25 | 18 | 1 | 42 | 11 | 5. 968191 |
| 2 | 4 | 6 | 28 | 18 | 1 | 44 | 11 | 5. 968595 |
| 3 | 4 | 7 | 31 | 9 | 1 | 46 | 8 | 5. 969003 |
| 4 | 4 | 8 | 33 | 54 | 1 | 48 | 3 | 5. 969412 |
| 5 | 4 | 9 | 36 | 31 | 1 | 49 | 56 | 5. 969825 |
| 6 | 4 | 10 | 39 | 2 | 1 | 51 | 46 | 5. 970240 |
| 7 | 4 | 11 | 41 | 25 | 1 | 53 | 34 | 5. 970657 |
| 8 | 4 | 12 | 43 | 40 | 1 | 55 | 19 | 5. 971076 |
| 9 | 4 | 13 | 45 | 50 | 1 | 57 | 2 | 5. 971496 |
| 10 | 4 | 14 | 47 | 51 | 1 | 58 | 42 | 5. 971918 |
| 11 | 4 | 15 | 49 | 46 | 2 | 0 | 20 | 5. 972343 |
| 12 | 4 | 16 | 51 | 33 | 2 | 1 | 56 | 5. 972768 |
| 13 | 4 | 17 | 53 | 12 | 2 | 3 | 29 | 5. 973194 |
| 14 | 4 | 18 | 54 | 44 | 2 | 4 | 59 | 5. 973621 |
| 15 | 4 | 19 | 56 | 10 | 2 | 6 | 27 | 5. 974050 |
| 16 | 4 | 20 | 57 | 27 | 2 | 7 | 52 | 5. 974480 |
| 17 | 4 | 21 | 58 | 38 | 2 | 9 | 14 | 5. 974910 |
| 18 | 4 | 22 | 59 | 42 | 2 | 10 | 34 | 5. 975341 |
| 19 | 4 | 24 | 0 | 38 | 2 | 11 | 51 | 5. 975771 |
| 20 | 4 | 25 | 1 | 27 | 2 | 13 | 6 | 5. 976203 |
| 21 | 4 | 26 | 2 | 8 | 2 | 14 | 18 | 5. 976635 |
| 22 | 4 | 27 | 2 | 42 | 2 | 15 | 27 | 5. 977067 |
| 23 | 4 | 28 | 3 | 9 | 2 | 16 | 34 | 5. 977498 |
| 24 | 4 | 29 | 3 | 28 | 2 | 17 | 38 | 5. 977930 |
| 25 | 4 | 0 | 3 | 41 | 2 | 18 | 39 | 5. 978361 |
| 26 | 5 | 1 | 3 | 46 | 2 | 19 | 38 | 5. 978792 |
| 27 | 5 | 2 | 3 | 45 | 2 | 20 | 34 | 5. 979222 |
| 28 | 5 | 3 | 3 | 35 | 2 | 21 | 27 | 5. 979651 |
| 29 | 5 | 4 | 3 | 19 | 2 | 22 | 18 | 5. 980080 |
| 30 | 5 | 5 | 2 | 56 | 2 | 23 | 6 | 5. 980507 |

## A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | Sign. 9. Long. ♄ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 5 | 5 | 2 | 56 | 2 | 23 | 6 | 5. 980507 |
| 1 | 5 | 6 | 2 | 27 | 2 | 23 | 52 | 5. 980933 |
| 2 | 5 | 7 | 1 | 50 | 2 | 24 | 34 | 5. 981358 |
| 3 | 5 | 8 | 1 | 5 | 2 | 25 | 14 | 5. 981789 |
| 4 | 5 | 9 | 0 | 14 | 2 | 25 | 52 | 5. 982205 |
| 5 | 5 | 9 | 59 | 15 | 2 | 26 | 27 | 5. 982627 |
| 6 | 5 | 10 | 58 | 10 | 2 | 26 | 59 | 5. 983046 |
| 7 | 5 | 11 | 56 | 58 | 2 | 27 | 28 | 5. 983463 |
| 8 | 5 | 12 | 55 | 40 | 2 | 27 | 55 | 5. 983879 |
| 9 | 5 | 13 | 54 | 15 | 2 | 28 | 19 | 5. 984293 |
| 10 | 5 | 14 | 52 | 43 | 2 | 28 | 41 | 5. 984704 |
| 11 | 5 | 15 | 51 | 4 | 2 | 29 | 0 | 5. 985113 |
| 12 | 5 | 16 | 49 | 19 | 2 | 29 | 16 | 5. 985520 |
| 13 | 5 | 17 | 47 | 28 | 2 | 29 | 30 | 5. 985925 |
| 14 | 5 | 18 | 45 | 29 | 2 | 29 | 41 | 5. 986327 |
| 15 | 5 | 19 | 43 | 25 | 2 | 29 | 49 | 5. 986726 |
| 16 | 5 | 20 | 41 | 13 | 2 | 29 | 56 | 5. 987123 |
| 17 | 5 | 21 | 38 | 56 | 2 | 29 | 59 | 5. 987517 |
| 18 | 5 | 22 | 36 | 32 | 2 | 30 | 0 | 5. 987907 |
| 19 | 5 | 23 | 34 | 3 | 2 | 29 | 58 | 5. 988296 |
| 20 | 5 | 24 | 31 | 36 | 2 | 29 | 54 | 5. 988680 |
| 21 | 5 | 25 | 28 | 44 | 2 | 29 | 48 | 5. 989062 |
| 22 | 5 | 26 | 25 | 57 | 2 | 29 | 39 | 5. 989439 |
| 23 | 5 | 27 | 23 | 2 | 2 | 29 | 27 | 5. 989814 |
| 24 | 5 | 28 | 20 | 1 | 2 | 29 | 13 | 5. 990186 |
| 25 | 5 | 29 | 16 | 56 | 2 | 28 | 57 | 5. 990553 |
| 26 | 6 | 0 | 13 | 45 | 2 | 28 | 38 | 5. 990917 |
| 27 | 6 | 1 | 10 | 27 | 2 | 28 | 17 | 5. 991278 |
| 28 | 6 | 2 | 7 | 4 | 2 | 27 | 54 | 5. 991634 |
| 29 | 6 | 3 | 3 | 36 | 2 | 27 | 28 | 5. 991986 |
| 30 | 6 | 4 | 0 | 2 | 2 | 27 | 0 | 5. 992335 |

## A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | Sign. 10. Long. ♄ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 6 | 4 | 0 | 2 | 2 | 27 | 0 | 5. 992335 |
| 1 | 6 | 4 | 56 | 23 | 2 | 26 | 29 | 5. 992680 |
| 2 | 6 | 5 | 52 | 39 | 2 | 25 | 56 | 5. 993021 |
| 3 | 6 | 6 | 48 | 48 | 2 | 25 | 21 | 5. 993357 |
| 4 | 6 | 7 | 44 | 53 | 2 | 24 | 44 | 5. 993688 |
| 5 | 6 | 8 | 40 | 54 | 2 | 24 | 4 | 5. 994016 |
| 6 | 6 | 9 | 36 | 48 | 2 | 23 | 22 | 5. 994338 |
| 7 | 6 | 10 | 32 | 39 | 2 | 22 | 38 | 5. 994656 |
| 8 | 6 | 11 | 28 | 24 | 2 | 21 | 52 | 5. 994970 |
| 9 | 6 | 12 | 24 | 4 | 2 | 21 | 3 | 5. 945278 |
| 10 | 6 | 13 | 19 | 39 | 2 | 20 | 13 | 5. 995583 |
| 11 | 6 | 14 | 15 | 9 | 2 | 19 | 20 | 5. 995882 |
| 12 | 6 | 15 | 10 | 36 | 2 | 18 | 25 | 5. 996177 |
| 13 | 6 | 16 | 5 | 58 | 2 | 17 | 28 | 5. 996466 |
| 14 | 6 | 17 | 1 | 16 | 2 | 16 | 29 | 5. 996751 |
| 15 | 6 | 17 | 56 | 29 | 2 | 15 | 28 | 5. 997031 |
| 16 | 6 | 18 | 51 | 38 | 2 | 14 | 25 | 5. 997305 |
| 17 | 6 | 19 | 46 | 43 | 2 | 13 | 20 | 5. 997574 |
| 18 | 6 | 20 | 41 | 43 | 2 | 12 | 13 | 5. 997838 |
| 19 | 6 | 21 | 36 | 40 | 2 | 11 | 4 | 5. 998096 |
| 20 | 6 | 22 | 31 | 34 | 2 | 9 | 53 | 5. 998350 |
| 21 | 6 | 23 | 26 | 23 | 2 | 8 | 41 | 5. 998598. |
| 22 | 6 | 24 | 21 | 8 | 2 | 7 | 26 | 5. 998840 |
| 23 | 6 | 25 | 15 | 50 | 2 | 6 | 10 | 5. 999076 |
| 24 | 6 | 26 | 10 | 29 | 2 | 4 | 51 | 5. 999308 |
| 25 | 6 | 27 | 5 | 4 | 2 | 3 | 31 | 5. 999533 |
| 26 | 6 | 27 | 59 | 34 | 2 | 2 | 9 | 5. 999753 |
| 27 | 6 | 28 | 54 | 3 | 2 | 0 | 46 | 5. 999968 |
| 28 | 6 | 29 | 48 | 28 | 1 | 59 | 20 | 6. 000176 |
| 29 | 7 | 0 | 42 | 50 | 1 | 57 | 53 | 6. 000379 |
| 30 | 7 | 1 | 37 | 10 | 1 | 56 | 24 | 6. 000575 |

## A Table of the Heliocentrick Place of *Saturn*.

| Mid. Anom. | *Sign.* 11. Long. ♄ à 1 ✱ ♈ s | o | ′ | ″ | Inc. South. o | ′ | ″ | Dif. à ☉ Curt. Logarithm. | |
|---|---|---|---|---|---|---|---|---|---|
| o | 7 | 1 | 37 | 10 | 1 | 56 | 24 | 6. | 000575 |
| 1 | 7 | 2 | 31 | 26 | 1 | 54 | 54 | 6. | 000767 |
| 2 | 7 | 3 | 25 | 39 | 1 | 53 | 22 | 6. | 000951 |
| 3 | 7 | 4 | 19 | 50 | 1 | 51 | 48 | 6. | 001131 |
| 4 | 7 | 5 | 13 | 58 | 1 | 50 | 13 | 6. | 001304 |
| 5 | 7 | 6 | 8 | 4 | 1 | 48 | 36 | 6. | 001472 |
| 6 | 7 | 7 | 2 | 7 | 1 | 46 | 57 | 6. | 001632 |
| 7 | 7 | 7 | 56 | 7 | 1 | 45 | 17 | 6. | 001787 |
| 8 | 7 | 8 | 50 | 6 | 1 | 43 | 36 | 6. | 001936 |
| 9 | 7 | 9 | 44 | 3 | 1 | 41 | 53 | 6. | 002079 |
| 10 | 7 | 10 | 37 | 57 | 1 | 40 | 9 | 6. | 002216 |
| 11 | 7 | 11 | 31 | 49 | 1 | 38 | 23 | 6. | 002345 |
| 12 | 7 | 12 | 25 | 40 | 1 | 36 | 36 | 6. | 002470 |
| 13 | 7 | 13 | 19 | 28 | 1 | 34 | 47 | 6. | 002588 |
| 14 | 7 | 14 | 13 | 14 | 1 | 32 | 58 | 6. | 002698 |
| 15 | 7 | 15 | 7 | 0 | 1 | 31 | 7 | 6. | 002803 |
| 16 | 7 | 16 | 0 | 44 | 1 | 29 | 14 | 6. | 002902 |
| 17 | 7 | 16 | 54 | 26 | 1 | 27 | 20 | 6. | 002994 |
| 18 | 7 | 17 | 48 | 8 | 1 | 25 | 25 | 6. | 003081 |
| 19 | 7 | 18 | 41 | 48 | 1 | 23 | 29 | 6. | 003160 |
| 20 | 7 | 19 | 35 | 27 | 1 | 21 | 34 | 6. | 003234 |
| 21 | 7 | 20 | 29 | 4 | 1 | 19 | 34 | 6. | 003301 |
| 22 | 7 | 21 | 22 | 41 | 1 | 17 | 34 | 6. | 003360 |
| 23 | 7 | 22 | 16 | 17 | 1 | 15 | 33 | 6. | 003414 |
| 24 | 7 | 23 | 9 | 52 | 1 | 13 | 31 | 6. | 003462 |
| 25 | 7 | 24 | 3 | 26 | 1 | 11 | 29 | 6. | 003502 |
| 26 | 7 | 24 | 57 | 0 | 1 | 9 | 25 | 6. | 003536 |
| 27 | 7 | 25 | 50 | 33 | 1 | 7 | 20 | 6. | 003565 |
| 28 | 7 | 26 | 44 | 7 | 1 | 5 | 14 | 6. | 003585 |
| 29 | 7 | 27 | 37 | 40 | 1 | 3 | 7 | 6. | 003600 |
| 30 | 7 | 28 | 31 | 13 | 1 | 1 | 0 | 6. | 003608 |



## A Table of the mean Motion of *Jupiter* from the *Aphelion*.



| Years from Chriſt | Anomaly ♃ s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 0 | 13 | 54 | 30 |
| 1501 | 5 | 28 | 17 | 0 |
| 1581 | 2 | 26 | 15 | 0 |
| 1601 | 11 | 3 | 14 | 30 |
| 1621 | 7 | 10 | 14 | 0 |
| 1641 | 3 | 17 | 13 | 30 |
| 1661 | 11 | 24 | 13 | 0 |
| 1681 | 8 | 1 | 12 | 30 |
| 1701 | 4 | 8 | 12 | 0 |
| 1721 | 0 | 15 | 11 | 30 |
| 1741 | 8 | 22 | 11 | 0 |
| 1761 | 4 | 29 | 10 | 30 |
| 1781 | 1 | 6 | 10 | 0 |
| 1801 | 9 | 13 | 9 | 30 |
| 1901 | 2 | 13 | 7 | 0 |
| 2001 | 7 | 23 | 4 | 30 |

| Years | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 20 | 8 | 6 | 59 | 30 |
| 40 | 4 | 13 | 59 | 0 |
| 60 | 0 | 20 | 58 | 30 |
| 80 | 8 | 27 | 58 | 0 |
| 100 | 5 | 4 | 57 | 30 |
| 200 | 10 | 9 | 55 | 0 |
| 300 | 3 | 14 | 52 | 30 |
| 400 | 8 | 19 | 50 | 0 |
| 500 | 1 | 24 | 47 | 30 |
| 600 | 6 | 29 | 45 | 0 |
| 700 | 0 | 4 | 42 | 30 |
| 800 | 5 | 9 | 40 | 0 |
| 900 | 10 | 14 | 37 | 30 |
| 1000 | 3 | 19 | 55 | 0 |
| 2000 | 7 | 9 | 10 | 0 |
| 3000 | 10 | 28 | 45 | 0 |
| 4000 | 2 | 18 | 20 | 0 |
| 5000 | 6 | 7 | 55 | 0 |
| 6000 | 9 | 27 | 30 | 0 |

| Years. | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 1 | 0 | 19 | 44 |
| 2 | 2 | 0 | 39 | 27 |
| 3 | 3 | 0 | 59 | 11 |
| 4 | 4 | 1 | 23 | 54 |
| 5 | 5 | 1 | 43 | 38 |
| 6 | 6 | 2 | 3 | 21 |
| 7 | 7 | 2 | 23 | 5 |
| 8 | 8 | 2 | 47 | 48 |
| 9 | 9 | 3 | 7 | 52 |
| 10 | 10 | 3 | 27 | 15 |
| 11 | 11 | 3 | 46 | 59 |
| 12 | 0 | 4 | 11 | 42 |
| 13 | 1 | 4 | 31 | 26 |
| 14 | 2 | 4 | 51 | 9 |
| 15 | 3 | 5 | 10 | 53 |
| 16 | 4 | 5 | 35 | 36 |
| 17 | 5 | 5 | 55 | 20 |
| 18 | 6 | 6 | 15 | 3 |
| 19 | 7 | 6 | 34 | 47 |
| 20 | 8 | 6 | 59 | 30 |

| Months | Anom. Mot. o | ′ | ″ |
|---|---|---|---|
| *January* | 0 | 0 | 0 |
| *February* | 2 | 34 | 33 |
| *March* | 4 | 54 | 9 |
| *April* | 7 | 28 | 42 |
| *May* | 9 | 58 | 16 |
| *June* | 12 | 32 | 49 |
| *July* | 15 | 2 | 23 |
| *Auguſt* | 17 | 36 | 56 |
| *September* | 20 | 11 | 29 |
| *October* | 22 | 41 | 3 |
| *November* | 25 | 15 | 37 |
| *December* | 27 | 45 | 11 |

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

## A Table of the mean Motion of *Jupiter* from the *Aphelion*.

| Days | Anom. Mot. ° ′ ″ | | H. | Anom. Mot. ′ ″ ‴ | | H. | Anom. Mot. ′ ″ ‴ |
|---|---|---|---|---|---|---|---|
| 1 | 0 4 59 | | 1 | 0 12 | | 31 | 6 26 |
| 2 | 0 9 58 | | 2 | 0 25 | | 32 | 6 39 |
| 3 | 0 14 57 | | 3 | 0 37 | | 33 | 6 51 |
| 4 | 0 19 57 | | 4 | 0 50 | | 34 | 7 4 |
| 5 | 0 24 56 | | 5 | 1 2 | | 35 | 7 16 |
| 6 | 0 29 55 | | 6 | 1 15 | | 36 | 7 29 |
| 7 | 0 34 54 | | 7 | 1 27 | | 37 | 7 41 |
| 8 | 0 39 53 | | 8 | 1 40 | | 38 | 7 44 |
| 9 | 0 44 52 | | 9 | 1 52 | | 39 | 8 6 |
| 10 | 0 49 51 | | 10 | 2 5 | | 40 | 8 19 |
| 11 | 0 54 50 | | 11 | 2 17 | | 41 | 8 31 |
| 12 | 0 49 50 | | 12 | 2 30 | | 42 | 8 43 |
| 13 | 1 4 49 | | 13 | 2 42 | | 43 | 8 56 |
| 14 | 1 9 48 | | 14 | 2 54 | | 44 | 8 8 |
| 15 | 1 14 47 | | 15 | 3 7 | | 45 | 9 21 |
| 16 | 1 19 46 | | 16 | 3 19 | | 46 | 9 33 |
| 17 | 1 24 45 | | 17 | 3 32 | | 47 | 9 46 |
| 18 | 1 29 44 | | 18 | 3 44 | | 48 | 9 58 |
| 19 | 1 34 44 | | 19 | 3 57 | | 49 | 10 11 |
| 20 | 1 39 43 | | 20 | 4 9 | | 50 | 10 23 |
| 21 | 1 44 42 | | 21 | 4 22 | | 51 | 10 36 |
| 22 | 1 49 41 | | 22 | 4 34 | | 52 | 10 48 |
| 23 | 1 54 40 | | 23 | 4 47 | | 53 | 11 1 |
| 24 | 1 59 39 | | 24 | 4 59 | | 54 | 11 13 |
| 25 | 2 4 38 | | 25 | 5 12 | | 55 | 11 26 |
| 26 | 2 9 37 | | 26 | 5 24 | | 56 | 11 38 |
| 27 | 2 14 37 | | 27 | 5 35 | | 57 | 11 50 |
| 28 | 2 19 36 | | 28 | 5 49 | | 58 | 11 3 |
| 29 | 2 24 35 | | 29 | 6 1 | | 59 | 12 15 |
| 30 | 2 29 34 | | 30 | 6 14 | | 60 | 12 28 |
| 31 | 2 34 33 | | | | | | |
| 32 | 2 39 32 | | | | | | |

| | ♄ | ° | ′ | ″ |
|---|---|---|---|---|
| Long. Aph. ♃ à ☊ ✶ ♈ | 5 | 9 | 50 | 0 |
| Long. ☊ ♃ à ☊ ✶ ♈ | 2 | 8 | 00 | 0 |
| Inclin. Orb. ♃ | | 1 | 20 | 0 |
| Dist. Mid. ♃ à ☉ | | 5 | 20 | 10 |
| Eccentricity | | 2 | 50 | 50 |

## A Table of the Heliocentrick Place of *Jupiter*. 36

| Mid. Anom. | Sign. ♋ Long. ♃ à ☊ ✶ ♈ ♄ | ° | ′ | ″ | Inc. North. ° | ′ | ″ | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 9 | 50 | 9 | 1 | 19 | 58 | 5. 736406 |
| 1 | 5 | 10 | 44 | 36 | 1 | 19 | 55 | 5. 736403 |
| 2 | 5 | 11 | 39 | 10 | 1 | 19 | 51 | 5. 736395 |
| 3 | 5 | 12 | 33 | 44 | 1 | 19 | 45 | 5. 736381 |
| 4 | 5 | 13 | 28 | 18 | 1 | 19 | 38 | 5. 736362 |
| 5 | 5 | 14 | 22 | 53 | 1 | 19 | 30 | 5. 736338 |
| 6 | 5 | 15 | 17 | 28 | 1 | 19 | 21 | 5. 736308 |
| 7 | 5 | 16 | 12 | 4 | 1 | 19 | 11 | 5. 736273 |
| 8 | 5 | 17 | 6 | 40 | 1 | 18 | 59 | 5. 736231 |
| 9 | 5 | 18 | 1 | 17 | 1 | 18 | 47 | 5. 736185 |
| 10 | 5 | 18 | 55 | 55 | 1 | 18 | 33 | 5. 736134 |
| 11 | 5 | 19 | 50 | 32 | 1 | 18 | 18 | 5. 736076 |
| 12 | 5 | 20 | 45 | 11 | 1 | 18 | 2 | 5. 736014 |
| 13 | 5 | 21 | 39 | 52 | 1 | 17 | 44 | 5. 735947 |
| 14 | 5 | 22 | 34 | 33 | 1 | 17 | 26 | 5. 735873 |
| 15 | 5 | 23 | 29 | 15 | 1 | 17 | 6 | 5. 735795 |
| 16 | 5 | 24 | 23 | 59 | 1 | 16 | 45 | 5. 735710 |
| 17 | 5 | 25 | 18 | 44 | 1 | 16 | 23 | 5. 735621 |
| 18 | 5 | 26 | 13 | 30 | 1 | 15 | 59 | 5. 735526 |
| 19 | 5 | 27 | 8 | 18 | 1 | 15 | 35 | 5. 735426 |
| 20 | 5 | 28 | 3 | 8 | 1 | 15 | 9 | 5. 735321 |
| 21 | 5 | 28 | 57 | 59 | 1 | 14 | 42 | 5. 735210 |
| 22 | 5 | 29 | 52 | 52 | 1 | 14 | 14 | 5. 735094 |
| 23 | 6 | 0 | 47 | 46 | 1 | 13 | 45 | 5. 734973 |
| 24 | 6 | 1 | 42 | 43 | 1 | 13 | 15 | 5. 734846 |
| 25 | 6 | 2 | 37 | 40 | 1 | 11 | 44 | 5. 734714 |
| 26 | 6 | 3 | 32 | 41 | 1 | 12 | 11 | 5. 734577 |
| 27 | 6 | 4 | 27 | 43 | 1 | 11 | 37 | 5. 734436 |
| 28 | 6 | 5 | 42 | 47 | 1 | 11 | 2 | 5. 734289 |
| 29 | 6 | 6 | 17 | 55 | 1 | 10 | 27 | 5. 734137 |
| 30 | 6 | 7 | 13 | 4 | 1 | 9 | 50 | 5. 733980 |

## A Table of the Heliocentrick Place of *Jupiter*.

*Sign.* 1.

| Mid. Anom. | Long. ♈ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 6 | 7 | 13 | 4 | 1 | 9 | 50 | 5. 733980 |
| 1 | 6 | 8 | 8 | 15 | 1 | 9 | 11 | 5. 733818 |
| 2 | 6 | 9 | 3 | 30 | 1 | 8 | 32 | 5. 733652 |
| 3 | 6 | 9 | 58 | 46 | 1 | 7 | 52 | 5. 733479 |
| 4 | 6 | 10 | 54 | 5 | 1 | 7 | 10 | 5. 733302 |
| 5 | 6 | 11 | 49 | 28 | 1 | 6 | 28 | 5. 733120 |
| 6 | 6 | 12 | 44 | 53 | 1 | 5 | 44 | 5. 732934 |
| 7 | 6 | 13 | 40 | 20 | 1 | 5 | 0 | 5. 732741 |
| 8 | 6 | 14 | 35 | 52 | 1 | 4 | 14 | 5. 732545 |
| 9 | 6 | 15 | 31 | 26 | 1 | 3 | 27 | 5. 732344 |
| 10 | 6 | 16 | 27 | 3 | 1 | 2 | 39 | 5. 732139 |
| 11 | 6 | 17 | 22 | 43 | 1 | 1 | 51 | 5. 731928 |
| 12 | 6 | 18 | 18 | 26 | 1 | 1 | 1 | 5. 731713 |
| 13 | 6 | 19 | 14 | 14 | 1 | 0 | 10 | 5. 731492 |
| 14 | 6 | 20 | 10 | 4 | 0 | 59 | 18 | 5. 731268 |
| 15 | 6 | 21 | 5 | 58 | 0 | 58 | 25 | 5. 731039 |
| 16 | 6 | 22 | 1 | 55 | 0 | 57 | 31 | 5. 730807 |
| 17 | 6 | 22 | 57 | 56 | 0 | 56 | 36 | 5. 730570 |
| 18 | 6 | 23 | 54 | 1 | 0 | 55 | 41 | 5. 730327 |
| 19 | 6 | 24 | 50 | 9 | 0 | 54 | 44 | 5. 730081 |
| 20 | 6 | 25 | 46 | 22 | 0 | 53 | 46 | 5. 729831 |
| 21 | 6 | 26 | 42 | 38 | 0 | 52 | 48 | 5. 729576 |
| 22 | 6 | 27 | 38 | 57 | 0 | 51 | 48 | 5. 729318 |
| 23 | 6 | 28 | 35 | 21 | 0 | 50 | 48 | 5. 729055 |
| 24 | 6 | 29 | 31 | 50 | 0 | 49 | 46 | 5. 728788 |
| 25 | 7 | 0 | 28 | 23 | 0 | 48 | 44 | 5. 728517 |
| 26 | 7 | 1 | 25 | 0 | 0 | 47 | 41 | 5. 728243 |
| 27 | 7 | 2 | 21 | 41 | 0 | 46 | 37 | 5. 727965 |
| 28 | 7 | 3 | 18 | 26 | 0 | 45 | 32 | 5. 727683 |
| 29 | 7 | 4 | 15 | 17 | 0 | 44 | 27 | 5. 727397 |
| 30 | 7 | 5 | 12 | 10 | 0 | 43 | 20 | 5. 727106 |

## A Table of the Heliocentrick Place of *Jupiter*.

*Sign.* 2.

| Mid. Anom. | Long. ♈ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 7 | 5 | 12 | 10 | 0 | 43 | 20 | 5. 727106 |
| 1 | 7 | 6 | 9 | 10 | 0 | 42 | 13 | 5. 726813 |
| 2 | 7 | 7 | 6 | 14 | 0 | 41 | 5 | 5. 726517 |
| 3 | 7 | 8 | 3 | 22 | 0 | 39 | 56 | 5. 726216 |
| 4 | 7 | 9 | 0 | 36 | 0 | 38 | 47 | 5. 725912 |
| 5 | 7 | 9 | 57 | 54 | 0 | 37 | 36 | 5. 725607 |
| 6 | 7 | 10 | 55 | 16 | 0 | 36 | 25 | 5. 725297 |
| 7 | 7 | 11 | 52 | 45 | 0 | 35 | 14 | 5. 724983 |
| 8 | 7 | 12 | 50 | 17 | 0 | 34 | 1 | 5. 724667 |
| 9 | 7 | 13 | 47 | 56 | 0 | 32 | 48 | 5. 724348 |
| 10 | 7 | 14 | 45 | 39 | 0 | 31 | 34 | 5. 724026 |
| 11 | 7 | 15 | 43 | 28 | 0 | 30 | 20 | 5. 723700 |
| 12 | 7 | 16 | 41 | 21 | 0 | 29 | 5 | 5. 723372 |
| 13 | 7 | 17 | 39 | 19 | 0 | 27 | 49 | 5. 723043 |
| 14 | 7 | 18 | 37 | 23 | 0 | 26 | 33 | 5. 722709 |
| 15 | 7 | 19 | 35 | 32 | 0 | 25 | 16 | 5. 722373 |
| 16 | 7 | 20 | 33 | 48 | 0 | 23 | 59 | 5. 722035 |
| 17 | 7 | 21 | 32 | 8 | 0 | 22 | 41 | 5. 721696 |
| 18 | 7 | 22 | 30 | 34 | 0 | 21 | 22 | 5. 721354 |
| 19 | 7 | 23 | 29 | 6 | 0 | 20 | 3 | 5. 721009 |
| 20 | 7 | 24 | 27 | 43 | 0 | 18 | 44 | 5. 720662 |
| 21 | 7 | 25 | 26 | 26 | 0 | 17 | 24 | 5. 720312 |
| 22 | 7 | 26 | 25 | 14 | 0 | 16 | 4 | 5. 719962 |
| 23 | 7 | 27 | 24 | 9 | 0 | 14 | 43 | 5. 719610 |
| 24 | 7 | 28 | 23 | 9 | 0 | 13 | 22 | 5. 719256 |
| 25 | 7 | 29 | 22 | 14 | 0 | 12 | 0 | 5. 718900 |
| 26 | 8 | 0 | 21 | 26 | 0 | 10 | 39 | 5. 718543 |
| 27 | 8 | 1 | 20 | 43 | 0 | 9 | 16 | 5. 718184 |
| 28 | 8 | 2 | 20 | 7 | 0 | 7 | 54 | 5. 717825 |
| 29 | 8 | 3 | 19 | 36 | 0 | 6 | 31 | 5. 717463 |
| 30 | 8 | 4 | 19 | 11 | 0 | 5 | 8 | 5. 717101 |

## A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 3. Long. ♑ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 8 | 4 | 19 | 11 | 0 | 5 | 8 | 5. 717101 |
| 1 | 8 | 5 | 18 | 52 | 0 | 3 | 45 | 5. 716738 |
| 2 | 8 | 6 | 18 | 39 | 0 | 2 | 22 | 5. 716374 |
| 3 | 8 | 7 | 18 | 32 | 0 | 0 | 58 | 5. 716009 |
| 4 | 8 | 8 | 18 | 32 | Sou. 0 | | 26 | 5. 715644 |
| 5 | 8 | 9 | 18 | 37 | 0 | 1 | 50 | 5. 715278 |
| 6 | 8 | 10 | 18 | 49 | 0 | 3 | 14 | 5. 714911 |
| 7 | 8 | 11 | 19 | 6 | 0 | 4 | 38 | 5. 714545 |
| 8 | 8 | 12 | 19 | 30 | 0 | 6 | 2 | 5. 714177 |
| 9 | 8 | 13 | 20 | 0 | 0 | 7 | 26 | 5. 713809 |
| 10 | 8 | 14 | 20 | 36 | 0 | 8 | 50 | 5. 713443 |
| 11 | 8 | 15 | 21 | 18 | 0 | 10 | 15 | 5. 713076 |
| 12 | 8 | 16 | 22 | 6 | 0 | 11 | 39 | 5. 712710 |
| 13 | 8 | 17 | 23 | 1 | 0 | 13 | 3 | 5. 712342 |
| 14 | 8 | 18 | 24 | 2 | 0 | 14 | 27 | 5. 711976 |
| 15 | 8 | 19 | 25 | 9 | 0 | 15 | 50 | 5. 711611 |
| 16 | 8 | 20 | 26 | 22 | 0 | 17 | 14 | 5. 711248 |
| 17 | 8 | 21 | 27 | 41 | 0 | 18 | 38 | 5. 710884 |
| 18 | 8 | 22 | 29 | 6 | 0 | 20 | 1 | 5. 710521 |
| 19 | 8 | 23 | 30 | 38 | 0 | 21 | 24 | 5. 710159 |
| 20 | 8 | 24 | 32 | 15 | 0 | 22 | 47 | 5. 709798 |
| 21 | 8 | 25 | 34 | 0 | 0 | 24 | 9 | 5. 709439 |
| 22 | 8 | 26 | 35 | 50 | 0 | 25 | 31 | 5. 709081 |
| 23 | 8 | 27 | 37 | 46 | 0 | 26 | 53 | 5. 708725 |
| 24 | 8 | 28 | 39 | 48 | 0 | 28 | 14 | 5. 708371 |
| 25 | 8 | 29 | 41 | 56 | 0 | 29 | 35 | 5. 708018 |
| 26 | 9 | 0 | 44 | 11 | 0 | 30 | 55 | 5. 707667 |
| 27 | 9 | 1 | 46 | 31 | 0 | 32 | 15 | 5. 707319 |
| 28 | 9 | 2 | 48 | 58 | 0 | 33 | 35 | 5. 706972 |
| 29 | 9 | 3 | 51 | 30 | 0 | 34 | 54 | 5. 706629 |
| 30 | 9 | 4 | 54 | 9 | 0 | 36 | 12 | 5. 706287 |

## A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 4. Long. ♑ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 9 | 4 | 54 | 9 | 0 | 36 | 12 | 5. 706287 |
| 1 | 9 | 5 | 56 | 53 | 0 | 37 | 30 | 5. 705948 |
| 2 | 9 | 6 | 59 | 43 | 0 | 38 | 47 | 5. 705611 |
| 3 | 9 | 8 | 2 | 39 | 0 | 40 | 4 | 5. 705278 |
| 4 | 9 | 9 | 5 | 40 | 0 | 41 | 19 | 5. 704948 |
| 5 | 9 | 10 | 8 | 48 | 0 | 42 | 34 | 5. 704620 |
| 6 | 9 | 11 | 12 | 1 | 0 | 43 | 49 | 5. 704296 |
| 7 | 9 | 12 | 15 | 19 | 0 | 45 | 2 | 5. 703975 |
| 8 | 9 | 13 | 18 | 44 | 0 | 46 | 15 | 5. 703658 |
| 9 | 9 | 14 | 22 | 14 | 0 | 47 | 27 | 5. 703344 |
| 10 | 9 | 15 | 25 | 49 | 0 | 48 | 38 | 5. 703034 |
| 11 | 9 | 16 | 29 | 30 | 0 | 49 | 48 | 5. 702727 |
| 12 | 9 | 17 | 33 | 16 | 0 | 50 | 57 | 5. 702424 |
| 13 | 9 | 18 | 37 | 7 | 0 | 52 | 5 | 5. 702126 |
| 14 | 9 | 19 | 41 | 4 | 0 | 53 | 12 | 5. 701832 |
| 15 | 9 | 20 | 45 | 6 | 0 | 54 | 19 | 5. 701542 |
| 16 | 9 | 21 | 49 | 13 | 0 | 55 | 24 | 5. 701257 |
| 17 | 9 | 22 | 53 | 24 | 0 | 56 | 28 | 5. 700974 |
| 18 | 9 | 23 | 57 | 41 | 0 | 57 | 31 | 5. 700698 |
| 19 | 9 | 25 | 2 | 3 | 0 | 58 | 33 | 5. 700427 |
| 20 | 9 | 26 | 6 | 29 | 0 | 59 | 33 | 5. 700160 |
| 21 | 9 | 27 | 11 | 1 | 1 | 0 | 33 | 5. 699899 |
| 22 | 9 | 28 | 15 | 37 | 1 | 1 | 31 | 5. 699642 |
| 23 | 9 | 29 | 20 | 17 | 1 | 2 | 28 | 5. 699391 |
| 24 | 10 | 0 | 25 | 2 | 1 | 3 | 24 | 5. 699145 |
| 25 | 10 | 1 | 29 | 52 | 1 | 4 | 19 | 5. 698904 |
| 26 | 10 | 2 | 34 | 45 | 1 | 5 | 12 | 5. 698669 |
| 27 | 10 | 3 | 39 | 41 | 1 | 6 | 4 | 5. 698440 |
| 28 | 10 | 4 | 44 | 44 | 1 | 6 | 54 | 5. 698216 |
| 29 | 10 | 5 | 49 | 49 | 1 | 7 | 43 | 5. 697999 |
| 30 | 10 | 6 | 54 | 58 | 1 | 8 | 31 | 5. 697786 |

A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 5. Long. ♈ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 10 | 6 | 54 | 58 | 1 | 8 | 31 | 5. 697786 |
| 0 | 10 | 8 | 0 | 12 | 1 | 9 | 17 | 5. 697580 |
| 1 | 10 | 9 | 5 | 28 | 1 | 10 | 2 | 5. 697380 |
| 2 | 10 | 10 | 10 | 49 | 1 | 10 | 45 | 5. 697186 |
| 3 | 10 | 11 | 16 | 13 | 1 | 11 | 27 | 5. 696998 |
| 4 | 10 | 12 | 21 | 39 | 1 | 12 | 8 | 5. 696817 |
| 5 | 10 | 13 | 27 | 10 | 1 | 12 | 46 | 5. 696643 |
| 6 | 10 | 14 | 32 | 44 | 1 | 13 | 24 | 5. 696474 |
| 7 | 10 | 15 | 38 | 19 | 1 | 13 | 59 | 5. 696313 |
| 8 | 10 | 16 | 43 | 59 | 1 | 14 | 33 | 5. 696159 |
| 9 | 10 | 17 | 49 | 41 | 1 | 15 | 6 | 5. 696010 |
| 10 | 10 | 18 | 55 | 26 | 1 | 15 | 36 | 5. 695869 |
| 11 | 10 | 20 | 1 | 13 | 1 | 16 | 6 | 5. 695734 |
| 12 | 10 | 21 | 7 | 2 | 1 | 16 | 33 | 5. 695606 |
| 13 | 10 | 22 | 12 | 53 | 1 | 16 | 59 | 5. 695486 |
| 14 | 10 | 23 | 18 | 47 | 1 | 17 | 23 | 5. 695372 |
| 15 | 10 | 24 | 24 | 43 | 1 | 17 | 46 | 5. 695266 |
| 16 | 10 | 25 | 30 | 41 | 1 | 18 | 6 | 5. 695167 |
| 17 | 10 | 26 | 36 | 41 | 1 | 18 | 26 | 5. 695074 |
| 18 | 10 | 27 | 42 | 42 | 1 | 18 | 43 | 5. 694989 |
| 19 | 10 | 28 | 48 | 44 | 1 | 18 | 58 | 5. 694911 |
| 20 | 10 | 29 | 54 | 48 | 1 | 19 | 12 | 5. 694842 |
| 21 | 11 | 1 | 0 | 53 | 1 | 19 | 24 | 5. 694779 |
| 22 | 11 | 2 | 6 | 59 | 1 | 19 | 35 | 5. 694723 |
| 23 | 11 | 3 | 13 | 6 | 1 | 19 | 43 | 5. 694675 |
| 24 | 11 | 4 | 19 | 14 | 1 | 19 | 50 | 5. 694634 |
| 25 | 11 | 5 | 25 | 23 | 1 | 19 | 55 | 5. 694601 |
| 26 | 11 | 6 | 31 | 33 | 1 | 19 | 58 | 5. 694575 |
| 27 | 11 | 7 | 37 | 42 | 1 | 20 | 0 | 5. 694555 |
| 28 | 11 | 8 | 43 | 52 | 1 | 20 | 0 | 5. 694544 |
| 29 | 11 | 9 | 50 | 2 | 1 | 19 | 58 | 5. 694540 |

A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 6. Long. ♈ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 11 | 9 | 50 | 2 | 1 | 19 | 58 | 5. 694540 |
| 0 | 11 | 10 | 56 | 12 | 1 | 19 | 54 | 5. 694545 |
| 1 | 11 | 12 | 2 | 22 | 1 | 19 | 48 | 5. 694556 |
| 2 | 11 | 13 | 8 | 31 | 1 | 19 | 41 | 5. 694576 |
| 3 | 11 | 14 | 14 | 40 | 1 | 19 | 32 | 5. 694602 |
| 4 | 11 | 15 | 20 | 49 | 1 | 19 | 21 | 5. 694635 |
| 5 | 11 | 16 | 26 | 57 | 1 | 19 | 8 | 5. 694677 |
| 6 | 11 | 17 | 33 | 4 | 1 | 18 | 53 | 5. 694725 |
| 7 | 11 | 18 | 39 | 10 | 1 | 18 | 37 | 5. 694781 |
| 8 | 11 | 19 | 45 | 15 | 1 | 18 | 19 | 5. 694844 |
| 9 | 11 | 20 | 51 | 19 | 1 | 18 | 0 | 5. 694914 |
| 10 | 11 | 21 | 57 | 21 | 1 | 17 | 38 | 5. 694992 |
| 11 | 11 | 23 | 3 | 22 | 1 | 17 | 15 | 5. 695077 |
| 12 | 11 | 24 | 9 | 22 | 1 | 16 | 51 | 5. 695171 |
| 13 | 11 | 25 | 15 | 20 | 1 | 16 | 24 | 5. 695270 |
| 14 | 11 | 26 | 21 | 15 | 1 | 15 | 56 | 5. 695376 |
| 15 | 11 | 27 | 27 | 9 | 1 | 15 | 26 | 5. 695490 |
| 16 | 11 | 28 | 33 | 0 | 1 | 14 | 55 | 5. 695611 |
| 17 | 11 | 29 | 38 | 50 | 1 | 14 | 22 | 5. 695738 |
| 18 | 0 | 0 | 44 | 37 | 1 | 13 | 47 | 5. 695874 |
| 19 | 0 | 1 | 50 | 22 | 1 | 13 | 11 | 5. 696016 |
| 20 | 0 | 2 | 56 | 3 | 1 | 12 | 33 | 5. 696164 |
| 21 | 0 | 4 | 1 | 43 | 1 | 11 | 53 | 5. 696319 |
| 22 | 0 | 5 | 7 | 18 | 1 | 11 | 12 | 5. 696481 |
| 23 | 0 | 6 | 12 | 52 | 1 | 10 | 30 | 5. 696649 |
| 24 | 0 | 7 | 18 | 23 | 1 | 9 | 46 | 5. 6.6824 |
| 25 | 0 | 8 | 23 | 49 | 1 | 9 | 0 | 5. 697005 |
| 26 | 0 | 9 | 29 | 13 | 1 | 8 | 14 | 5. 697192 |
| 27 | 0 | 10 | 34 | 33 | 1 | 7 | 25 | 5. 697386 |
| 28 | 0 | 11 | 39 | 50 | 1 | 6 | 35 | 5. 697587 |
| 29 | 0 | 12 | 45 | 3 | 1 | 5 | 44 | 5. 697793 |

## A Table of the Heliocentrick Place of *Jupiter*.

*Sign.* 7.

| Mid. Anom. | Long. ♈ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 0 | 12 | 45 | 3 | 1 | 5 | 44 | 5. 697793 |
| 1 | 0 | 13 | 50 | 12 | 1 | 4 | 52 | 5. 698006 |
| 2 | 0 | 14 | 55 | 18 | 1 | 3 | 58 | 5. 698223 |
| 3 | 0 | 16 | 0 | 20 | 1 | 3 | 2 | 5. 698447 |
| 4 | 0 | 17 | 5 | 16 | 1 | 2 | 6 | 5. 698676 |
| 5 | 0 | 18 | 10 | 9 | 1 | 1 | 8 | 5. 698911 |
| 6 | 0 | 19 | 14 | 59 | 1 | 0 | 9 | 5. 699153 |
| 7 | 0 | 20 | 19 | 44 | 0 | 59 | 9 | 5. 699399 |
| 8 | 0 | 21 | 24 | 24 | 0 | 58 | 7 | 5. 699650 |
| 9 | 0 | 22 | 28 | 59 | 0 | 57 | 5 | 5. 699906 |
| 10 | 0 | 23 | 33 | 31 | 0 | 56 | 1 | 5. 700167 |
| 11 | 0 | 24 | 37 | 57 | 0 | 54 | 56 | 5. 700435 |
| 12 | 0 | 25 | 42 | 19 | 0 | 53 | 50 | 5. 700706 |
| 13 | 0 | 26 | 46 | 36 | 0 | 52 | 44 | 5. 700982 |
| 14 | 0 | 27 | 50 | 46 | 0 | 51 | 36 | 5. 701264 |
| 15 | 0 | 28 | 54 | 53 | 0 | 50 | 27 | 5. 701549 |
| 16 | 0 | 29 | 38 | 55 | 0 | 49 | 17 | 5. 701839 |
| 17 | 1 | 1 | 2 | 52 | 0 | 48 | 6 | 5. 702133 |
| 18 | 1 | 2 | 6 | 43 | 0 | 46 | 54 | 5. 702432 |
| 19 | 1 | 3 | 10 | 29 | 0 | 45 | 41 | 5. 702735 |
| 20 | 1 | 4 | 14 | 10 | 0 | 44 | 28 | 5. 703041 |
| 21 | 1 | 5 | 17 | 45 | 0 | 43 | 14 | 5. 703351 |
| 22 | 1 | 6 | 21 | 15 | 0 | 41 | 59 | 5. 703665 |
| 23 | 1 | 7 | 24 | 40 | 0 | 40 | 43 | 5. 703982 |
| 24 | 1 | 8 | 27 | 58 | 0 | 39 | 26 | 5. 704302 |
| 25 | 1 | 9 | 31 | 10 | 0 | 38 | 9 | 5. 704626 |
| 26 | 1 | 10 | 34 | 17 | 0 | 36 | 51 | 5. 704954 |
| 27 | 1 | 11 | 37 | 19 | 0 | 35 | 33 | 5. 705284 |
| 28 | 1 | 12 | 40 | 14 | 0 | 34 | 14 | 5. 705617 |
| 29 | 1 | 13 | 43 | 5 | 0 | 32 | 54 | 5. 705954 |
| 30 | 1 | 14 | 45 | 49 | 0 | 31 | 34 | 5. 706293 |

## A Table of the Heliocentrick Place of *Jupiter*.

*Sign.* 8.

| Mid. Anom. | Long. ♈ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 1 | 14 | 45 | 49 | 0 | 31 | 34 | 5. 706293 |
| 1 | 1 | 15 | 48 | 28 | 0 | 30 | 13 | 5. 706634 |
| 2 | 1 | 16 | 51 | 0 | 0 | 28 | 52 | 5. 706978 |
| 3 | 1 | 17 | 53 | 26 | 0 | 27 | 31 | 5. 707324 |
| 4 | 1 | 18 | 55 | 46 | 0 | 26 | 9 | 5. 707672 |
| 5 | 1 | 19 | 58 | 0 | 0 | 24 | 46 | 5. 708023 |
| 6 | 1 | 21 | 0 | 9 | 0 | 23 | 23 | 5. 708376 |
| 7 | 1 | 22 | 2 | 11 | 0 | 22 | 0 | 5. 708729 |
| 8 | 1 | 23 | 4 | 7 | 0 | 20 | 37 | 5. 709085 |
| 9 | 1 | 24 | 5 | 57 | 0 | 19 | 13 | 5. 709443 |
| 10 | 1 | 25 | 7 | 41 | 0 | 17 | 49 | 5. 709820 |
| 11 | 1 | 26 | 9 | 18 | 0 | 16 | 25 | 5. 710162 |
| 12 | 1 | 27 | 10 | 51 | 0 | 15 | 1 | 5. 710524 |
| 13 | 1 | 28 | 12 | 16 | 0 | 13 | 37 | 5. 710887 |
| 14 | 1 | 29 | 13 | 35 | 0 | 12 | 12 | 5. 711250 |
| 15 | 2 | 0 | 14 | 48 | 0 | 10 | 48 | 5. 711614 |
| 16 | 2 | 1 | 15 | 55 | 0 | 9 | 23 | 5. 711978 |
| 17 | 2 | 2 | 16 | 56 | 0 | 7 | 58 | 5. 712344 |
| 18 | 2 | 3 | 17 | 51 | 0 | 6 | 34 | 5. 712711 |
| 19 | 2 | 4 | 18 | 39 | 0 | 5 | 9 | 5. 713078 |
| 20 | 2 | 5 | 19 | 21 | 0 | 3 | 44 | 5. 713444 |
| 21 | 2 | 6 | 19 | 57 | 0 | 2 | 20 | 5. 713810 |
| 22 | 2 | 7 | 20 | 27 | 0 | 0 | 55 | 5. 714178 |
| 23 | 2 | 8 | 20 | 51 | North | 0 | 29 | 5. 714545 |
| 24 | 2 | 9 | 21 | 8 | 0 | 1 | 53 | 5. 714911 |
| 25 | 2 | 10 | 21 | 20 | 0 | 3 | 17 | 5. 715278 |
| 26 | 2 | 11 | 21 | 25 | 0 | 4 | 41 | 5. 715644 |
| 27 | 2 | 12 | 21 | 25 | 0 | 6 | 5 | 5. 716008 |
| 28 | 2 | 13 | 21 | 18 | 0 | 7 | 28 | 5. 716373 |
| 29 | 2 | 14 | 21 | 5 | 0 | 8 | 51 | 5. 716737 |
| 30 | 2 | 15 | 20 | 46 | 0 | 10 | 14 | 5. 717099 |

A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 9. Long. ♃ à 1 ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 2 | 15 | 20 | 46 | 0 | 10 | 14 | 5. 717099 |
| 0 | 2 | 16 | 20 | 21 | 0 | 11 | 36 | 5. 717462 |
| 1 | 2 | 17 | 19 | 50 | 0 | 12 | 58 | 5. 717823 |
| 2 | 2 | 18 | 19 | 14 | 0 | 14 | 20 | 5. 718182 |
| 3 | 2 | 19 | 18 | 31 | 0 | 15 | 41 | 5. 718540 |
| 4 | 2 | 20 | 17 | 44 | 0 | 17 | 2 | 5. 718898 |
| 5 | 2 | 21 | 16 | 49 | 0 | 18 | 23 | 5. 719253 |
| 6 | 2 | 22 | 15 | 49 | 0 | 19 | 43 | 5. 719607 |
| 7 | 2 | 23 | 14 | 43 | 0 | 21 | 2 | 5. 719959 |
| 8 | 2 | 24 | 13 | 31 | 0 | 22 | 21 | 5. 720309 |
| 9 | 2 | 25 | 12 | 14 | 0 | 23 | 40 | 5. 720658 |
| 10 | 2 | 26 | 10 | 52 | 0 | 24 | 58 | 5. 721005 |
| 11 | 2 | 27 | 9 | 23 | 0 | 26 | 15 | 5. 721349 |
| 12 | 2 | 28 | 7 | 49 | 0 | 27 | 32 | 5. 721691 |
| 13 | 2 | 29 | 6 | 9 | 0 | 28 | 48 | 5. 722031 |
| 14 | 3 | 0 | 4 | 24 | 0 | 30 | 4 | 5. 722368 |
| 15 | 3 | 1 | 2 | 34 | 0 | 31 | 19 | 5. 722704 |
| 16 | 3 | 2 | 0 | 38 | 0 | 32 | 33 | 5. 723038 |
| 17 | 3 | 2 | 58 | 37 | 0 | 33 | 47 | 5. 723367 |
| 18 | 3 | 3 | 56 | 30 | 0 | 35 | 0 | 5. 723694 |
| 19 | 3 | 4 | 54 | 19 | 0 | 36 | 12 | 5. 724020 |
| 20 | 3 | 5 | 52 | 2 | 0 | 37 | 24 | 5. 724342 |
| 21 | 3 | 6 | 49 | 40 | 0 | 38 | 35 | 5. 724661 |
| 22 | 3 | 7 | 47 | 13 | 0 | 39 | 45 | 5. 724977 |
| 23 | 3 | 8 | 44 | 41 | 0 | 40 | 54 | 5. 725290 |
| 24 | 3 | 9 | 42 | 4 | 0 | 42 | 3 | 5. 725601 |
| 25 | 3 | 10 | 39 | 23 | 0 | 43 | 10 | 5. 725906 |
| 26 | 3 | 11 | 36 | 36 | 0 | 44 | 17 | 5. 726209 |
| 27 | 3 | 12 | 33 | 45 | 0 | 45 | 23 | 5. 726510 |
| 28 | 3 | 13 | 30 | 49 | 0 | 46 | 29 | 5. 726806 |
| 29 | 3 | 14 | 27 | 49 | 0 | 47 | 33 | 5. 727099 |
| 30 | 3 | 14 | 27 | 49 | 0 | 47 | 33 | 5. 727099 |

A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 10. Long. ♃ à 1 ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 3 | 14 | 27 | 49 | 0 | 47 | 33 | 5. 727099 |
| 1 | 3 | 15 | 24 | 42 | 0 | 48 | 37 | 5. 727390 |
| 2 | 3 | 16 | 21 | 33 | 0 | 49 | 39 | 5. 727676 |
| 3 | 3 | 17 | 18 | 18 | 0 | 50 | 41 | 5. 727958 |
| 4 | 3 | 18 | 15 | 0 | 0 | 51 | 42 | 5. 728236 |
| 5 | 3 | 19 | 11 | 36 | 0 | 52 | 42 | 5. 728510 |
| 6 | 3 | 20 | 8 | 9 | 0 | 53 | 41 | 5. 728781 |
| 7 | 3 | 21 | 4 | 38 | 0 | 54 | 39 | 5. 729047 |
| 8 | 3 | 22 | 1 | 2 | 0 | 55 | 36 | 5. 729310 |
| 9 | 3 | 22 | 57 | 22 | 0 | 56 | 32 | 5. 729568 |
| 10 | 3 | 23 | 53 | 38 | 0 | 57 | 27 | 5. 729823 |
| 11 | 3 | 24 | 49 | 51 | 0 | 58 | 21 | 5. 730073 |
| 12 | 3 | 25 | 45 | 59 | 0 | 59 | 14 | 5. 730320 |
| 13 | 3 | 26 | 42 | 4 | 1 | 0 | 6 | 5. 730563 |
| 14 | 3 | 27 | 38 | 6 | 1 | 0 | 58 | 5. 730800 |
| 15 | 3 | 28 | 34 | 3 | 1 | 1 | 48 | 5. 731032 |
| 16 | 3 | 29 | 29 | 57 | 1 | 2 | 37 | 5. 731261 |
| 17 | 4 | 0 | 25 | 47 | 1 | 3 | 25 | 5. 731485 |
| 18 | 4 | 1 | 21 | 34 | 1 | 4 | 12 | 5. 731705 |
| 19 | 4 | 2 | 17 | 18 | 1 | 4 | 58 | 5. 731920 |
| 20 | 4 | 3 | 12 | 58 | 1 | 5 | 43 | 5. 732132 |
| 21 | 4 | 4 | 8 | 35 | 1 | 6 | 26 | 5. 732337 |
| 22 | 4 | 5 | 4 | 10 | 1 | 7 | 9 | 5. 732538 |
| 23 | 4 | 5 | 59 | 41 | 1 | 7 | 51 | 5. 732734 |
| 24 | 4 | 6 | 55 | 8 | 1 | 8 | 31 | 5. 732927 |
| 25 | 4 | 7 | 50 | 34 | 1 | 9 | 11 | 5. 733113 |
| 26 | 4 | 8 | 45 | 56 | 1 | 9 | 49 | 5. 733295 |
| 27 | 4 | 9 | 41 | 16 | 1 | 10 | 26 | 5. 733473 |
| 28 | 4 | 10 | 36 | 33 | 1 | 11 | 2 | 5. 733645 |
| 29 | 4 | 11 | 31 | 47 | 1 | 11 | 37 | 5. 733812 |
| 30 | 4 | 12 | 26 | 58 | 1 | 12 | 11 | 5. 733974 |

## A Table of the Heliocentrick Place of *Jupiter*.

| Mid. Anom. | Sign. 11. Long. ♃ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 4 | 12 | 26 | 58 | 1 | 12 | 11 | 5. 733974 |
| 1 | 4 | 13 | 22 | 7 | 1 | 12 | 43 | 5. 734131 |
| 2 | 4 | 14 | 17 | 14 | 1 | 13 | 15 | 5. 734283 |
| 3 | 4 | 15 | 12 | 19 | 1 | 13 | 45 | 5. 734430 |
| 4 | 4 | 16 | 7 | 21 | 1 | 14 | 14 | 5. 734572 |
| 5 | 4 | 17 | 2 | 22 | 1 | 14 | 42 | 5. 734708 |
| 6 | 4 | 17 | 57 | 20 | 1 | 15 | 9 | 5. 734841 |
| 7 | 4 | 18 | 52 | 17 | 1 | 15 | 35 | 5. 734968 |
| 8 | 4 | 19 | 47 | 12 | 1 | 16 | 0 | 5. 735089 |
| 9 | 4 | 20 | 42 | 4 | 1 | 16 | 23 | 5. 735206 |
| 10 | 4 | 21 | 36 | 55 | 1 | 16 | 45 | 5. 735317 |
| 11 | 4 | 22 | 31 | 45 | 1 | 17 | 6 | 5. 735422 |
| 12 | 4 | 23 | 26 | 32 | 1 | 17 | 26 | 5. 735522 |
| 13 | 4 | 24 | 21 | 19 | 1 | 17 | 45 | 5. 735617 |
| 14 | 4 | 25 | 16 | 4 | 1 | 18 | 2 | 5. 735706 |
| 15 | 4 | 26 | 10 | 48 | 1 | 18 | 18 | 5. 735791 |
| 16 | 4 | 27 | 5 | 30 | 1 | 18 | 33 | 5. 735870 |
| 17 | 4 | 28 | 0 | 11 | 1 | 18 | 47 | 5. 735944 |
| 18 | 4 | 28 | 54 | 52 | 1 | 19 | 0 | 5. 736011 |
| 19 | 4 | 29 | 49 | 31 | 1 | 19 | 11 | 5. 736074 |
| 20 | 5 | 0 | 44 | 9 | 1 | 19 | 21 | 5. 736131 |
| 21 | 5 | 1 | 38 | 47 | 1 | 19 | 31 | 5. 736183 |
| 22 | 5 | 2 | 33 | 24 | 1 | 19 | 38 | 5. 736229 |
| 23 | 5 | 3 | 28 | 0 | 1 | 19 | 45 | 5. 736271 |
| 24 | 5 | 4 | 22 | 35 | 1 | 19 | 50 | 5. 736307 |
| 25 | 5 | 5 | 17 | 10 | 1 | 19 | 55 | 5. 736337 |
| 26 | 5 | 6 | 11 | 45 | 1 | 19 | 58 | 5. 736361 |
| 27 | 5 | 7 | 6 | 20 | 1 | 19 | 59 | 5. 736380 |
| 28 | 5 | 8 | 0 | 54 | 1 | 20 | 0 | 5. 736394 |
| 29 | 5 | 8 | 55 | 28 | 1 | 19 | 59 | 5. 736402 |
| 30 | 5 | 9 | 50 | 2 | 1 | 19 | 58 | 5. 736406 |

A Table

## A Table of the mean Motion of *Mars* from the *Aphelion*.



| Years from Christ | Anomaly ♂ s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 9 | 2 | 3 | 36 |
| 1501 | 3 | 7 | 33 | 36 |
| 1581 | 9 | 19 | 51 | 12 |
| 1601 | 5 | 7 | 55 | 36 |
| 1621 | 0 | 26 | 0 | 0 |
| 1641 | 8 | 14 | 4 | 24 |
| 1661 | 4 | 2 | 8 | 48 |
| 1681 | 11 | 20 | 13 | 12 |
| 1701 | 7 | 8 | 17 | 36 |
| 1721 | 2 | 26 | 22 | 0 |
| 1741 | 10 | 14 | 26 | 24 |
| 1761 | 6 | 2 | 30 | 48 |
| 1781 | 1 | 20 | 35 | 12 |
| 1801 | 9 | 8 | 39 | 36 |
| 1901 | 11 | 9 | 1 | 36 |
| 2001 | 1 | 9 | 23 | 36 |

| Years | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 20 | 7 | 18 | 4 | 24 |
| 40 | 3 | 6 | 8 | 48 |
| 60 | 10 | 24 | 13 | 12 |
| 80 | 6 | 12 | 17 | 36 |
| 100 | 2 | 0 | 22 | 0 |
| 200 | 4 | 0 | 44 | 0 |
| 300 | 6 | 1 | 6 | 0 |
| 400 | 8 | 1 | 28 | 0 |
| 500 | 10 | 1 | 50 | 0 |
| 600 | 0 | 2 | 12 | 0 |
| 700 | 2 | 2 | 34 | 0 |
| 800 | 4 | 2 | 56 | 0 |
| 900 | 6 | 3 | 18 | 0 |
| 1000 | 8 | 3 | 40 | 0 |
| 2000 | 4 | 7 | 20 | 0 |
| 3000 | 0 | 11 | 0 | 0 |
| 4000 | 8 | 14 | 40 | 0 |
| 5000 | 4 | 18 | 20 | 0 |
| 6000 | 0 | 22 | 0 | 0 |

| Years. | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 6 | 11 | 16 | 22 |
| 2 | 0 | 22 | 32 | 43 |
| 3 | 7 | 3 | 49 | 5 |
| 4 | 1 | 15 | 36 | 53 |
| 5 | 7 | 26 | 53 | 14 |
| 6 | 2 | 8 | 9 | 30 |
| 7 | 8 | 19 | 25 | 58 |
| 8 | 3 | 1 | 13 | 46 |
| 9 | 9 | 12 | 30 | 7 |
| 10 | 3 | 23 | 46 | 29 |
| 11 | 10 | 5 | 2 | 50 |
| 12 | 4 | 16 | 50 | 38 |
| 13 | 10 | 28 | 7 | 0 |
| 14 | 5 | 9 | 23 | 22 |
| 15 | 11 | 20 | 39 | 43 |
| 16 | 6 | 2 | 27 | 31 |
| 17 | 0 | 13 | 43 | 53 |
| 18 | 6 | 25 | 0 | 14 |
| 19 | 1 | 6 | 16 | 36 |
| 20 | 7 | 18 | 4 | 24 |

| Months | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| *January* | 0 | 0 | 0 | 0 |
| *February* | 0 | 16 | 14 | 42 |
| *March* | 1 | 0 | 55 | 5 |
| *April* | 1 | 17 | 9 | 47 |
| *May* | 2 | 2 | 53 | 3 |
| *June* | 2 | 19 | 7 | 45 |
| *July* | 3 | 4 | 51 | 1 |
| *August* | 3 | 21 | 5 | 43 |
| *September* | 4 | 7 | 20 | 26 |
| *October* | 4 | 23 | 3 | 41 |
| *November* | 5 | 9 | 18 | 24 |
| *December* | 5 | 25 | 1 | 39 |

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

## A Table of the mean Motion of *Mars* from the *Aphelion*.

| Days | Anom. Mot. ° ′ ″ | H. | Anom. Mot. ° ′ ″ ‴ | H. | Anom. Mot. ° ′ ″ ‴ |
|---|---|---|---|---|---|
| 1 | 0 31 27 | 1 | 0 1 19 | 31 | 0 40 37 |
| 2 | 1 2 53 | 2 | 0 2 37 | 32 | 0 41 55 |
| 3 | 1 34 20 | 3 | 0 3 56 | 33 | 0 43 14 |
| 4 | 2 5 46 | 4 | 0 5 14 | 34 | 0 44 33 |
| 5 | 2 37 13 | 5 | 0 6 33 | 35 | 0 45 51 |
| 6 | 3 8 39 | 6 | 0 7 52 | 36 | 0 47 10 |
| 7 | 3 40 6 | 7 | 0 9 10 | 37 | 0 48 28 |
| 8 | 4 11 32 | 8 | 0 10 29 | 38 | 0 49 47 |
| 9 | 4 42 59 | 9 | 0 11 47 | 39 | 0 51 6 |
| 10 | 5 14 25 | 10 | 0 13 6 | 40 | 0 52 24 |
| 11 | 5 45 52 | 11 | 0 14 25 | 41 | 0 53 43 |
| 12 | 6 17 18 | 12 | 0 15 43 | 42 | 0 55 1 |
| 13 | 6 48 45 | 13 | 0 17 2 | 43 | 0 56 20 |
| 14 | 7 20 11 | 14 | 0 18 20 | 44 | 0 57 39 |
| 15 | 7 51 38 | 15 | 0 19 39 | 45 | 0 58 57 |
| 16 | 8 23 4 | 16 | 0 20 58 | 46 | 1 0 16 |
| 17 | 8 54 31 | 17 | 0 22 16 | 47 | 1 1 34 |
| 18 | 9 25 57 | 18 | 0 23 35 | 48 | 1 2 53 |
| 19 | 9 57 24 | 19 | 0 24 53 | 49 | 1 4 12 |
| 20 | 10 28 50 | 20 | 0 26 12 | 50 | 1 5 30 |
| 21 | 11 0 17 | 21 | 0 27 31 | 51 | 1 6 49 |
| 22 | 11 31 44 | 22 | 0 28 49 | 52 | 1 8 7 |
| 23 | 12 3 10 | 23 | 0 30 8 | 53 | 1 9 26 |
| 24 | 12 34 37 | 24 | 0 31 27 | 54 | 1 10 45 |
| 25 | 13 6 3 | 25 | 0 32 45 | 55 | 1 12 3 |
| 26 | 13 37 30 | 26 | 0 34 4 | 56 | 1 13 22 |
| 27 | 14 8 56 | 27 | 0 35 22 | 57 | 1 14 40 |
| 28 | 14 40 23 | 28 | 0 36 41 | 58 | 1 15 59 |
| 29 | 15 11 49 | 29 | 0 38 0 | 59 | 1 17 18 |
| 30 | 15 43 16 | 30 | 0 39 18 | 60 | 1 18 36 |
| 31 | 16 14 42 | | | | |
| 32 | 16 46 9 | | | | |

| | s | ° | ′ | ″ |
|---|---|---|---|---|
| Long. Aph. ♂ à ☊ ✶ ♈ | 4 | 1 | 12 | 0 |
| Long. ☊ ♂ à ☊ ✶ ♈ | 0 | 19 | 10 | 0 |
| Inclin. Orb. ♂ | | 1 | 52 | 0 |
| Dist. Mid. ♂ à ☉ | | | 152369 | |
| Eccentricity | | | 14100 | |

## A Table of the Heliocentrick Place of *Mars*.



| Mid. Anom. | Sign. ☊. Long. ♂ à ☊ ✶ ♈ s ° ′ ″ | Inc. North. ° ′ ″ | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|
| 0 | 4 1 12 22 | 1 49 32 | 5. 221113 |
| 1 | 4 2 2 27 | 1 49 11 | 5. 221110 |
| 2 | 4 2 52 32 | 1 48 49 | 5. 221098 |
| 3 | 4 3 42 37 | 1 48 25 | 5. 221076 |
| 4 | 4 4 32 42 | 1 48 0 | 5. 221044 |
| 5 | 4 5 22 47 | 1 47 33 | 5. 221003 |
| 6 | 4 6 12 53 | 1 47 5 | 5. 220953 |
| 7 | 4 7 3 1 | 1 46 36 | 5. 220894 |
| 8 | 4 7 53 8 | 1 46 5 | 5. 220826 |
| 9 | 4 8 43 17 | 1 45 33 | 5. 220748 |
| 10 | 4 9 33 27 | 1 44 59 | 5. 220661 |
| 11 | 4 10 23 38 | 1 44 24 | 5. 220565 |
| 12 | 4 11 13 51 | 1 43 48 | 5. 220460 |
| 13 | 4 12 4 6 | 1 43 11 | 5. 220345 |
| 14 | 4 12 54 22 | 1 42 32 | 5. 220221 |
| 15 | 4 13 44 39 | 1 41 52 | 5. 220088 |
| 16 | 4 14 34 58 | 1 41 10 | 5. 219946 |
| 17 | 4 15 25 19 | 1 40 27 | 5. 219795 |
| 18 | 4 16 15 43 | 1 39 43 | 5. 219634 |
| 19 | 4 17 6 8 | 1 38 57 | 5. 219464 |
| 20 | 4 17 56 37 | 1 38 11 | 5. 219285 |
| 21 | 4 18 47 8 | 1 37 22 | 5. 219097 |
| 22 | 4 19 37 40 | 1 36 33 | 5. 218900 |
| 23 | 4 20 28 17 | 1 35 42 | 5. 218694 |
| 24 | 4 21 18 56 | 1 34 50 | 5. 218478 |
| 25 | 4 22 9 38 | 1 33 57 | 5. 218254 |
| 26 | 4 23 0 24 | 1 33 2 | 5. 218020 |
| 27 | 4 23 51 12 | 1 32 6 | 5. 217777 |
| 28 | 4 24 42 4 | 1 31 9 | 5. 217526 |
| 29 | 4 25 32 59 | 1 30 11 | 5. 217267 |
| 30 | 4 26 23 59 | 1 29 11 | 5. 216997 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | *Sign.* 1. Long. ♂ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. | |
|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | | |
| 0 | 4 | 26 | 23 | 59 | 1 | 29 | 11 | 5. | 216997 |
| 1 | 4 | 27 | 15 | 2 | 1 | 28 | 10 | 5. | 216719 |
| 2 | 4 | 28 | 6 | 9 | 1 | 27 | 8 | 5. | 216433 |
| 3 | 4 | 28 | 57 | 20 | 1 | 26 | 4 | 5. | 216137 |
| 4 | 4 | 29 | 48 | 34 | 1 | 25 | 0 | 5. | 215832 |
| 5 | 5 | 0 | 39 | 54 | 1 | 23 | 54 | 5. | 215519 |
| 6 | 5 | 1 | 31 | 18 | 1 | 22 | 47 | 5. | 215197 |
| 7 | 5 | 2 | 22 | 47 | 1 | 21 | 39 | 5. | 214866 |
| 8 | 5 | 3 | 14 | 20 | 1 | 20 | 29 | 5. | 214527 |
| 9 | 5 | 4 | 5 | 58 | 1 | 19 | 18 | 5. | 214179 |
| 10 | 5 | 4 | 57 | 41 | 1 | 18 | 6 | 5. | 213823 |
| 11 | 5 | 5 | 49 | 29 | 1 | 16 | 53 | 5. | 213458 |
| 12 | 5 | 6 | 41 | 22 | 1 | 15 | 39 | 5. | 213084 |
| 13 | 5 | 7 | 33 | 21 | 1 | 14 | 24 | 5. | 212702 |
| 14 | 5 | 8 | 25 | 26 | 1 | 13 | 7 | 5. | 212312 |
| 15 | 5 | 9 | 17 | 36 | 1 | 11 | 49 | 5. | 211914 |
| 16 | 5 | 10 | 9 | 52 | 1 | 10 | 30 | 5. | 211507 |
| 17 | 5 | 11 | 2 | 13 | 1 | 9 | 10 | 5. | 211092 |
| 18 | 5 | 11 | 54 | 41 | 1 | 7 | 49 | 5. | 210668 |
| 19 | 5 | 12 | 47 | 15 | 1 | 6 | 27 | 5. | 210237 |
| 20 | 5 | 13 | 39 | 55 | 1 | 5 | 3 | 5. | 209798 |
| 21 | 5 | 14 | 32 | 42 | 1 | 3 | 39 | 5. | 209351 |
| 22 | 5 | 15 | 25 | 35 | 1 | 2 | 13 | 5. | 208896 |
| 23 | 5 | 16 | 18 | 35 | 1 | 0 | 47 | 5. | 208433 |
| 24 | 5 | 17 | 11 | 41 | 0 | 59 | 19 | 5. | 207962 |
| 25 | 5 | 18 | 4 | 55 | 0 | 57 | 50 | 5. | 207484 |
| 26 | 5 | 18 | 58 | 15 | 0 | 56 | 21 | 5. | 206998 |
| 27 | 5 | 19 | 51 | 43 | 0 | 54 | 50 | 5. | 206504 |
| 28 | 5 | 20 | 45 | 19 | 0 | 53 | 18 | 5. | 206003 |
| 29 | 5 | 21 | 39 | 2 | 0 | 51 | 45 | 5. | 205495 |
| 30 | 5 | 22 | 32 | 53 | 0 | 50 | 12 | 5. | 204979 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | *Sign.* 2. Long. ♂ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. | |
|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | | |
| 0 | 5 | 22 | 32 | 53 | 0 | 50 | 12 | 5. | 204979 |
| 1 | 5 | 23 | 26 | 51 | 0 | 48 | 37 | 5. | 204456 |
| 2 | 5 | 24 | 20 | 57 | 0 | 47 | 1 | 5. | 203925 |
| 3 | 5 | 25 | 15 | 12 | 0 | 45 | 25 | 5. | 203388 |
| 4 | 5 | 26 | 9 | 34 | 0 | 43 | 47 | 5. | 202844 |
| 5 | 5 | 27 | 4 | 4 | 0 | 42 | 9 | 5. | 202292 |
| 6 | 5 | 27 | 58 | 42 | 0 | 40 | 30 | 5. | 201734 |
| 7 | 5 | 28 | 53 | 29 | 0 | 38 | 49 | 5. | 201169 |
| 8 | 5 | 29 | 48 | 25 | 0 | 37 | 8 | 5. | 200598 |
| 9 | 6 | 0 | 43 | 30 | 0 | 35 | 26 | 5. | 200020 |
| 10 | 6 | 1 | 38 | 44 | 0 | 33 | 44 | 5. | 199436 |
| 11 | 6 | 2 | 34 | 7 | 0 | 32 | 0 | 5. | 198846 |
| 12 | 6 | 3 | 29 | 39 | 0 | 30 | 16 | 5. | 198249 |
| 13 | 6 | 4 | 25 | 21 | 0 | 28 | 31 | 5. | 197646 |
| 14 | 6 | 5 | 21 | 12 | 0 | 26 | 45 | 5. | 197038 |
| 15 | 6 | 6 | 17 | 11 | 0 | 24 | 58 | 5. | 196424 |
| 16 | 6 | 7 | 13 | 21 | 0 | 23 | 11 | 5. | 195804 |
| 17 | 6 | 8 | 9 | 41 | 0 | 21 | 23 | 5. | 195178 |
| 18 | 6 | 9 | 6 | 10 | 0 | 19 | 35 | 5. | 194546 |
| 19 | 6 | 10 | 2 | 49 | 0 | 17 | 45 | 5. | 193909 |
| 20 | 6 | 10 | 59 | 38 | 0 | 15 | 56 | 5. | 193267 |
| 21 | 6 | 11 | 56 | 38 | 0 | 14 | 5 | 5. | 192620 |
| 22 | 6 | 12 | 53 | 48 | 0 | 12 | 14 | 5. | 191969 |
| 23 | 6 | 13 | 51 | 9 | 0 | 10 | 23 | 5. | 191313 |
| 24 | 6 | 14 | 48 | 39 | 0 | 8 | 31 | 5. | 190652 |
| 25 | 6 | 15 | 46 | 21 | 0 | 6 | 38 | 5. | 189987 |
| 26 | 6 | 16 | 44 | 13 | 0 | 4 | 45 | 5. | 189318 |
| 27 | 6 | 17 | 42 | 16 | 0 | 2 | 52 | 5. | 188644 |
| 28 | 6 | 18 | 40 | 29 | 0 | 0 | 58 | 5. | 187966 |
| 29 | 6 | 19 | 38 | 54 | Sou. 0 | | 57 | 5. | 187285 |
| 30 | 6 | 20 | 37 | 31 | 0 | 2 | 51 | 5. | 186600 |

## A Table of the Heliocentrick Place of *Mars*.

*Sign.* 3.

| Mid. Anom. | Long. ♂ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 6 | 20 | 37 | 31 | 0 | 2 | 51 | 5. 186600 |
| 0 | 6 | 21 | 36 | 18 | 0 | 4 | 46 | 5. 185911 |
| 1 | 6 | 22 | 35 | 17 | 0 | 6 | 41 | 5. 185219 |
| 2 | 6 | 23 | 34 | 27 | 0 | 8 | 37 | 5. 184525 |
| 3 | 6 | 24 | 33 | 48 | 0 | 10 | 32 | 5. 183827 |
| 4 | 6 | 25 | 33 | 21 | 0 | 12 | 28 | 5. 183127 |
| 5 | 6 | 26 | 33 | 7 | 0 | 14 | 24 | 5. 182424 |
| 6 | 6 | 27 | 33 | 3 | 0 | 16 | 20 | 5. 181719 |
| 7 | 6 | 28 | 33 | 12 | 0 | 18 | 16 | 5. 181012 |
| 8 | 6 | 29 | 33 | 32 | 0 | 20 | 13 | 5. 180302 |
| 9 | 7 | 0 | 34 | 5 | 0 | 22 | 9 | 5. 179592 |
| 10 | 7 | 1 | 34 | 49 | 0 | 24 | 5 | 5. 178880 |
| 11 | 7 | 2 | 35 | 45 | 0 | 26 | 1 | 5. 178167 |
| 12 | 7 | 3 | 36 | 55 | 0 | 27 | 57 | 5. 177452 |
| 13 | 7 | 4 | 38 | 15 | 0 | 29 | 53 | 5. 176737 |
| 14 | 7 | 5 | 39 | 48 | 0 | 31 | 49 | 5. 176021 |
| 15 | 7 | 6 | 41 | 34 | 0 | 33 | 44 | 5. 175305 |
| 16 | 7 | 7 | 43 | 31 | 0 | 35 | 39 | 5. 174589 |
| 17 | 7 | 8 | 45 | 41 | 0 | 37 | 34 | 5. 173872 |
| 18 | 7 | 9 | 48 | 3 | 0 | 39 | 29 | 5. 173156 |
| 19 | 7 | 10 | 50 | 38 | 0 | 41 | 23 | 5. 172442 |
| 20 | 7 | 11 | 53 | 25 | 0 | 43 | 17 | 5. 171728 |
| 21 | 7 | 12 | 56 | 24 | 0 | 45 | 10 | 5. 171015 |
| 22 | 7 | 13 | 59 | 37 | 0 | 47 | 2 | 5. 170304 |
| 23 | 7 | 15 | 3 | 2 | 0 | 48 | 54 | 5. 169594 |
| 24 | 7 | 16 | 6 | 39 | 0 | 50 | 46 | 5. 168886 |
| 25 | 7 | 17 | 10 | 29 | 0 | 52 | 37 | 5. 168180 |
| 26 | 7 | 18 | 14 | 31 | 0 | 54 | 27 | 5. 167478 |
| 27 | 7 | 19 | 18 | 46 | 0 | 56 | 16 | 5. 166777 |
| 28 | 7 | 20 | 23 | 13 | 0 | 58 | 4 | 5. 166079 |
| 29 | 7 | 21 | 27 | 53 | 0 | 59 | 52 | 5. 165385 |
| 30 | | | | | | | | |

## A Table of the Heliocentrick Place of *Mars*.

*Sign.* 4.

| Mid. Anom. | Long. ♂ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 7 | 21 | 27 | 53 | 0 | 59 | 52 | 5. 165385 |
| 1 | 7 | 22 | 32 | 44 | 1 | 1 | 38 | 5. 164695 |
| 2 | 7 | 23 | 37 | 49 | 1 | 3 | 24 | 5. 164008 |
| 3 | 7 | 24 | 43 | 5 | 1 | 5 | 8 | 5. 163326 |
| 4 | 7 | 25 | 48 | 34 | 1 | 6 | 52 | 5. 162648 |
| 5 | 7 | 26 | 54 | 16 | 1 | 8 | 34 | 5. 161976 |
| 6 | 7 | 28 | 0 | 9 | 1 | 10 | 15 | 5. 161308 |
| 7 | 7 | 29 | 6 | 15 | 1 | 11 | 55 | 5. 160645 |
| 8 | 8 | 0 | 12 | 33 | 1 | 13 | 33 | 5. 159988 |
| 9 | 8 | 1 | 19 | 3 | 1 | 15 | 11 | 5. 159337 |
| 10 | 8 | 2 | 25 | 44 | 1 | 16 | 46 | 5. 158692 |
| 11 | 8 | 3 | 32 | 37 | 1 | 18 | 21 | 5. 158054 |
| 12 | 8 | 4 | 39 | 43 | 1 | 19 | 53 | 5. 157423 |
| 13 | 8 | 5 | 47 | 0 | 1 | 21 | 25 | 5. 156798 |
| 14 | 8 | 6 | 54 | 29 | 1 | 22 | 54 | 5. 156182 |
| 15 | 8 | 8 | 2 | 8 | 1 | 24 | 22 | 5. 155573 |
| 16 | 8 | 9 | 9 | 59 | 1 | 25 | 49 | 5. 154972 |
| 17 | 8 | 10 | 18 | 1 | 1 | 27 | 13 | 5. 154379 |
| 18 | 8 | 11 | 26 | 15 | 1 | 28 | 36 | 5. 153795 |
| 19 | 8 | 12 | 34 | 39 | 1 | 29 | 56 | 5. 153220 |
| 20 | 8 | 13 | 43 | 14 | 1 | 31 | 15 | 5. 152655 |
| 21 | 8 | 14 | 51 | 59 | 1 | 32 | 32 | 5. 152099 |
| 22 | 8 | 16 | 0 | 55 | 1 | 33 | 47 | 5. 151553 |
| 23 | 8 | 17 | 10 | 2 | 1 | 35 | 0 | 5. 151017 |
| 24 | 8 | 18 | 19 | 18 | 1 | 36 | 10 | 5. 150491 |
| 25 | 8 | 19 | 28 | 44 | 1 | 37 | 18 | 5. 149976 |
| 26 | 8 | 20 | 38 | 20 | 1 | 38 | 25 | 5. 149472 |
| 27 | 8 | 21 | 48 | 6 | 1 | 39 | 28 | 5. 148979 |
| 28 | 8 | 22 | 58 | 1 | 1 | 40 | 30 | 5. 148497 |
| 29 | 8 | 24 | 8 | 4 | 1 | 41 | 29 | 5. 148028 |
| 30 | 8 | 25 | 18 | 17 | 1 | 42 | 26 | 5. 147570 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | Sign. 5. Long. ♂ à 1 ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 8 | 25 | 18 | 17 | 1 | 42 | 26 | 5. 147570 |
| 1 | 8 | 26 | 28 | 39 | 1 | 43 | 20 | 5. 147125 |
| 2 | 8 | 27 | 39 | 9 | 1 | 44 | 12 | 5. 146692 |
| 3 | 8 | 28 | 49 | 48 | 1 | 45 | 1 | 5. 146273 |
| 4 | 9 | 0 | 0 | 34 | 1 | 45 | 48 | 5. 145866 |
| 5 | 9 | 1 | 11 | 27 | 1 | 46 | 32 | 5. 145472 |
| 6 | 9 | 2 | 22 | 29 | 1 | 47 | 14 | 5. 145093 |
| 7 | 9 | 3 | 33 | 37 | 1 | 47 | 52 | 5. 144727 |
| 8 | 9 | 4 | 44 | 53 | 1 | 48 | 28 | 5. 144375 |
| 9 | 9 | 5 | 56 | 16 | 1 | 49 | 2 | 5. 144037 |
| 10 | 9 | 7 | 7 | 44 | 1 | 49 | 32 | 5. 143713 |
| 11 | 9 | 8 | 19 | 19 | 1 | 50 | 0 | 5. 143405 |
| 12 | 9 | 9 | 31 | 0 | 1 | 50 | 25 | 5. 143110 |
| 13 | 9 | 10 | 42 | 46 | 1 | 50 | 47 | 5. 142831 |
| 14 | 9 | 11 | 54 | 38 | 1 | 51 | 6 | 5. 142567 |
| 15 | 9 | 13 | 6 | 35 | 1 | 51 | 23 | 5. 142318 |
| 16 | 9 | 14 | 18 | 36 | 1 | 51 | 36 | 5. 142085 |
| 17 | 9 | 15 | 30 | 43 | 1 | 51 | 46 | 5. 141867 |
| 18 | 9 | 16 | 42 | 53 | 1 | 51 | 54 | 5. 141666 |
| 19 | 9 | 17 | 55 | 7 | 1 | 51 | 58 | 5. 141480 |
| 20 | 9 | 19 | 7 | 25 | 1 | 52 | 0 | 5. 141309 |
| 21 | 9 | 20 | 19 | 45 | 1 | 51 | 58 | 5. 141156 |
| 22 | 9 | 21 | 32 | 9 | 1 | 51 | 54 | 5. 141018 |
| 23 | 9 | 22 | 44 | 35 | 1 | 51 | 47 | 5. 140896 |
| 24 | 9 | 23 | 57 | 4 | 1 | 51 | 37 | 5. 140791 |
| 25 | 9 | 25 | 9 | 34 | 1 | 51 | 23 | 5. 140702 |
| 26 | 9 | 26 | 22 | 6 | 1 | 51 | 7 | 5. 140629 |
| 27 | 9 | 27 | 34 | 49 | 1 | 50 | 48 | 5. 140572 |
| 28 | 9 | 28 | 47 | 13 | 1 | 50 | 26 | 5. 140533 |
| 29 | 9 | 29 | 59 | 47 | 1 | 50 | 0 | 5. 140511 |
| 30 | 10 | 1 | 12 | 22 | 1 | 49 | 32 | 5. 140505 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | Sign. 6. Long. ♂ à 1 ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 10 | 1 | 12 | 22 | 1 | 49 | 32 | 5. 140505 |
| 1 | 10 | 2 | 24 | 57 | 1 | 49 | 1 | 5. 140515 |
| 2 | 10 | 3 | 37 | 31 | 1 | 48 | 27 | 5. 140541 |
| 3 | 10 | 4 | 50 | 5 | 1 | 47 | 50 | 5. 140584 |
| 4 | 10 | 6 | 2 | 38 | 1 | 47 | 11 | 5. 140645 |
| 5 | 10 | 7 | 15 | 10 | 1 | 46 | 28 | 5. 140722 |
| 6 | 10 | 8 | 27 | 40 | 1 | 45 | 43 | 5. 140815 |
| 7 | 10 | 9 | 40 | 8 | 1 | 44 | 55 | 5. 140924 |
| 8 | 10 | 10 | 52 | 34 | 1 | 44 | 4 | 5. 141049 |
| 9 | 10 | 12 | 4 | 57 | 1 | 43 | 10 | 5. 141190 |
| 10 | 10 | 13 | 17 | 26 | 1 | 42 | 14 | 5. 141348 |
| 11 | 10 | 14 | 29 | 33 | 1 | 41 | 15 | 5. 141522 |
| 12 | 10 | 15 | 41 | 46 | 1 | 40 | 13 | 5. 141711 |
| 13 | 10 | 16 | 53 | 55 | 1 | 39 | 9 | 5. 141916 |
| 14 | 10 | 18 | 6 | 0 | 1 | 38 | 2 | 5. 142137 |
| 15 | 10 | 19 | 18 | 0 | 1 | 36 | 52 | 5. 142374 |
| 16 | 10 | 20 | 29 | 56 | 1 | 35 | 41 | 5. 142626 |
| 17 | 10 | 21 | 41 | 48 | 1 | 34 | 26 | 5. 142893 |
| 18 | 10 | 22 | 53 | 33 | 1 | 33 | 10 | 5. 143174 |
| 19 | 10 | 24 | 5 | 13 | 1 | 31 | 51 | 5. 143471 |
| 20 | 10 | 25 | 16 | 46 | 1 | 30 | 29 | 5. 143783 |
| 21 | 10 | 26 | 28 | 13 | 1 | 29 | 9 | 5. 144109 |
| 22 | 10 | 27 | 39 | 34 | 1 | 27 | 40 | 5. 144449 |
| 23 | 10 | 28 | 50 | 49 | 1 | 26 | 13 | 5. 144804 |
| 24 | 11 | 0 | 1 | 55 | 1 | 24 | 43 | 5. 145172 |
| 25 | 11 | 1 | 12 | 55 | 1 | 23 | 11 | 5. 145554 |
| 26 | 11 | 2 | 23 | 48 | 1 | 21 | 37 | 5. 145950 |
| 27 | 11 | 3 | 34 | 32 | 1 | 20 | 1 | 5. 146358 |
| 28 | 11 | 4 | 45 | 9 | 1 | 18 | 24 | 5. 146779 |
| 29 | 11 | 5 | 55 | 37 | 1 | 16 | 44 | 5. 147213 |
| 30 | 11 | 7 | 5 | 56 | 1 | 15 | 3 | 5. 147659 |

## A Table of the Heliocentrick Place of *Mars*.

*Sign.* 7.

| Mid. Anom. | Long. ♂ à ☊ ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 11 | 7 | 5 | 56 | 1 | 15 | 3 | 5. 147659 |
| 1 | 11 | 8 | 16 | 8 | 1 | 13 | 21 | 5. 148118 |
| 2 | 11 | 9 | 26 | 10 | 1 | 11 | 36 | 5. 148589 |
| 3 | 11 | 10 | 36 | 4 | 1 | 9 | 50 | 5. 149071 |
| 4 | 11 | 11 | 45 | 47 | 1 | 8 | 3 | 5. 149564 |
| 5 | 11 | 12 | 55 | 21 | 1 | 6 | 14 | 5. 150069 |
| 6 | 11 | 14 | 4 | 46 | 1 | 4 | 24 | 5. 150585 |
| 7 | 11 | 15 | 14 | 0 | 1 | 2 | 32 | 5. 151111 |
| 8 | 11 | 16 | 23 | 5 | 1 | 0 | 39 | 5. 151647 |
| 9 | 11 | 17 | 31 | 59 | 0 | 58 | 45 | 5. 152193 |
| 10 | 11 | 18 | 40 | 42 | 0 | 56 | 50 | 5. 152749 |
| 11 | 11 | 19 | 49 | 15 | 0 | 54 | 54 | 5. 153314 |
| 12 | 11 | 20 | 57 | 37 | 0 | 52 | 57 | 5. 153888 |
| 13 | 11 | 22 | 5 | 49 | 0 | 50 | 59 | 5. 154471 |
| 14 | 11 | 23 | 13 | 50 | 0 | 49 | 0 | 5. 155063 |
| 15 | 11 | 24 | 21 | 40 | 0 | 47 | 0 | 5. 155663 |
| 16 | 11 | 25 | 29 | 18 | 0 | 45 | 0 | 5. 156271 |
| 17 | 11 | 26 | 36 | 44 | 0 | 42 | 58 | 5. 156886 |
| 18 | 11 | 27 | 43 | 59 | 0 | 40 | 56 | 5. 157509 |
| 19 | 11 | 28 | 51 | 3 | 0 | 38 | 54 | 5. 158139 |
| 20 | 11 | 29 | 57 | 54 | 0 | 36 | 51 | 5. 158776 |
| 21 | 0 | 1 | 4 | 35 | 0 | 34 | 47 | 5. 159419 |
| 22 | 0 | 2 | 11 | 3 | 0 | 32 | 43 | 5. 160068 |
| 23 | 0 | 3 | 17 | 20 | 0 | 30 | 39 | 5. 160723 |
| 24 | 0 | 4 | 23 | 24 | 0 | 28 | 35 | 5. 161383 |
| 25 | 0 | 5 | 29 | 16 | 0 | 26 | 30 | 5. 162049 |
| 26 | 0 | 6 | 34 | 56 | 0 | 24 | 25 | 5. 162719 |
| 27 | 0 | 7 | 40 | 24 | 0 | 22 | 19 | 5. 163395 |
| 28 | 0 | 8 | 45 | 40 | 0 | 20 | 14 | 5. 164075 |
| 29 | 0 | 9 | 50 | 44 | 0 | 18 | 9 | 5. 164749 |
| 30 | 0 | 10 | 55 | 34 | 0 | 16 | 4 | 5. 165446 |

## A Table of the Heliocentrick Place of *Mars*.

*Sign.* 8.

| Mid. Anom. | Long. ♂ à ☊ ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 0 | 10 | 55 | 34 | 0 | 16 | 4 | 5. 165446 |
| 1 | 0 | 12 | 0 | 13 | 0 | 13 | 58 | 5. 166137 |
| 2 | 0 | 13 | 4 | 39 | 0 | 11 | 53 | 5. 166832 |
| 3 | 0 | 14 | 8 | 53 | 0 | 9 | 48 | 5. 167530 |
| 4 | 0 | 15 | 12 | 54 | 0 | 7 | 43 | 5. 168230 |
| 5 | 0 | 16 | 16 | 43 | 0 | 5 | 39 | 5. 168932 |
| 6 | 0 | 17 | 20 | 19 | 0 | 3 | 35 | 5. 169638 |
| 7 | 0 | 18 | 23 | 43 | 0 | 1 | 31 | 5. 170345 |
| 8 | 0 | 19 | 26 | 54 | Nor. | 0 | 33 | 5. 171053 |
| 9 | 0 | 20 | 29 | 53 | 0 | 2 | 36 | 5. 171762 |
| 10 | 0 | 21 | 32 | 40 | 0 | 4 | 39 | 5. 172473 |
| 11 | 0 | 22 | 35 | 14 | 0 | 6 | 41 | 5. 173184 |
| 12 | 0 | 23 | 37 | 36 | 0 | 8 | 43 | 5. 173897 |
| 13 | 0 | 24 | 39 | 45 | 0 | 10 | 44 | 5. 174610 |
| 14 | 0 | 25 | 41 | 42 | 0 | 12 | 44 | 5. 175323 |
| 15 | 0 | 26 | 43 | 27 | 0 | 14 | 44 | 5. 176036 |
| 16 | 0 | 27 | 45 | 1 | 0 | 16 | 43 | 5. 176748 |
| 17 | 0 | 28 | 46 | 21 | 0 | 18 | 42 | 5. 177460 |
| 18 | 0 | 29 | 47 | 30 | 0 | 20 | 39 | 5. 178171 |
| 19 | 1 | 0 | 48 | 26 | 0 | 22 | 36 | 5. 178882 |
| 20 | 1 | 1 | 49 | 11 | 0 | 24 | 32 | 5. 179590 |
| 21 | 1 | 2 | 49 | 43 | 0 | 26 | 28 | 5. 180297 |
| 22 | 1 | 3 | 50 | 3 | 0 | 28 | 22 | 5. 181003 |
| 23 | 1 | 4 | 50 | 12 | 0 | 30 | 16 | 5. 181707 |
| 24 | 1 | 5 | 50 | 9 | 0 | 32 | 8 | 5. 182409 |
| 25 | 1 | 6 | 49 | 55 | 0 | 34 | 0 | 5. 183109 |
| 26 | 1 | 7 | 49 | 28 | 0 | 35 | 51 | 5. 183806 |
| 27 | 1 | 8 | 48 | 50 | 0 | 37 | 40 | 5. 184500 |
| 28 | 1 | 9 | 48 | 1 | 0 | 39 | 29 | 5. 185191 |
| 29 | 1 | 10 | 47 | 0 | 0 | 41 | 16 | 5. 185880 |
| 30 | 1 | 11 | 45 | 47 | 0 | 43 | 3 | 5. 186566 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | Sign. 9. Long. ♂ à ☉ ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 1 | 11 | 45 | 47 | 0 | 43 | 3 | 5. 186566 |
| 1 | 1 | 12 | 44 | 24 | 0 | 44 | 48 | 5. 187248 |
| 2 | 1 | 13 | 42 | 50 | 0 | 46 | 33 | 5. 187926 |
| 3 | 1 | 14 | 41 | 4 | 0 | 48 | 16 | 5. 188601 |
| 4 | 1 | 15 | 39 | 9 | 0 | 49 | 58 | 5. 189272 |
| 5 | 1 | 16 | 37 | 2 | 0 | 51 | 39 | 5. 189939 |
| 6 | 1 | 17 | 34 | 45 | 0 | 53 | 18 | 5. 190601 |
| 7 | 1 | 18 | 32 | 16 | 0 | 54 | 57 | 5. 191260 |
| 8 | 1 | 19 | 29 | 37 | 0 | 56 | 34 | 5. 191913 |
| 9 | 1 | 20 | 26 | 48 | 0 | 58 | 10 | 5. 192562 |
| 10 | 1 | 21 | 23 | 48 | 0 | 59 | 45 | 5. 193206 |
| 11 | 1 | 22 | 20 | 38 | 1 | 1 | 18 | 5. 193846 |
| 12 | 1 | 23 | 17 | 18 | 1 | 2 | 51 | 5. 194480 |
| 13 | 1 | 24 | 13 | 48 | 1 | 4 | 21 | 5. 195110 |
| 14 | 1 | 25 | 10 | 9 | 1 | 5 | 51 | 5. 195733 |
| 15 | 1 | 26 | 6 | 20 | 1 | 7 | 19 | 5. 196351 |
| 16 | 1 | 27 | 2 | 21 | 1 | 8 | 46 | 5. 196964 |
| 17 | 1 | 27 | 58 | 12 | 1 | 10 | 12 | 5. 197570 |
| 18 | 1 | 28 | 53 | 55 | 1 | 11 | 36 | 5. 198172 |
| 19 | 1 | 29 | 49 | 29 | 1 | 12 | 59 | 5. 198767 |
| 20 | 2 | 0 | 44 | 53 | 1 | 14 | 21 | 5. 199355 |
| 21 | 2 | 1 | 40 | 7 | 1 | 15 | 41 | 5. 199938 |
| 22 | 2 | 2 | 35 | 13 | 1 | 17 | 0 | 5. 200514 |
| 23 | 2 | 3 | 30 | 11 | 1 | 18 | 17 | 5. 201084 |
| 24 | 2 | 4 | 24 | 59 | 1 | 19 | 33 | 5. 201648 |
| 25 | 2 | 5 | 19 | 39 | 1 | 20 | 48 | 5. 202205 |
| 26 | 2 | 6 | 14 | 11 | 1 | 22 | 1 | 5. 202755 |
| 27 | 2 | 7 | 8 | 35 | 1 | 23 | 13 | 5. 203299 |
| 28 | 2 | 8 | 2 | 51 | 1 | 24 | 23 | 5. 203835 |
| 29 | 2 | 8 | 56 | 58 | 1 | 25 | 32 | 5. 204365 |
| 30 | 2 | 9 | 50 | 57 | 1 | 26 | 40 | 5. 204887 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | Sign. 10. Long. ♂ à ☉ ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 2 | 9 | 50 | 57 | 1 | 26 | 40 | 5. 204887 |
| 1 | 2 | 10 | 44 | 49 | 1 | 27 | 46 | 5. 205402 |
| 2 | 2 | 11 | 38 | 33 | 1 | 28 | 50 | 5. 205910 |
| 3 | 2 | 12 | 32 | 10 | 1 | 29 | 53 | 5. 206411 |
| 4 | 2 | 13 | 25 | 40 | 1 | 30 | 55 | 5. 206904 |
| 5 | 2 | 14 | 19 | 2 | 1 | 31 | 55 | 5. 207390 |
| 6 | 2 | 15 | 12 | 17 | 1 | 32 | 54 | 5. 207868 |
| 7 | 2 | 16 | 5 | 25 | 1 | 33 | 52 | 5. 208339 |
| 8 | 2 | 16 | 58 | 27 | 1 | 34 | 47 | 5. 208802 |
| 9 | 2 | 17 | 51 | 21 | 1 | 35 | 42 | 5. 209257 |
| 10 | 2 | 18 | 44 | 9 | 1 | 36 | 35 | 5. 209705 |
| 11 | 2 | 19 | 36 | 50 | 1 | 37 | 26 | 5. 210144 |
| 12 | 2 | 20 | 29 | 26 | 1 | 38 | 16 | 5. 210576 |
| 13 | 2 | 21 | 21 | 55 | 1 | 39 | 5 | 5. 211000 |
| 14 | 2 | 22 | 14 | 18 | 1 | 39 | 52 | 5. 211415 |
| 15 | 2 | 23 | 6 | 35 | 1 | 40 | 37 | 5. 211823 |
| 16 | 2 | 23 | 58 | 46 | 1 | 41 | 21 | 5. 212222 |
| 17 | 2 | 24 | 50 | 52 | 1 | 42 | 4 | 5. 212613 |
| 18 | 2 | 25 | 42 | 52 | 1 | 42 | 45 | 5. 212995 |
| 19 | 2 | 26 | 34 | 47 | 1 | 43 | 25 | 5. 213369 |
| 20 | 2 | 27 | 26 | 37 | 1 | 44 | 3 | 5. 213736 |
| 21 | 2 | 28 | 18 | 21 | 1 | 44 | 40 | 5. 214094 |
| 22 | 2 | 29 | 10 | 0 | 1 | 45 | 15 | 5. 214443 |
| 23 | 3 | 0 | 1 | 35 | 1 | 45 | 49 | 5. 214783 |
| 24 | 3 | 0 | 53 | 4 | 1 | 46 | 21 | 5. 215115 |
| 25 | 3 | 1 | 44 | 29 | 1 | 46 | 52 | 5. 215438 |
| 26 | 3 | 2 | 35 | 50 | 1 | 47 | 21 | 5. 215753 |
| 27 | 3 | 3 | 27 | 6 | 1 | 47 | 49 | 5. 216059 |
| 28 | 3 | 4 | 18 | 18 | 1 | 48 | 15 | 5. 216357 |
| 29 | 3 | 5 | 9 | 26 | 1 | 48 | 40 | 5. 216645 |
| 30 | 3 | 6 | 0 | 30 | 1 | 49 | 4 | 5. 216925 |

## A Table of the Heliocentrick Place of *Mars*.

| Mid. Anom. | *Sign.* 11. Long. ♂ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 3 | 6 | 0 | 30 | 1 | 49 | 4 | 5. 216925 |
| 1 | 3 | 6 | 51 | 30 | 1 | 49 | 26 | 5. 217196 |
| 2 | 3 | 7 | 42 | 27 | 1 | 49 | 46 | 5. 217458 |
| 3 | 3 | 8 | 33 | 19 | 1 | 50 | 5 | 5. 217710 |
| 4 | 3 | 9 | 24 | 8 | 1 | 50 | 23 | 5. 217955 |
| 5 | 3 | 10 | 14 | 55 | 1 | 50 | 39 | 5. 218191 |
| 6 | 3 | 11 | 5 | 37 | 1 | 50 | 53 | 5. 218417 |
| 7 | 3 | 11 | 56 | 17 | 1 | 51 | 7 | 5. 218635 |
| 8 | 3 | 12 | 46 | 54 | 1 | 51 | 18 | 5. 218843 |
| 9 | 3 | 13 | 37 | 28 | 1 | 51 | 29 | 5. 219042 |
| 10 | 3 | 14 | 28 | 0 | 1 | 51 | 37 | 5. 219233 |
| 11 | 3 | 15 | 18 | 29 | 1 | 51 | 45 | 5. 219415 |
| 12 | 3 | 16 | 8 | 55 | 1 | 51 | 51 | 5. 219587 |
| 13 | 3 | 16 | 59 | 19 | 1 | 51 | 55 | 5. 219750 |
| 14 | 3 | 17 | 49 | 41 | 1 | 51 | 58 | 5. 219904 |
| 15 | 3 | 18 | 40 | 2 | 1 | 52 | 0 | 5. 220048 |
| 16 | 3 | 19 | 30 | 20 | 1 | 52 | 0 | 5. 220184 |
| 17 | 3 | 20 | 20 | 36 | 1 | 51 | 59 | 5. 220311 |
| 18 | 3 | 21 | 10 | 51 | 1 | 51 | 56 | 5. 220428 |
| 19 | 3 | 22 | 1 | 4 | 1 | 51 | 52 | 5. 220536 |
| 20 | 3 | 22 | 51 | 15 | 1 | 51 | 46 | 5. 220634 |
| 21 | 3 | 23 | 41 | 26 | 1 | 51 | 39 | 5. 220724 |
| 22 | 3 | 24 | 31 | 36 | 1 | 51 | 31 | 5. 220804 |
| 23 | 3 | 25 | 21 | 43 | 1 | 51 | 21 | 5. 220875 |
| 24 | 3 | 26 | 11 | 51 | 1 | 51 | 10 | 5. 220937 |
| 25 | 3 | 27 | 1 | 57 | 1 | 50 | 57 | 5. 220990 |
| 26 | 3 | 27 | 52 | 3 | 1 | 50 | 43 | 5. 221033 |
| 27 | 3 | 28 | 42 | 8 | 1 | 50 | 27 | 5. 221067 |
| 28 | 3 | 29 | 32 | 14 | 1 | 50 | 10 | 5. 221092 |
| 29 | 4 | 0 | 22 | 18 | 1 | 49 | 52 | 5. 221107 |
| 30 | 4 | 1 | 12 | 22 | 1 | 49 | 32 | 5. 221113 |

## A Table of the mean Motion of *Venus* from the *Aphelion*.



| Years from Christ | Anomaly ♀ s | o | ′ | ″ |
|---|---|---|---|---|
| - 1 | 4 | 3 | 48 | 55 |
| 1501 | 7 | 0 | 22 | 40 |
| 1581 | 7 | 14 | 35 | 40 |
| 1601 | 1 | 18 | 8 | 55 |
| 1621 | 7 | 21 | 42 | 10 |
| 1641 | 1 | 25 | 15 | 25 |
| 1661 | 7 | 28 | 48 | 40 |
| 1681 | 2 | 2 | 21 | 55 |
| 1701 | 8 | 5 | 55 | 10 |
| 1721 | 2 | 9 | 28 | 25 |
| 1741 | 8 | 13 | 1 | 40 |
| 1761 | 2 | 16 | 34 | 55 |
| 1781 | 8 | 20 | 8 | 10 |
| 1801 | 2 | 23 | 41 | 25 |
| 1901 | 9 | 11 | 27 | 40 |
| 2001 | 3 | 29 | 13 | 55 |

| Years | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 20 | 6 | 3 | 33 | 15 |
| 40 | 0 | 7 | 6 | 30 |
| 60 | 6 | 10 | 39 | 45 |
| 80 | 0 | 14 | 13 | 0 |
| 100 | 6 | 17 | 46 | 15 |
| 200 | 1 | 5 | 33 | 30 |
| 300 | 7 | 23 | 18 | 45 |
| 400 | 2 | 11 | 5 | 0 |
| 500 | 8 | 28 | 51 | 15 |
| 600 | 3 | 16 | 37 | 30 |
| 700 | 10 | 4 | 23 | 45 |
| 800 | 4 | 22 | 10 | 0 |
| 900 | 11 | 9 | 56 | 15 |
| 1000 | 5 | 27 | 42 | 30 |
| 2000 | 11 | 52 | 25 | 0 |
| 3000 | 5 | 23 | 7 | 30 |
| 4000 | 11 | 20 | 50 | 0 |
| 5000 | 5 | 18 | 32 | 30 |
| 6000 | 11 | 16 | 15 | 0 |

| Years. | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 7 | 14 | 46 | 38 |
| 2 | 2 | 29 | 33 | 16 |
| 3 | 10 | 14 | 19 | 54 |
| 4 | 6 | 0 | 42 | 39 |
| 5 | 1 | 15 | 29 | 17 |
| 6 | 9 | 0 | 15 | 55 |
| 7 | 4 | 15 | 2 | 33 |
| 8 | 0 | 1 | 25 | 18 |
| 9 | 7 | 16 | 11 | 56 |
| 10 | 3 | 0 | 58 | 34 |
| 11 | 10 | 15 | 45 | 12 |
| 12 | 6 | 2 | 7 | 57 |
| 13 | 1 | 16 | 54 | 35 |
| 14 | 9 | 1 | 41 | 13 |
| 15 | 4 | 16 | 27 | 51 |
| 16 | 0 | 2 | 50 | 36 |
| 17 | 7 | 17 | 37 | 14 |
| 18 | 3 | 2 | 23 | 52 |
| 19 | 0 | 17 | 10 | 30 |
| 20 | 16 | 3 | 33 | 15 |

| Months | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| *January* | 0 | 0 | 0 | 0 |
| *February* | 1 | 19 | 39 | 58 |
| *March* | 3 | 4 | 31 | 32 |
| *April* | 4 | 24 | 11 | 30 |
| *May* | 6 | 12 | 15 | 20 |
| *June* | 8 | 1 | 55 | 17 |
| *July* | 9 | 19 | 59 | 7 |
| *August* | 11 | 9 | 39 | 5 |
| *September* | 0 | 29 | 19 | 3 |
| *October* | 2 | 17 | 22 | 53 |
| *November* | 4 | 7 | 2 | 50 |
| *December.* | 5 | 25 | 6 | 40 |

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

## A Table of the mean Motion of *Venus* from the *Aphelion*.

| Days | Anom. Mot. s | ° | ′ | ″ | H. | Anom. Mot. ° | ′ | ″ | H. | Anom. Mot. ° | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ′ | ′ | ″ | ‴ | | ′ | ″ | ‴ |
| 1 | 0 | 1 | 36 | 8 | 1 | 0 | 4 | 0 | 31 | 2 | 4 | 10 |
| 2 | 0 | 3 | 12 | 15 | 2 | 0 | 8 | 1 | 32 | 2 | 8 | 10 |
| 3 | 0 | 4 | 48 | 23 | 3 | 0 | 12 | 1 | 33 | 2 | 12 | 11 |
| 4 | 0 | 6 | 24 | 31 | 4 | 0 | 16 | 1 | 34 | 2 | 16 | 11 |
| 5 | 0 | 8 | 0 | 38 | 5 | 0 | 20 | 2 | 35 | 2 | 20 | 11 |
| 6 | 0 | 9 | 36 | 46 | 6 | 0 | 24 | 2 | 36 | 2 | 24 | 11 |
| 7 | 0 | 11 | 12 | 54 | 7 | 0 | 28 | 2 | 37 | 2 | 28 | 12 |
| 8 | 0 | 12 | 49 | 1 | 8 | 0 | 32 | 3 | 38 | 2 | 32 | 12 |
| 9 | 0 | 14 | 25 | 9 | 9 | 0 | 36 | 3 | 39 | 2 | 36 | 12 |
| 10 | 0 | 16 | 1 | 17 | 10 | 0 | 40 | 3 | 40 | 2 | 40 | 13 |
| 11 | 0 | 17 | 37 | 24 | 11 | 0 | 44 | 4 | 41 | 2 | 44 | 13 |
| 12 | 0 | 19 | 13 | 33 | 12 | 0 | 48 | 4 | 42 | 2 | 48 | 13 |
| 13 | 0 | 20 | 49 | 40 | 13 | 0 | 52 | 4 | 43 | 2 | 52 | 14 |
| 14 | 0 | 22 | 25 | 47 | 14 | 0 | 56 | 4 | 44 | 2 | 56 | 14 |
| 15 | 0 | 24 | 1 | 55 | 15 | 1 | 0 | 5 | 45 | 3 | 0 | 14 |
| 16 | 0 | 25 | 33 | 3 | 16 | 1 | 4 | 5 | 46 | 3 | 4 | 15 |
| 17 | 0 | 27 | 14 | 10 | 17 | 1 | 8 | 5 | 47 | 3 | 8 | 15 |
| 18 | 0 | 28 | 50 | 18 | 18 | 1 | 12 | 6 | 48 | 3 | 12 | 15 |
| 19 | 1 | 0 | 26 | 26 | 19 | 1 | 16 | 6 | 49 | 3 | 16 | 16 |
| 20 | 1 | 2 | 2 | 33 | 20 | 1 | 20 | 6 | 50 | 3 | 20 | 16 |
| 21 | 1 | 3 | 38 | 41 | 21 | 1 | 24 | 7 | 51 | 3 | 24 | 16 |
| 22 | 1 | 5 | 14 | 49 | 22 | 1 | 28 | 7 | 52 | 3 | 28 | 17 |
| 23 | 1 | 6 | 50 | 56 | 23 | 1 | 32 | 7 | 53 | 3 | 32 | 17 |
| 24 | 1 | 8 | 27 | 4 | 24 | 1 | 36 | 8 | 54 | 3 | 36 | 17 |
| 25 | 1 | 10 | 3 | 12 | 25 | 1 | 40 | 8 | 55 | 3 | 40 | 18 |
| 26 | 1 | 11 | 39 | 19 | 26 | 1 | 44 | 8 | 56 | 3 | 44 | 18 |
| 27 | 1 | 13 | 15 | 27 | 27 | 1 | 48 | 9 | 57 | 3 | 48 | 18 |
| 28 | 1 | 14 | 51 | 35 | 28 | 1 | 52 | 9 | 58 | 3 | 52 | 19 |
| 29 | 1 | 16 | 27 | 42 | 29 | 1 | 56 | 9 | 59 | 3 | 56 | 19 |
| 30 | 1 | 18 | 3 | 50 | 30 | 2 | 0 | 10 | 60 | 4 | 0 | 19 |
| 31 | 1 | 19 | 39 | 58 | | | | | | | | |
| 32 | 1 | 21 | 16 | 5 | | | | | | | | |

| | s | ° | ′ | ″ |
|---|---|---|---|---|
| Long. Aph. ♀ à 1 ✶ ♈ | 9 | 5 | 0 | 0 |
| Long. ☊ ♀ à 1 ✱ ♈ | 1 | 15 | 16 | 0 |
| Inclin. Orb. ♀ | | | 3 | 24 | 0 |
| Dist. Mid. ♀ à ☉ | | | | 72333 |
| Eccentricity | | | | 517 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | ♀ Long. ♀ à 1 ✶ ♈ s | ° | ′ | ″ | Inc. South. ° | ′ | ″ | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| 0 | 9 | 4 | 57 | 1 | 2 | 35 | 37 | 4. 861985 |
| 1 | 9 | 5 | 56 | 11 | 2 | 37 | 52 | 4. 861971 |
| 2 | 9 | 6 | 55 | 21 | 2 | 40 | 4 | 4. 861957 |
| 3 | 9 | 7 | 54 | 32 | 2 | 42 | 13 | 4. 861941 |
| 4 | 9 | 8 | 53 | 42 | 2 | 44 | 20 | 4. 861926 |
| 5 | 9 | 9 | 52 | 53 | 2 | 46 | 23 | 4. 861909 |
| 6 | 9 | 10 | 52 | 5 | 2 | 48 | 23 | 4. 861892 |
| 7 | 9 | 11 | 51 | 17 | 2 | 50 | 11 | 4. 861874 |
| 8 | 9 | 12 | 50 | 29 | 2 | 52 | 15 | 4. 861854 |
| 9 | 9 | 13 | 49 | 42 | 2 | 54 | 6 | 4. 861834 |
| 10 | 9 | 14 | 48 | 55 | 2 | 55 | 55 | 4. 861814 |
| 11 | 9 | 15 | 48 | 7 | 2 | 57 | 40 | 4. 861793 |
| 12 | 9 | 16 | 47 | 20 | 2 | 59 | 22 | 4. 861772 |
| 13 | 9 | 17 | 46 | 34 | 3 | 1 | 1 | 4. 861750 |
| 14 | 9 | 18 | 45 | 48 | 3 | 2 | 36 | 4. 861726 |
| 15 | 9 | 19 | 45 | 2 | 3 | 4 | 9 | 4. 861703 |
| 16 | 9 | 20 | 44 | 17 | 3 | 5 | 38 | 4. 861679 |
| 17 | 9 | 21 | 43 | 32 | 3 | 7 | 3 | 4. 861654 |
| 18 | 9 | 22 | 42 | 48 | 3 | 8 | 26 | 4. 861628 |
| 19 | 9 | 23 | 42 | 4 | 3 | 9 | 45 | 4. 861602 |
| 20 | 9 | 24 | 41 | 20 | 3 | 11 | 1 | 4. 861575 |
| 21 | 9 | 25 | 40 | 37 | 3 | 12 | 13 | 4. 861548 |
| 22 | 9 | 26 | 39 | 55 | 3 | 13 | 22 | 4. 861521 |
| 23 | 9 | 27 | 39 | 12 | 3 | 14 | 27 | 4. 861492 |
| 24 | 9 | 28 | 38 | 31 | 3 | 15 | 29 | 4. 861463 |
| 25 | 9 | 29 | 37 | 50 | 3 | 16 | 28 | 4. 861434 |
| 26 | 10 | 0 | 37 | 9 | 3 | 17 | 23 | 4. 861405 |
| 27 | 10 | 1 | 36 | 29 | 3 | 18 | 15 | 4. 861375 |
| 28 | 10 | 2 | 35 | 50 | 3 | 19 | 3 | 4. 861345 |
| 29 | 10 | 3 | 35 | 10 | 3 | 19 | 47 | 4. 861315 |
| 30 | 10 | 4 | 34 | 31 | 3 | 20 | 28 | 4. 861284 |

A Table

## A Table of the Heliocentrick Place of *Venus*.

*Sign.* 1.

| Mid. Anom. | Long. ♀ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 10 | 4 | 34 | 31 | 3 | 20 | 28 | 4. 861284 |
| 1 | 10 | 5 | 33 | 53 | 3 | 21 | 5 | 4. 861253 |
| 2 | 10 | 6 | 33 | 15 | 3 | 21 | 39 | 4. 861221 |
| 3 | 10 | 7 | 32 | 38 | 3 | 22 | 9 | 4. 861189 |
| 4 | 10 | 8 | 32 | 1 | 3 | 22 | 36 | 4. 861155 |
| 5 | 10 | 9 | 31 | 25 | 3 | 22 | 59 | 4. 861122 |
| 6 | 10 | 10 | 30 | 49 | 3 | 23 | 18 | 4. 861088 |
| 7 | 10 | 11 | 30 | 14 | 3 | 23 | 34 | 4. 861055 |
| 8 | 10 | 12 | 29 | 40 | 3 | 23 | 46 | 4. 861021 |
| 9 | 10 | 13 | 29 | 6 | 3 | 23 | 54 | 4. 860987 |
| 10 | 10 | 14 | 28 | 33 | 3 | 23 | 59 | 4. 860952 |
| 11 | 10 | 15 | 28 | 0 | 3 | 24 | 0 | 4. 860917 |
| 12 | 10 | 16 | 27 | 27 | 3 | 23 | 57 | 4. 860882 |
| 13 | 10 | 17 | 26 | 156 | 3 | 23 | 51 | 4. 860847 |
| 14 | 10 | 18 | 26 | 25 | 3 | 23 | 41 | 4. 860811 |
| 15 | 10 | 19 | 25 | 54 | 3 | 23 | 28 | 4. 860776 |
| 16 | 10 | 20 | 25 | 25 | 3 | 23 | 11 | 4. 860740 |
| 17 | 10 | 21 | 24 | 56 | 3 | 22 | 50 | 4. 860704 |
| 18 | 10 | 22 | 24 | 27 | 3 | 22 | 25 | 4. 860668 |
| 19 | 10 | 23 | 23 | 59 | 3 | 21 | 57 | 4. 860631 |
| 20 | 10 | 24 | 23 | 31 | 3 | 21 | 25 | 4. 860594 |
| 21 | 10 | 25 | 23 | 4 | 3 | 20 | 50 | 4. 860557 |
| 22 | 10 | 26 | 22 | 38 | 3 | 20 | 11 | 4. 860520 |
| 23 | 10 | 27 | 22 | 12 | 3 | 19 | 29 | 4. 860483 |
| 24 | 10 | 28 | 21 | 46 | 3 | 18 | 42 | 4. 860446 |
| 25 | 10 | 29 | 21 | 22 | 3 | 17 | 53 | 4. 860408 |
| 26 | 11 | 0 | 20 | 59 | 3 | 16 | 59 | 4. 860371 |
| 27 | 11 | 1 | 20 | 35 | 3 | 16 | 2 | 4. 860334 |
| 28 | 11 | 2 | 20 | 13 | 3 | 15 | 2 | 4. 860295 |
| 29 | 11 | 3 | 19 | 51 | 3 | 13 | 58 | 4. 860256 |
| 30 | 11 | 4 | 19 | 30 | 3 | 12 | 51 | 4. 860218 |

## A Table of the Heliocentrick Place of *Venus*.

*Sign.* 2.

| Mid. Anom. | Long. ♀ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 11 | 4 | 19 | 30 | 3 | 12 | 51 | 4. 860218 |
| 1 | 11 | 5 | 19 | 9 | 3 | 11 | 40 | 4. 860181 |
| 2 | 11 | 6 | 18 | 48 | 3 | 10 | 25 | 4. 860142 |
| 3 | 11 | 7 | 18 | 29 | 3 | 9 | 7 | 4. 860104 |
| 4 | 11 | 8 | 18 | 10 | 3 | 7 | 46 | 4. 860065 |
| 5 | 11 | 9 | 17 | 52 | 3 | 6 | 21 | 4. 860027 |
| 6 | 11 | 10 | 17 | 35 | 3 | 4 | 53 | 4. 859988 |
| 7 | 11 | 11 | 17 | 18 | 3 | 3 | 22 | 4. 859949 |
| 8 | 11 | 12 | 17 | 2 | 3 | 1 | 47 | 4. 859910 |
| 9 | 11 | 13 | 16 | 46 | 3 | 0 | 9 | 4. 859870 |
| 10 | 11 | 14 | 16 | 32 | 2 | 58 | 27 | 4. 859831 |
| 11 | 11 | 15 | 16 | 17 | 2 | 56 | 43 | 4. 859792 |
| 12 | 11 | 16 | 16 | 4 | 2 | 54 | 55 | 4. 859753 |
| 13 | 11 | 17 | 15 | 51 | 2 | 53 | 4 | 4. 859713 |
| 14 | 11 | 18 | 15 | 39 | 2 | 51 | 10 | 4. 859673 |
| 15 | 11 | 19 | 15 | 27 | 2 | 49 | 12 | 4. 859634 |
| 16 | 11 | 20 | 15 | 16 | 2 | 47 | 12 | 4. 859594 |
| 17 | 11 | 21 | 15 | 6 | 2 | 45 | 8 | 4. 859554 |
| 18 | 11 | 22 | 14 | 56 | 2 | 43 | 2 | 4. 859514 |
| 19 | 11 | 23 | 14 | 47 | 2 | 40 | 52 | 4. 859474 |
| 20 | 11 | 24 | 14 | 39 | 2 | 38 | 40 | 4. 859434 |
| 21 | 11 | 25 | 14 | 31 | 2 | 36 | 24 | 4. 859394 |
| 22 | 11 | 26 | 14 | 24 | 2 | 34 | 6 | 4. 859353 |
| 23 | 11 | 27 | 14 | 18 | 2 | 31 | 45 | 4. 859313 |
| 24 | 11 | 28 | 14 | 12 | 2 | 29 | 21 | 4. 859273 |
| 25 | 11 | 29 | 14 | 7 | 2 | 26 | 54 | 4. 859232 |
| 26 | 0 | 0 | 14 | 3 | 2 | 24 | 25 | 4. 859192 |
| 27 | 0 | 1 | 13 | 59 | 2 | 21 | 53 | 4. 859151 |
| 28 | 0 | 2 | 13 | 56 | 2 | 19 | 18 | 4. 859110 |
| 29 | 0 | 3 | 13 | 54 | 2 | 16 | 41 | 4. 859070 |
| 30 | 0 | 4 | 13 | 52 | 2 | 14 | 1 | 4. 859029 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign. 3. Long. ♀ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 0 | 4 | 13 | 52 | 2 | 14 | 1 | 4. 859029 |
| 1 | 0 | 5 | 13 | 51 | 2 | 11 | 19 | 4. 858988 |
| 2 | 0 | 6 | 13 | 51 | 2 | 8 | 34 | 4. 858946 |
| 3 | 0 | 7 | 13 | 50 | 2 | 5 | 47 | 4. 858905 |
| 4 | 0 | 8 | 13 | 52 | 2 | 2 | 58 | 4. 858864 |
| 5 | 0 | 9 | 13 | 54 | 2 | 0 | 6 | 4. 858823 |
| 6 | 0 | 10 | 13 | 56 | 1 | 57 | 12 | 4. 858782 |
| 7 | 0 | 11 | 13 | 59 | 1 | 54 | 16 | 4. 858740 |
| 8 | 0 | 12 | 14 | 3 | 1 | 51 | 18 | 4. 858698 |
| 9 | 0 | 13 | 14 | 7 | 1 | 48 | 17 | 4. 858657 |
| 10 | 0 | 14 | 14 | 12 | 1 | 45 | 15 | 4. 858615 |
| 11 | 0 | 15 | 14 | 18 | 1 | 42 | 11 | 4. 858573 |
| 12 | 0 | 16 | 14 | 25 | 1 | 39 | 4 | 4. 858532 |
| 13 | 0 | 17 | 14 | 32 | 1 | 35 | 56 | 4. 858490 |
| 14 | 0 | 18 | 14 | 40 | 1 | 32 | 46 | 4. 858448 |
| 15 | 0 | 19 | 14 | 49 | 1 | 29 | 35 | 4. 858406 |
| 16 | 0 | 20 | 14 | 58 | 1 | 26 | 21 | 4. 858364 |
| 17 | 0 | 21 | 15 | 8 | 1 | 23 | 6 | 4. 858321 |
| 18 | 0 | 22 | 15 | 18 | 1 | 19 | 50 | 4. 858279 |
| 19 | 0 | 23 | 15 | 30 | 1 | 16 | 31 | 4. 858236 |
| 20 | 0 | 24 | 15 | 42 | 1 | 13 | 12 | 4. 858194 |
| 21 | 0 | 25 | 15 | 55 | 1 | 9 | 51 | 4. 858152 |
| 22 | 0 | 26 | 16 | 9 | 1 | 6 | 29 | 4. 858110 |
| 23 | 0 | 27 | 16 | 24 | 1 | 3 | 5 | 4. 858068 |
| 24 | 0 | 28 | 16 | 39 | 0 | 59 | 40 | 4. 858026 |
| 25 | 0 | 29 | 16 | 54 | 0 | 56 | 34 | 4. 857983 |
| 26 | 1 | 0 | 17 | 10 | 0 | 52 | 47 | 4. 857941 |
| 27 | 1 | 1 | 17 | 27 | 0 | 49 | 19 | 4. 857898 |
| 28 | 1 | 2 | 17 | 45 | 0 | 45 | 50 | 4. 857855 |
| 29 | 1 | 3 | 18 | 4 | 0 | 42 | 21 | 4. 857813 |
| 30 | 1 | 4 | 18 | 23 | 0 | 38 | 50 | 4. 857770 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign. 4. Long. ♀ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 1 | 4 | 18 | 23 | 0 | 38 | 50 | 4. 857770 |
| 1 | 1 | 5 | 18 | 43 | 0 | 35 | 18 | 4. 857728 |
| 2 | 1 | 6 | 19 | 4 | 0 | 31 | 46 | 4. 857685 |
| 3 | 1 | 7 | 19 | 25 | 0 | 28 | 13 | 4. 857643 |
| 4 | 1 | 8 | 19 | 48 | 0 | 24 | 40 | 4. 857601 |
| 5 | 1 | 9 | 20 | 11 | 0 | 21 | 6 | 4. 857559 |
| 6 | 1 | 10 | 20 | 34 | 0 | 17 | 32 | 4. 859516 |
| 7 | 1 | 11 | 20 | 58 | 0 | 13 | 57 | 4. 857474 |
| 8 | 1 | 12 | 21 | 22 | 0 | 10 | 22 | 4. 857433 |
| 9 | 1 | 13 | 21 | 48 | 0 | 6 | 47 | 4. 857391 |
| 10 | 1 | 14 | 22 | 14 | 0 | 3 | 12 | 4. 857350 |
| 11 | 1 | 15 | 22 | 41 | Nor. 0 | | 24 | 4. 857308 |
| 12 | 1 | 16 | 23 | 8 | 0 | 3 | 59 | 4. 857267 |
| 13 | 1 | 17 | 23 | 37 | 0 | 7 | 35 | 4. 857226 |
| 14 | 1 | 18 | 24 | 6 | 0 | 11 | 10 | 4. 857185 |
| 15 | 1 | 19 | 24 | 36 | 0 | 14 | 45 | 4. 857143 |
| 16 | 1 | 20 | 25 | 6 | 0 | 18 | 20 | 4. 857103 |
| 17 | 1 | 21 | 25 | 37 | 0 | 21 | 55 | 4. 857062 |
| 18 | 1 | 22 | 26 | 9 | 0 | 25 | 29 | 4. 857022 |
| 19 | 1 | 23 | 26 | 42 | 0 | 29 | 3 | 4. 856081 |
| 20 | 1 | 24 | 27 | 15 | 0 | 32 | 37 | 4. 856941 |
| 21 | 1 | 25 | 27 | 49 | 0 | 36 | 9 | 4. 856902 |
| 22 | 1 | 26 | 28 | 23 | 0 | 39 | 41 | 4. 856863 |
| 23 | 1 | 27 | 28 | 58 | 0 | 43 | 13 | 4. 856824 |
| 24 | 1 | 28 | 29 | 34 | 0 | 46 | 44 | 4. 856786 |
| 25 | 1 | 29 | 30 | 10 | 0 | 50 | 13 | 4. 856748 |
| 26 | 2 | 0 | 30 | 47 | 0 | 53 | 42 | 4. 856709 |
| 27 | 2 | 1 | 31 | 24 | 0 | 57 | 10 | 4. 856672 |
| 28 | 2 | 2 | 32 | 2 | 1 | 0 | 37 | 4. 856635 |
| 29 | 2 | 3 | 32 | 41 | 1 | 4 | 3 | 4. 856598 |
| 30 | 2 | 4 | 33 | 20 | 1 | 7 | 28 | 4. 856562 |

A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign. 5. Long. ♀ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ⊙ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 2 | 4 | 33 | 20 | 1 | 7 | 28 | 4. 856562 |
| 1 | 2 | 5 | 34 | 0 | 1 | 10 | 51 | 4. 856526 |
| 2 | 2 | 6 | 34 | 42 | 1 | 14 | 13 | 4. 856491 |
| 3 | 2 | 7 | 35 | 24 | 1 | 17 | 34 | 4. 856456 |
| 4 | 2 | 8 | 36 | 5 | 1 | 20 | 53 | 4. 856422 |
| 5 | 2 | 9 | 36 | 47 | 1 | 24 | 11 | 4. 856388 |
| 6 | 2 | 10 | 37 | 30 | 1 | 27 | 27 | 4. 856354 |
| 7 | 2 | 11 | 38 | 13 | 1 | 30 | 42 | 4. 856322 |
| 8 | 2 | 12 | 38 | 58 | 1 | 33 | 55 | 4. 856290 |
| 9 | 2 | 13 | 39 | 43 | 1 | 37 | 6 | 4. 856259 |
| 10 | 2 | 14 | 40 | 28 | 1 | 40 | 15 | 4. 856228 |
| 11 | 2 | 15 | 41 | 14 | 1 | 43 | 23 | 4. 856198 |
| 12 | 2 | 16 | 42 | 0 | 1 | 46 | 29 | 4. 856169 |
| 13 | 2 | 17 | 42 | 47 | 1 | 49 | 32 | 4. 856140 |
| 14 | 2 | 18 | 43 | 33 | 1 | 52 | 34 | 4. 856112 |
| 15 | 2 | 19 | 44 | 20 | 1 | 55 | 33 | 4. 856085 |
| 16 | 2 | 20 | 45 | 8 | 1 | 58 | 31 | 4. 856058 |
| 17 | 2 | 21 | 45 | 57 | 2 | 1 | 26 | 4. 856032 |
| 18 | 2 | 22 | 46 | 46 | 2 | 4 | 19 | 4. 856007 |
| 19 | 2 | 23 | 47 | 36 | 2 | 7 | 10 | 4. 855983 |
| 20 | 2 | 24 | 48 | 25 | 2 | 9 | 58 | 4. 855960 |
| 21 | 2 | 25 | 49 | 15 | 2 | 12 | 43 | 4. 855937 |
| 22 | 2 | 26 | 50 | 6 | 2 | 15 | 27 | 4. 855915 |
| 23 | 2 | 27 | 50 | 57 | 2 | 18 | 7 | 4. 855894 |
| 24 | 2 | 28 | 51 | 48 | 2 | 20 | 46 | 4. 855875 |
| 25 | 2 | 29 | 52 | 39 | 2 | 23 | 21 | 4. 855856 |
| 26 | 3 | 0 | 53 | 30 | 2 | 25 | 54 | 4. 855838 |
| 27 | 3 | 1 | 54 | 22 | 2 | 28 | 24 | 4. 855821 |
| 28 | 3 | 2 | 55 | 15 | 2 | 30 | 51 | 4. 855805 |
| 29 | 3 | 3 | 56 | 8 | 2 | 33 | 16 | 4. 855790 |
| 30 | 3 | 4 | 57 | 1 | 2 | 35 | 37 | 4. 855776 |

A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign. 6. Long. ♀ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ⊙ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 3 | 4 | 57 | 1 | 2 | 35 | 37 | 4. 855776 |
| 1 | 3 | 5 | 57 | 54 | 2 | 37 | 56 | 4. 855763 |
| 2 | 3 | 6 | 58 | 48 | 2 | 40 | 12 | 4. 855751 |
| 3 | 3 | 7 | 59 | 41 | 2 | 42 | 24 | 4. 855741 |
| 4 | 3 | 9 | 0 | 35 | 2 | 44 | 34 | 4. 855731 |
| 5 | 3 | 10 | 1 | 28 | 2 | 46 | 41 | 4. 855722 |
| 6 | 3 | 11 | 2 | 22 | 2 | 48 | 44 | 4. 855715 |
| 7 | 3 | 12 | 3 | 16 | 2 | 50 | 44 | 4. 855709 |
| 8 | 3 | 13 | 4 | 11 | 2 | 52 | 41 | 4. 855704 |
| 9 | 3 | 14 | 5 | 5 | 2 | 54 | 35 | 4. 855700 |
| 10 | 3 | 15 | 5 | 59 | 2 | 56 | 25 | 4. 855698 |
| 11 | 3 | 16 | 6 | 53 | 2 | 58 | 13 | 4. 855696 |
| 12 | 3 | 17 | 7 | 48 | 2 | 59 | 56 | 4. 855696 |
| 13 | 3 | 18 | 8 | 42 | 3 | 1 | 37 | 4. 855697 |
| 14 | 3 | 19 | 9 | 37 | 3 | 3 | 14 | 4. 855699 |
| 15 | 3 | 20 | 10 | 31 | 3 | 4 | 47 | 4. 855702 |
| 16 | 3 | 21 | 11 | 25 | 3 | 6 | 17 | 4. 855707 |
| 17 | 3 | 22 | 12 | 19 | 3 | 7 | 44 | 4. 855713 |
| 18 | 3 | 23 | 13 | 13 | 3 | 9 | 7 | 4. 855720 |
| 19 | 3 | 24 | 14 | 7 | 3 | 10 | 6 | 4. 855728 |
| 20 | 3 | 25 | 15 | 0 | 3 | 11 | 42 | 4. 855737 |
| 21 | 3 | 26 | 15 | 53 | 3 | 12 | 54 | 4. 855748 |
| 22 | 3 | 27 | 16 | 47 | 3 | 14 | 3 | 4. 855760 |
| 23 | 3 | 28 | 17 | 40 | 3 | 15 | 8 | 4. 855773 |
| 24 | 3 | 29 | 18 | 33 | 3 | 16 | 9 | 4. 855788 |
| 25 | 4 | 0 | 19 | 25 | 3 | 17 | 7 | 4. 855804 |
| 26 | 4 | 1 | 20 | 18 | 3 | 18 | 1 | 4. 855821 |
| 27 | 4 | 2 | 21 | 10 | 3 | 18 | 51 | 4. 855839 |
| 28 | 4 | 3 | 22 | 2 | 3 | 19 | 38 | 4. 855859 |
| 29 | 4 | 4 | 22 | 54 | 3 | 20 | 20 | 4. 855880 |
| 30 | 4 | 5 | 23 | 45 | 3 | 20 | 59 | 4. 855903 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign 7. Long. ♀ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 4 | 5 | 23 | 45 | 3 | 20 | 59 | 4. 855903 |
| 1 | 4 | 6 | 24 | 35 | 3 | 21 | 34 | 4. 855927 |
| 2 | 4 | 7 | 25 | 25 | 3 | 22 | 6 | 4. 855952 |
| 3 | 4 | 8 | 26 | 15 | 3 | 22 | 33 | 4. 855978 |
| 4 | 4 | 9 | 27 | 4 | 3 | 22 | 57 | 4. 856005 |
| 5 | 4 | 10 | 27 | 53 | 3 | 23 | 17 | 4. 856934 |
| 6 | 4 | 11 | 28 | 42 | 3 | 23 | 33 | 4. 856064 |
| 7 | 4 | 12 | 29 | 30 | 3 | 23 | 46 | 4. 856095 |
| 8 | 4 | 13 | 30 | 17 | 3 | 23 | 54 | 4. 856128 |
| 9 | 4 | 14 | 31 | 3 | 3 | 23 | 59 | 4. 856161 |
| 10 | 4 | 15 | 31 | 50 | 3 | 24 | 0 | 4. 856196 |
| 11 | 4 | 16 | 32 | 35 | 3 | 23 | 57 | 4. 856232 |
| 12 | 4 | 17 | 33 | 21 | 3 | 23 | 50 | 4. 856270 |
| 13 | 4 | 18 | 34 | 5 | 3 | 23 | 40 | 4. 856308 |
| 14 | 4 | 19 | 34 | 48 | 3 | 23 | 25 | 4. 856348 |
| 15 | 4 | 20 | 35 | 32 | 3 | 23 | 7 | 4. 856389 |
| 16 | 4 | 21 | 36 | 14 | 3 | 22 | 45 | 4. 856431 |
| 17 | 4 | 22 | 36 | 55 | 3 | 22 | 20 | 4. 856474 |
| 18 | 4 | 23 | 37 | 37 | 3 | 21 | 50 | 4. 856518 |
| 19 | 4 | 24 | 38 | 16 | 3 | 21 | 17 | 4. 856563 |
| 20 | 4 | 25 | 38 | 55 | 3 | 20 | 40 | 4. 856610 |
| 21 | 4 | 26 | 39 | 34 | 3 | 19 | 59 | 4. 856657 |
| 22 | 4 | 27 | 40 | 12 | 3 | 19 | 15 | 4. 856705 |
| 23 | 4 | 28 | 40 | 48 | 3 | 18 | 27 | 4. 856754 |
| 24 | 4 | 29 | 41 | 25 | 3 | 17 | 35 | 4. 856804 |
| 25 | 5 | 0 | 42 | 0 | 3 | 16 | 40 | 4. 856856 |
| 26 | 5 | 1 | 42 | 34 | 3 | 15 | 41 | 4. 856909 |
| 27 | 5 | 2 | 43 | 8 | 3 | 14 | 38 | 4. 856962 |
| 28 | 5 | 3 | 43 | 41 | 3 | 13 | 31 | 4. 857016 |
| 29 | 5 | 4 | 44 | 13 | 3 | 12 | 22 | 4. 857071 |
| 30 | 5 | 5 | 44 | 44 | 3 | 11 | 8 | 4. 857126 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign 8. Long. ♀ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 5 | 5 | 44 | 44 | 2 | 11 | 8 | 4. 857126 |
| 1 | 5 | 6 | 45 | 13 | 3 | 9 | 51 | 4. 857183 |
| 2 | 5 | 7 | 45 | 42 | 3 | 8 | 31 | 4. 857241 |
| 3 | 5 | 8 | 46 | 10 | 3 | 7 | 7 | 4. 857299 |
| 4 | 5 | 9 | 46 | 37 | 3 | 5 | 39 | 4. 857358 |
| 5 | 5 | 10 | 47 | 3 | 3 | 4 | 8 | 4. 857418 |
| 6 | 5 | 11 | 47 | 28 | 3 | 2 | 34 | 4. 857478 |
| 7 | 5 | 12 | 47 | 52 | 3 | 0 | 57 | 4. 857539 |
| 8 | 5 | 13 | 48 | 15 | 2 | 59 | 16 | 4. 857600 |
| 9 | 5 | 14 | 48 | 37 | 2 | 57 | 32 | 4. 857662 |
| 10 | 5 | 15 | 48 | 58 | 2 | 55 | 44 | 4. 857725 |
| 11 | 5 | 16 | 49 | 18 | 2 | 53 | 54 | 4. 857788 |
| 12 | 5 | 17 | 49 | 37 | 2 | 52 | 0 | 4. 857852 |
| 13 | 5 | 18 | 49 | 54 | 2 | 50 | 3 | 4. 857917 |
| 14 | 5 | 19 | 50 | 11 | 2 | 48 | 3 | 4. 857982 |
| 15 | 5 | 20 | 50 | 26 | 2 | 46 | 0 | 4. 858047 |
| 16 | 5 | 21 | 50 | 41 | 2 | 43 | 53 | 4. 858112 |
| 17 | 5 | 22 | 50 | 54 | 2 | 41 | 44 | 4. 858178 |
| 18 | 5 | 23 | 51 | 6 | 2 | 39 | 32 | 4. 858244 |
| 19 | 5 | 24 | 51 | 18 | 2 | 37 | 17 | 4. 858310 |
| 20 | 5 | 25 | 51 | 28 | 2 | 34 | 59 | 4. 858377 |
| 21 | 5 | 26 | 51 | 37 | 2 | 32 | 39 | 4. 858444 |
| 22 | 5 | 27 | 51 | 44 | 2 | 30 | 15 | 4. 858511 |
| 23 | 5 | 28 | 51 | 50 | 2 | 27 | 49 | 4. 858578 |
| 24 | 5 | 29 | 51 | 57 | 2 | 25 | 20 | 4. 858646 |
| 25 | 6 | 0 | 52 | 1 | 2 | 22 | 49 | 4. 858713 |
| 26 | 6 | 1 | 52 | 4 | 2 | 20 | 15 | 4. 858780 |
| 27 | 6 | 2 | 52 | 7 | 2 | 17 | 38 | 4. 858848 |
| 28 | 6 | 3 | 52 | 7 | 2 | 14 | 59 | 4. 858915 |
| 29 | 6 | 4 | 52 | 7 | 2 | 12 | 18 | 4. 858983 |
| 30 | 6 | 5 | 52 | 6 | 2 | 9 | 34 | 4. 859050 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign. 9. Long. ♀ à ☉ ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| ° | s | ° | ′ | ″ | ° | ′ | ″ | |
| 0 | 6 | 5 | 52 | 6 | 2 | 9 | 34 | 4. 859050 |
| 1 | 6 | 6 | 52 | 4 | 2 | 6 | 48 | 4. 859117 |
| 2 | 6 | 7 | 52 | 0 | 2 | 4 | 0 | 4. 859184 |
| 3 | 6 | 8 | 51 | 57 | 2 | 1 | 9 | 4. 859251 |
| 4 | 6 | 9 | 51 | 51 | 1 | 58 | 16 | 4. 859318 |
| 5 | 6 | 10 | 51 | 44 | 1 | 55 | 21 | 4. 859384 |
| 6 | 6 | 11 | 51 | 37 | 1 | 52 | 25 | 4. 859451 |
| 7 | 6 | 12 | 51 | 27 | 1 | 49 | 26 | 4. 859517 |
| 8 | 6 | 13 | 51 | 17 | 1 | 46 | 25 | 4. 859582 |
| 9 | 6 | 14 | 51 | 6 | 1 | 43 | 22 | 4. 859648 |
| 10 | 6 | 15 | 50 | 54 | 1 | 40 | 17 | 4. 859712 |
| 11 | 6 | 16 | 50 | 41 | 1 | 37 | 11 | 4. 859776 |
| 12 | 6 | 17 | 50 | 27 | 1 | 34 | 3 | 4. 859840 |
| 13 | 6 | 18 | 50 | 12 | 1 | 30 | 53 | 4. 859903 |
| 14 | 6 | 19 | 49 | 56 | 1 | 27 | 42 | 4. 859966 |
| 15 | 6 | 20 | 49 | 38 | 1 | 24 | 29 | 4. 860029 |
| 16 | 6 | 21 | 49 | 19 | 1 | 21 | 15 | 4. 860091 |
| 17 | 6 | 22 | 49 | 0 | 1 | 17 | 59 | 4. 860152 |
| 18 | 6 | 23 | 48 | 40 | 1 | 14 | 42 | 4. 860212 |
| 19 | 6 | 24 | 48 | 19 | 1 | 11 | 23 | 4. 860272 |
| 20 | 6 | 25 | 47 | 56 | 1 | 8 | 4 | 4. 860331 |
| 21 | 6 | 26 | 47 | 34 | 1 | 4 | 43 | 4. 860390 |
| 22 | 6 | 27 | 47 | 10 | 1 | 1 | 21 | 4. 860448 |
| 23 | 6 | 28 | 46 | 44 | 0 | 57 | 58 | 4. 860505 |
| 24 | 6 | 29 | 46 | 18 | 0 | 54 | 34 | 4. 860561 |
| 25 | 7 | 0 | 45 | 50 | 0 | 51 | 9 | 4. 860617 |
| 26 | 7 | 1 | 45 | 22 | 0 | 47 | 43 | 4. 860671 |
| 27 | 7 | 2 | 44 | 54 | 0 | 44 | 16 | 4. 860725 |
| 28 | 7 | 3 | 44 | 24 | 0 | 40 | 49 | 4. 860778 |
| 29 | 7 | 4 | 43 | 53 | 0 | 37 | 20 | 4. 860830 |
| 30 | 7 | 5 | 43 | 21 | 0 | 33 | 52 | 4. 860881 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | Sign 10. Long. ♀ à ☉ ✶ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| ° | s | ° | ′ | ″ | ° | ′ | ″ | |
| 0 | 7 | 5 | 43 | 21 | 0 | 33 | 52 | 4. 860881 |
| 1 | 7 | 6 | 42 | 49 | 0 | 30 | 22 | 4. 860931 |
| 2 | 7 | 7 | 42 | 16 | 0 | 26 | 53 | 4. 860981 |
| 3 | 7 | 8 | 41 | 42 | 0 | 23 | 22 | 4. 861030 |
| 4 | 7 | 9 | 41 | 7 | 0 | 19 | 52 | 4. 861077 |
| 5 | 7 | 10 | 40 | 32 | 0 | 16 | 21 | 4. 861123 |
| 6 | 7 | 11 | 39 | 56 | 0 | 12 | 50 | 4. 861169 |
| 7 | 7 | 12 | 39 | 19 | 0 | 9 | 18 | 4. 861213 |
| 8 | 7 | 13 | 38 | 41 | 0 | 5 | 47 | 4. 861256 |
| 9 | 7 | 14 | 38 | 2 | 0 | 2 | 15 | 4. 861299 |
| 10 | 7 | 15 | 37 | 24 | Sou. | 1 | 16 | 4. 861340 |
| 11 | 7 | 16 | 36 | 44 | 0 | 4 | 48 | 4. 861380 |
| 12 | 7 | 17 | 36 | 3 | 0 | 8 | 19 | 4. 861420 |
| 13 | 7 | 18 | 35 | 22 | 0 | 11 | 50 | 4. 861458 |
| 14 | 7 | 19 | 34 | 41 | 0 | 15 | 21 | 4. 861495 |
| 15 | 7 | 20 | 33 | 58 | 0 | 18 | 52 | 4. 861530 |
| 16 | 7 | 21 | 33 | 15 | 0 | 22 | 22 | 4. 861565 |
| 17 | 7 | 22 | 32 | 32 | 0 | 25 | 52 | 4. 861599 |
| 18 | 7 | 23 | 31 | 48 | 0 | 29 | 21 | 4. 861631 |
| 19 | 7 | 24 | 31 | 3 | 0 | 32 | 50 | 4. 861663 |
| 20 | 7 | 25 | 30 | 18 | 0 | 36 | 18 | 4. 861693 |
| 21 | 7 | 26 | 29 | 33 | 0 | 39 | 46 | 4. 861722 |
| 22 | 7 | 27 | 28 | 47 | 0 | 43 | 12 | 4. 861750 |
| 23 | 7 | 28 | 28 | 2 | 0 | 46 | 38 | 4. 861777 |
| 24 | 7 | 29 | 27 | 15 | 0 | 50 | 3 | 4. 861802 |
| 25 | 8 | 0 | 26 | 27 | 0 | 53 | 27 | 4. 861827 |
| 26 | 8 | 1 | 25 | 40 | 0 | 56 | 51 | 4. 861851 |
| 27 | 8 | 2 | 24 | 51 | 1 | 0 | 13 | 4. 861873 |
| 28 | 8 | 3 | 24 | 3 | 1 | 3 | 34 | 4. 861894 |
| 29 | 8 | 4 | 23 | 14 | 1 | 6 | 54 | 4. 861914 |
| 30 | 8 | 5 | 22 | 25 | 1 | 10 | 12 | 4. 861932 |

## A Table of the Heliocentrick Place of *Venus*.

| Mid. Anom. | *Sign.* 11. Long. ♀ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 8 | 5 | 22 | 25 | 1 | 10 | 12 | 4. 861932 |
| 1 | 8 | 6 | 21 | 46 | 1 | 13 | 30 | 4. 861950 |
| 2 | 8 | 7 | 20 | 47 | 1 | 16 | 46 | 4. 861966 |
| 3 | 8 | 8 | 19 | 57 | 1 | 20 | 0 | 4. 861981 |
| 4 | 8 | 9 | 19 | 7 | 1 | 23 | 13 | 4. 861995 |
| 5 | 8 | 10 | 18 | 17 | 1 | 26 | 25 | 1. 862007 |
| 6 | 8 | 11 | 17 | 26 | 1 | 29 | 35 | 4. 862019 |
| 7 | 8 | 12 | 16 | 36 | 1 | 32 | 44 | 4. 862029 |
| 8 | 8 | 13 | 15 | 45 | 1 | 35 | 51 | 4. 862039 |
| 9 | 8 | 14 | 14 | 54 | 1 | 38 | 56 | 4. 862048 |
| 10 | 8 | 15 | 14 | 3 | 1 | 41 | 59 | 4. 862055 |
| 11 | 8 | 16 | 13 | 12 | 1 | 45 | 1 | 4. 862061 |
| 12 | 8 | 17 | 12 | 20 | 1 | 48 | 1 | 4. 862067 |
| 13 | 8 | 18 | 11 | 29 | 1 | 50 | 58 | 4. 862071 |
| 14 | 8 | 19 | 10 | 38 | 1 | 53 | 54 | 4. 862074 |
| 15 | 8 | 20 | 9 | 46 | 1 | 56 | 48 | 4. 862075 |
| 16 | 8 | 21 | 8 | 54 | 1 | 59 | 40 | 4. 862076 |
| 17 | 8 | 22 | 8 | 3 | 2 | 2 | 29 | 4. 862076 |
| 18 | 8 | 23 | 7 | 12 | 2 | 5 | 16 | 4. 862075 |
| 19 | 8 | 24 | 6 | 20 | 2 | 8 | 2 | 4. 862072 |
| 20 | 8 | 25 | 5 | 28 | 2 | 10 | 54 | 4. 862069 |
| 21 | 8 | 26 | 4 | 37 | 2 | 13 | 25 | 4. 862064 |
| 22 | 8 | 37 | 3 | 46 | 2 | 16 | 3 | 4. 862059 |
| 23 | 8 | 18 | 2 | 55 | 2 | 18 | 39 | 4. 862054 |
| 24 | 8 | 29 | 2 | 4 | 2 | 21 | 12 | 4. 862047 |
| 25 | 9 | 0 | 1 | 13 | 2 | 23 | 43 | 4. 862038 |
| 26 | 9 | 1 | 0 | 22 | 2 | 26 | 11 | 4. 862029 |
| 27 | 9 | 1 | 59 | 32 | 2 | 28 | 37 | 4. 862019 |
| 28 | 9 | 2 | 58 | 41 | 2 | 31 | 0 | 4. 862009 |
| 29 | 9 | 3 | 57 | 51 | 2 | 33 | 20 | 4. 861997 |
| 30 | 9 | 4 | 57 | 1 | 2 | 35 | 37 | 4. 861985 |

A Table

## A Table of the mean Motion of *Mercury* from the *Aphelion*. 41

| Years from Christ | Anomaly ☿ s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 3 | 1 | 32 | 0 |
| 1501 | 3 | 9 | 2 | 0 |
| 1581 | 5 | 7 | 2 | 0 |
| 1601 | 5 | 21 | 32 | 0 |
| 1621 | 6 | 6 | 2 | 0 |
| 1641 | 6 | 20 | 32 | 0 |
| 1661 | 7 | 5 | 2 | 0 |
| 1681 | 7 | 19 | 32 | 0 |
| 1701 | 8 | 4 | 2 | 0 |
| 1721 | 8 | 18 | 32 | 0 |
| 1741 | 9 | 3 | 2 | 0 |
| 1761 | 9 | 17 | 32 | 0 |
| 1781 | 10 | 2 | 2 | 0 |
| 1801 | 10 | 16 | 32 | 0 |
| 1901 | 0 | 29 | 2 | 0 |
| 2001 | 3 | 11 | 32 | 0 |

| Years | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 20 | 0 | 14 | 30 | 0 |
| 40 | 0 | 29 | 0 | 0 |
| 60 | 1 | 13 | 30 | 0 |
| 80 | 1 | 28 | 0 | 0 |
| 100 | 2 | 12 | 30 | 0 |
| 200 | 4 | 25 | 0 | 0 |
| 300 | 7 | 7 | 30 | 0 |
| 400 | 9 | 20 | 0 | 0 |
| 500 | 0 | 2 | 30 | 0 |
| 600 | 2 | 15 | 0 | 0 |
| 700 | 4 | 27 | 30 | 0 |
| 800 | 7 | 10 | 0 | 0 |
| 900 | 9 | 23 | 30 | 0 |
| 1000 | 0 | 5 | 0 | 0 |
| 2000 | 0 | 10 | 0 | 0 |
| 3000 | 0 | 15 | 0 | 0 |
| 4000 | 0 | 20 | 0 | 0 |
| 5000 | 0 | 25 | 0 | 0 |
| 6000 | 1 | 0 | 0 | 0 |

| Years. | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| 1 | 1 | 23 | 42 | 7 |
| 2 | 3 | 17 | 24 | 14 |
| 3 | 5 | 11 | 6 | 21 |
| 4 | 7 | 8 | 54 | 0 |
| 5 | 9 | 2 | 36 | 7 |
| 6 | 10 | 26 | 18 | 14 |
| 7 | 0 | 20 | 0 | 21 |
| 8 | 2 | 17 | 48 | 0 |
| 9 | 4 | 11 | 30 | 7 |
| 10 | 6 | 5 | 12 | 14 |
| 11 | 7 | 28 | 54 | 21 |
| 12 | 9 | 26 | 42 | 0 |
| 13 | 11 | 20 | 24 | 7 |
| 14 | 1 | 14 | 6 | 14 |
| 15 | 3 | 7 | 48 | 21 |
| 16 | 5 | 5 | 36 | 0 |
| 17 | 6 | 29 | 18 | 7 |
| 18 | 8 | 23 | 0 | 14 |
| 19 | 10 | 16 | 42 | 21 |
| 20 | 0 | 14 | 30 | 0 |

| Months | Anom. Mot. s | o | ′ | ″ |
|---|---|---|---|---|
| *January* | 0 | 0 | 0 | 0 |
| *February* | 4 | 6 | 51 | 44 |
| *March* | 8 | 1 | 26 | 52 |
| *April* | 0 | 8 | 18 | 36 |
| *May* | 4 | 11 | 4 | 48 |
| *June* | 8 | 17 | 56 | 33 |
| *July* | 0 | 20 | 42 | 45 |
| *August* | 4 | 27 | 34 | 29 |
| *September* | 9 | 4 | 26 | 14 |
| *October* | 1 | 7 | 12 | 26 |
| *November* | 5 | 14 | 4 | 10 |
| *December.* | 9 | 16 | 50 | 2 |

In Leap-Year (after *February*) add one Day, and the Motion of a Day.

## A Table of the mean Motion of *Mercury* from the *Aphelion*.

| Days | Anom. Mot. s | o | ′ | ″ | H. | Anom. Mot. o | ′ | ″ | H. | Anom. Mot. o | ′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 4 | 5 | 32 | ′ | ′ | ″ | ‴ | ′ | ′ | ″ | ‴ |
| 2 | 0 | 8 | 11 | 5 | | | | | | | | |
| 3 | 0 | 12 | 16 | 37 | 1 | 0 | 10 | 14 | 31 | 5 | 17 | 9 |
| 4 | 0 | 16 | 22 | 10 | 2 | 0 | 20 | 28 | 32 | 5 | 27 | 23 |
| 5 | 0 | 20 | 27 | 42 | 3 | 0 | 30 | 42 | 33 | 5 | 37 | 37 |
| 6 | 0 | 24 | 33 | 14 | 4 | 0 | 40 | 55 | 34 | 5 | 47 | 51 |
| 7 | 0 | 28 | 38 | 47 | 5 | 0 | 51 | 9 | 35 | 5 | 58 | 5 |
| 8 | 1 | 2 | 44 | 19 | 6 | 1 | 1 | 23 | 36 | 6 | 8 | 19 |
| 9 | 1 | 6 | 49 | 52 | 7 | 1 | 11 | 37 | 37 | 6 | 18 | 32 |
| 10 | 1 | 10 | 55 | 24 | 8 | 1 | 21 | 51 | 38 | 6 | 28 | 46 |
| 11 | 1 | 15 | 0 | 56 | 9 | 1 | 32 | 5 | 39 | 6 | 39 | 0 |
| 12 | 1 | 19 | 6 | 29 | 10 | 1 | 42 | 18 | 40 | 6 | 49 | 14 |
| 13 | 1 | 23 | 12 | 1 | 11 | 1 | 52 | 32 | 41 | 6 | 59 | 28 |
| 14 | 1 | 27 | 17 | 34 | 12 | 2 | 2 | 46 | 42 | 7 | 9 | 42 |
| 15 | 2 | 1 | 23 | 6 | 13 | 2 | 13 | 0 | 43 | 7 | 19 | 46 |
| 16 | 2 | 5 | 28 | 38 | 14 | 2 | 23 | 14 | 44 | 7 | 30 | 9 |
| 17 | 2 | 9 | 34 | 11 | 15 | 2 | 33 | 28 | 45 | 7 | 40 | 23 |
| 18 | 2 | 13 | 39 | 43 | 16 | 2 | 43 | 42 | 46 | 7 | 50 | 37 |
| 19 | 2 | 17 | 45 | 16 | 17 | 2 | 53 | 55 | 47 | 8 | 0 | 51 |
| 20 | 2 | 21 | 50 | 48 | 18 | 3 | 4 | 9 | 48 | 8 | 11 | 5 |
| 21 | 2 | 25 | 56 | 20 | 19 | 3 | 14 | 23 | 49 | 8 | 21 | 19 |
| 22 | 3 | 0 | 14 | 53 | 20 | 3 | 24 | 37 | 50 | 8 | 31 | 32 |
| 23 | 3 | 4 | 7 | 25 | 21 | 3 | 34 | 51 | 51 | 8 | 41 | 46 |
| 24 | 3 | 8 | 12 | 58 | 22 | 3 | 45 | 5 | 52 | 8 | 52 | 0 |
| 25 | 3 | 12 | 18 | 30 | 23 | 3 | 55 | 19 | 53 | 9 | 2 | 14 |
| 26 | 3 | 16 | 24 | 2 | 24 | 4 | 5 | 32 | 54 | 9 | 12 | 28 |
| 27 | 3 | 20 | 29 | 35 | 25 | 4 | 15 | 46 | 55 | 9 | 22 | 42 |
| 28 | 3 | 24 | 35 | 7 | 26 | 4 | 26 | 0 | 56 | 9 | 32 | 56 |
| 29 | 3 | 28 | 40 | 40 | 27 | 4 | 36 | 14 | 57 | 9 | 43 | 9 |
| 30 | 4 | 2 | 46 | 12 | 28 | 4 | 46 | 28 | 58 | 9 | 53 | 23 |
| 31 | 4 | 6 | 51 | 44 | 29 | 4 | 56 | 42 | 59 | 10 | 3 | 37 |
| 32 | 4 | 10 | 57 | 17 | 30 | 5 | 6 | 55 | 60 | 10 | 13 | 51 |

| | s | o | ′ | ″ |
|---|---|---|---|---|
| Long. Aph. ☿ à 1 ✳ ♈ | 7 | 13 | 48 | 0 |
| Long. ☊ ☿ à 1 ✳ ♈ | 0 | 15 | 42 | 0 |
| Inclin. Orb. ☿ | | 6 | 54 | 0 |
| Dist. Mid. ☿ à ☉ | | | 38710 | |
| Eccentricity | | | 7970 | |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. o. Long. ☿ à 1 ✳ ♈ s | o | ′ | ″ | Inc. North. o | ′ | ″ | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| 0 | 7 | 13 | 37 | 38 | 3 | 14 | 38 | 4. 668435 |
| 1 | 7 | 14 | 17 | 50 | 3 | 18 | 54 | 4. 668395 |
| 2 | 7 | 14 | 58 | 4 | 3 | 23 | 9 | 4. 668340 |
| 3 | 7 | 15 | 38 | 18 | 3 | 27 | 22 | 4. 668269 |
| 4 | 7 | 16 | 18 | 34 | 3 | 31 | 34 | 4. 668184 |
| 5 | 7 | 16 | 58 | 49 | 3 | 35 | 43 | 4. 668082 |
| 6 | 7 | 17 | 39 | 6 | 3 | 39 | 51 | 4. 667963 |
| 7 | 7 | 18 | 19 | 24 | 3 | 43 | 58 | 4. 667829 |
| 8 | 7 | 18 | 59 | 45 | 3 | 48 | 2 | 4. 667678 |
| 9 | 7 | 19 | 40 | 6 | 3 | 52 | 5 | 4. 667512 |
| 10 | 7 | 20 | 20 | 29 | 3 | 56 | 6 | 4. 667330 |
| 11 | 7 | 21 | 0 | 54 | 4 | 0 | 6 | 4. 667132 |
| 12 | 7 | 21 | 41 | 21 | 4 | 4 | 3 | 4. 666918 |
| 13 | 7 | 22 | 21 | 51 | 4 | 7 | 59 | 4. 666687 |
| 14 | 7 | 23 | 2 | 23 | 4 | 11 | 53 | 4. 666441 |
| 15 | 7 | 23 | 42 | 58 | 4 | 15 | 45 | 4. 666180 |
| 16 | 7 | 24 | 23 | 35 | 4 | 19 | 34 | 4. 665904 |
| 17 | 7 | 25 | 4 | 14 | 4 | 23 | 22 | 4. 665610 |
| 18 | 7 | 25 | 44 | 58 | 4 | 27 | 9 | 4. 665301 |
| 19 | 7 | 26 | 25 | 44 | 4 | 30 | 53 | 4. 664976 |
| 20 | 7 | 27 | 6 | 34 | 4 | 34 | 35 | 4. 664636 |
| 21 | 7 | 27 | 47 | 27 | 4 | 38 | 15 | 4. 664280 |
| 22 | 7 | 28 | 28 | 25 | 4 | 41 | 53 | 4. 663908 |
| 23 | 7 | 29 | 9 | 26 | 4 | 45 | 29 | 4. 663522 |
| 24 | 7 | 29 | 50 | 31 | 4 | 49 | 3 | 4. 663119 |
| 25 | 8 | 0 | 31 | 40 | 4 | 52 | 34 | 4. 662700 |
| 26 | 8 | 1 | 12 | 54 | 4 | 59 | 4 | 4. 662266 |
| 27 | 8 | 1 | 54 | 12 | 4 | 59 | 31 | 4. 661817 |
| 28 | 8 | 2 | 35 | 35 | 5 | 2 | 56 | 4. 661351 |
| 29 | 8 | 3 | 17 | 3 | 5 | 6 | 19 | 4. 660870 |
| 30 | 8 | 3 | 58 | 36 | 5 | 9 | 40 | 4. 660373 |

## A Table of the Heliocentrick Place of *Mercury*.

*Sign.* 1.

| Mid. Anom. | Long. ☿ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 8 | 3 | 58 | 36 | 5 | 9 | 40 | 4. 660373 |
| 1 | 8 | 4 | 40 | 16 | 5 | 12 | 58 | 4. 659860 |
| 2 | 8 | 5 | 22 | 1 | 5 | 16 | 14 | 4. 659332 |
| 3 | 8 | 6 | 3 | 51 | 5 | 19 | 27 | 4. 658789 |
| 4 | 8 | 6 | 45 | 47 | 5 | 22 | 38 | 4. 658231 |
| 5 | 8 | 7 | 27 | 50 | 5 | 25 | 47 | 4. 657656 |
| 6 | 8 | 8 | 9 | 56 | 5 | 28 | 53 | 4. 657066 |
| 7 | 8 | 8 | 52 | 15 | 5 | 31 | 57 | 4. 656459 |
| 8 | 8 | 9 | 34 | 37 | 5 | 34 | 58 | 4. 655838 |
| 9 | 8 | 10 | 17 | 6 | 5 | 37 | 57 | 4. 655201 |
| 10 | 8 | 10 | 59 | 41 | 5 | 40 | 53 | 4. 654549 |
| 11 | 8 | 11 | 42 | 24 | 5 | 43 | 46 | 4. 653882 |
| 12 | 8 | 12 | 25 | 15 | 5 | 46 | 37 | 4. 653199 |
| 13 | 8 | 13 | 8 | 15 | 5 | 49 | 25 | 4. 652500 |
| 14 | 8 | 13 | 51 | 22 | 5 | 52 | 10 | 4. 651787 |
| 15 | 8 | 14 | 34 | 37 | 5 | 54 | 52 | 4. 651059 |
| 16 | 8 | 15 | 18 | 1 | 5 | 57 | 32 | 4. 650314 |
| 17 | 8 | 16 | 1 | 33 | 6 | 0 | 8 | 4. 649555 |
| 18 | 8 | 16 | 45 | 14 | 6 | 2 | 41 | 4. 648780 |
| 19 | 8 | 17 | 29 | 4 | 6 | 5 | 12 | 4. 647989 |
| 20 | 8 | 18 | 13 | 4 | 6 | 7 | 40 | 4. 647183 |
| 21 | 8 | 18 | 57 | 15 | 6 | 10 | 4 | 4. 646363 |
| 22 | 8 | 19 | 41 | 35 | 6 | 12 | 25 | 4. 645526 |
| 23 | 8 | 20 | 26 | 5 | 6 | 14 | 44 | 4. 644674 |
| 24 | 8 | 21 | 10 | 45 | 6 | 16 | 58 | 4. 643808 |
| 25 | 8 | 21 | 55 | 36 | 6 | 19 | 10 | 4. 642925 |
| 26 | 8 | 22 | 40 | 37 | 6 | 21 | 18 | 4. 642028 |
| 27 | 8 | 23 | 25 | 50 | 6 | 23 | 23 | 4. 641115 |
| 28 | 8 | 24 | 11 | 14 | 6 | 25 | 25 | 4. 640187 |
| 29 | 8 | 24 | 56 | 51 | 6 | 27 | 22 | 4. 639244 |
| 30 | 8 | 25 | 42 | 39 | 6 | 29 | 17 | 4. 638286 |

## A Table of the Heliocentrick Place of *Mercury*.

*Sign* 2.

| Mid. Anom. | Long. ☿ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 8 | 25 | 42 | 39 | 6 | 29 | 17 | 4. 638286 |
| 1 | 8 | 26 | 28 | 39 | 6 | 31 | 7 | 4. 637312 |
| 2 | 8 | 27 | 14 | 51 | 6 | 32 | 54 | 4. 636323 |
| 3 | 8 | 28 | 1 | 17 | 6 | 34 | 37 | 4. 635320 |
| 4 | 8 | 28 | 47 | 57 | 6 | 36 | 17 | 4. 634303 |
| 5 | 8 | 29 | 34 | 39 | 6 | 37 | 52 | 4. 633270 |
| 6 | 9 | 0 | 21 | 54 | 6 | 39 | 24 | 4. 632221 |
| 7 | 9 | 1 | 9 | 14 | 6 | 40 | 51 | 4. 631158 |
| 8 | 9 | 1 | 56 | 48 | 6 | 42 | 14 | 4. 630081 |
| 9 | 9 | 2 | 44 | 37 | 6 | 43 | 33 | 4. 628988 |
| 10 | 9 | 3 | 32 | 40 | 6 | 44 | 48 | 4. 627880 |
| 11 | 9 | 4 | 21 | 0 | 6 | 45 | 59 | 4. 626757 |
| 12 | 9 | 5 | 9 | 33 | 6 | 47 | 5 | 4. 625620 |
| 13 | 9 | 5 | 58 | 22 | 6 | 48 | 6 | 4. 624469 |
| 14 | 9 | 6 | 47 | 29 | 6 | 49 | 3 | 4. 623302 |
| 15 | 9 | 7 | 36 | 51 | 6 | 49 | 55 | 4. 622121 |
| 16 | 9 | 8 | 26 | 30 | 6 | 50 | 43 | 4. 620926 |
| 17 | 9 | 9 | 16 | 26 | 6 | 51 | 25 | 4. 619717 |
| 18 | 9 | 10 | 6 | 39 | 6 | 52 | 3 | 4. 618492 |
| 19 | 9 | 10 | 57 | 10 | 6 | 52 | 36 | 4. 617253 |
| 20 | 9 | 11 | 48 | 0 | 6 | 53 | 3 | 4. 616001 |
| 21 | 9 | 12 | 39 | 7 | 6 | 53 | 25 | 4. 614734 |
| 22 | 9 | 13 | 30 | 34 | 6 | 53 | 42 | 4. 613454 |
| 23 | 9 | 14 | 22 | 20 | 6 | 53 | 53 | 4. 612159 |
| 24 | 9 | 15 | 14 | 24 | 6 | 53 | 59 | 4. 610851 |
| 25 | 9 | 16 | 6 | 49 | 6 | 53 | 59 | 4. 609529 |
| 26 | 9 | 16 | 59 | 33 | 6 | 53 | 54 | 4. 608194 |
| 27 | 9 | 17 | 52 | 38 | 6 | 53 | 42 | 4. 606845 |
| 28 | 9 | 18 | 46 | 5 | 6 | 53 | 25 | 4. 605482 |
| 29 | 9 | 19 | 39 | 52 | 6 | 53 | 1 | 4. 604107 |
| 30 | 9 | 20 | 34 | 1 | 6 | 52 | 31 | 4. 602718 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign ♈. Long. ☿ à ☉ ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 9 | 20 | 34 | 1 | 6 | 52 | 31 | 4. 602718 |
| 1 | 9 | 21 | 28 | 31 | 6 | 51 | 55 | 4. 601318 |
| 2 | 9 | 22 | 23 | 25 | 6 | 51 | 12 | 4. 599905 |
| 3 | 9 | 23 | 18 | 40 | 6 | 50 | 23 | 4. 598478 |
| 4 | 9 | 24 | 14 | 18 | 6 | 49 | 27 | 4. 597040 |
| 5 | 9 | 25 | 10 | 20 | 6 | 48 | 25 | 4. 595590 |
| 6 | 9 | 26 | 6 | 45 | 6 | 47 | 15 | 4. 594129 |
| 7 | 9 | 27 | 3 | 34 | 6 | 45 | 58 | 4. 592655 |
| 8 | 9 | 28 | 0 | 47 | 6 | 44 | 34 | 4. 591170 |
| 9 | 9 | 28 | 58 | 26 | 6 | 43 | 2 | 4. 589674 |
| 10 | 9 | 29 | 56 | 30 | 6 | 41 | 24 | 4. 588166 |
| 11 | 10 | 0 | 54 | 59 | 6 | 39 | 37 | 4. 586648 |
| 12 | 10 | 1 | 54 | 54 | 6 | 37 | 43 | 4. 585119 |
| 13 | 10 | 2 | 53 | 14 | 6 | 35 | 41 | 4. 583581 |
| 14 | 10 | 3 | 53 | 1 | 6 | 33 | 31 | 4. 582034 |
| 15 | 10 | 4 | 53 | 16 | 6 | 31 | 12 | 4. 580478 |
| 16 | 10 | 5 | 53 | 56 | 6 | 28 | 46 | 4. 578912 |
| 17 | 10 | 6 | 55 | 5 | 6 | 26 | 11 | 4. 577338 |
| 18 | 10 | 7 | 56 | 42 | 6 | 23 | 27 | 4. 575755 |
| 19 | 10 | 8 | 58 | 46 | 6 | 20 | 35 | 4. 574164 |
| 20 | 10 | 10 | 1 | 19 | 6 | 17 | 34 | 4. 572565 |
| 21 | 10 | 11 | 4 | 21 | 6 | 14 | 24 | 4. 570960 |
| 22 | 10 | 12 | 7 | 53 | 6 | 11 | 5 | 4. 569348 |
| 23 | 10 | 13 | 11 | 54 | 6 | 7 | 36 | 4. 567730 |
| 24 | 10 | 14 | 16 | 24 | 6 | 3 | 59 | 4. 566107 |
| 25 | 10 | 15 | 21 | 24 | 6 | 0 | 12 | 4. 564479 |
| 26 | 10 | 16 | 26 | 54 | 5 | 56 | 15 | 4. 562845 |
| 27 | 10 | 17 | 32 | 55 | 5 | 52 | 9 | 4. 561207 |
| 28 | 10 | 18 | 39 | 27 | 5 | 47 | 51 | 4. 559567 |
| 29 | 10 | 19 | 46 | 30 | 5 | 43 | 26 | 4. 557924 |
| 30 | 10 | 20 | 54 | 4 | 5 | 38 | 50 | 4. 556279 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. ♉. Long. ☿ à ☉ ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 10 | 20 | 54 | 4 | 5 | 38 | 50 | 4. 556279 |
| 1 | 10 | 22 | 2 | 10 | 5 | 34 | 4 | 4. 554631 |
| 2 | 10 | 23 | 10 | 48 | 5 | 29 | 7 | 4. 552984 |
| 3 | 10 | 24 | 19 | 58 | 5 | 24 | 1 | 4. 551335 |
| 4 | 10 | 25 | 29 | 39 | 5 | 18 | 44 | 4. 549687 |
| 5 | 10 | 26 | 39 | 53 | 5 | 13 | 16 | 4. 548040 |
| 6 | 10 | 27 | 50 | 40 | 5 | 7 | 38 | 4. 546395 |
| 7 | 10 | 29 | 1 | 58 | 5 | 1 | 49 | 4. 544752 |
| 8 | 11 | 0 | 13 | 49 | 4 | 55 | 50 | 4. 543114 |
| 9 | 11 | 1 | 26 | 14 | 4 | 49 | 40 | 4. 541479 |
| 10 | 11 | 2 | 39 | 12 | 4 | 43 | 19 | 4. 539849 |
| 11 | 11 | 3 | 52 | 42 | 4 | 36 | 48 | 4. 538226 |
| 12 | 11 | 5 | 6 | 46 | 4 | 30 | 6 | 4. 536608 |
| 13 | 11 | 6 | 21 | 23 | 4 | 23 | 13 | 4. 534999 |
| 14 | 11 | 7 | 36 | 32 | 4 | 16 | 10 | 4. 533397 |
| 15 | 11 | 8 | 52 | 15 | 4 | 8 | 56 | 4. 531805 |
| 16 | 11 | 10 | 8 | 31 | 4 | 1 | 31 | 4. 530225 |
| 17 | 11 | 11 | 25 | 20 | 3 | 53 | 56 | 4. 528655 |
| 18 | 11 | 12 | 42 | 42 | 3 | 46 | 11 | 4. 527097 |
| 19 | 11 | 14 | 0 | 38 | 3 | 38 | 15 | 4. 525553 |
| 20 | 11 | 15 | 19 | 5 | 3 | 30 | 8 | 4. 524023 |
| 21 | 11 | 16 | 38 | 5 | 3 | 21 | 52 | 4. 522509 |
| 22 | 11 | 17 | 57 | 38 | 3 | 13 | 26 | 4. 521011 |
| 23 | 11 | 19 | 17 | 42 | 3 | 4 | 50 | 4. 519531 |
| 24 | 11 | 20 | 38 | 18 | 2 | 56 | 4 | 4. 518069 |
| 25 | 11 | 21 | 59 | 26 | 2 | 47 | 9 | 4. 516626 |
| 26 | 11 | 23 | 21 | 5 | 2 | 38 | 4 | 4. 515205 |
| 27 | 11 | 24 | 43 | 16 | 2 | 28 | 51 | 4. 513806 |
| 28 | 11 | 26 | 5 | 58 | 2 | 19 | 29 | 4. 512430 |
| 29 | 11 | 27 | 29 | 9 | 2 | 9 | 58 | 4. 511079 |
| 30 | 11 | 28 | 52 | 50 | 2 | 0 | 20 | 4. 509752 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. 5. Long. ☿ à 1 ✱ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 11 | 28 | 52 | 50 | 2 | 0 | 20 | 4. 509752 |
| 1 | 0 | 0 | 17 | 0 | 1 | 50 | 33 | 4. 508451 |
| 2 | 0 | 1 | 41 | 39 | 1 | 40 | 39 | 4. 507179 |
| 3 | 0 | 3 | 6 | 47 | 1 | 30 | 38 | 4. 505935 |
| 4 | 0 | 4 | 32 | 22 | 1 | 20 | 31 | 4. 504721 |
| 5 | 0 | 5 | 58 | 25 | 1 | 10 | 16 | 4. 503537 |
| 6 | 0 | 7 | 24 | 54 | 0 | 59 | 56 | 4. 502386 |
| 7 | 0 | 8 | 51 | 49 | 0 | 49 | 31 | 4. 501268 |
| 8 | 0 | 10 | 19 | 9 | 0 | 39 | 1 | 4. 500185 |
| 9 | 0 | 11 | 46 | 55 | 0 | 28 | 26 | 4. 499137 |
| 10 | 0 | 13 | 15 | 3 | 0 | 17 | 47 | 4. 498126 |
| 11 | 0 | 14 | 43 | 35 | 0 | 7 | 4 | 4. 497152 |
| 12 | 0 | 16 | 12 | 30 | Nor. 3 | | 41 | 4. 496217 |
| 13 | 0 | 17 | 41 | 45 | 0 | 14 | 29 | 4. 495321 |
| 14 | 0 | 19 | 11 | 21 | 0 | 25 | 19 | 4. 494467 |
| 15 | 0 | 20 | 41 | 16 | 0 | 36 | 10 | 4. 493655 |
| 16 | 0 | 22 | 11 | 30 | 0 | 47 | 2 | 4. 492885 |
| 17 | 0 | 23 | 42 | 2 | 0 | 57 | 54 | 4. 492158 |
| 18 | 0 | 25 | 12 | 50 | 1 | 8 | 45 | 4. 491476 |
| 19 | 0 | 26 | 43 | 54 | 1 | 19 | 35 | 4. 490840 |
| 20 | 0 | 28 | 15 | 13 | 1 | 30 | 24 | 4. 490248 |
| 21 | 0 | 29 | 46 | 45 | 1 | 41 | 10 | 4. 489702 |
| 22 | 1 | 1 | 18 | 30 | 1 | 51 | 54 | 4. 489204 |
| 23 | 1 | 2 | 50 | 26 | 2 | 2 | 33 | 4. 488755 |
| 24 | 1 | 4 | 22 | 32 | 2 | 13 | 9 | 4. 488354 |
| 25 | 1 | 5 | 54 | 47 | 2 | 23 | 39 | 4. 488003 |
| 26 | 1 | 7 | 27 | 13 | 2 | 34 | 4 | 4. 487702 |
| 27 | 1 | 8 | 59 | 41 | 2 | 44 | 23 | 4. 487451 |
| 28 | 1 | 10 | 32 | 16 | 2 | 54 | 36 | 4. 487252 |
| 29 | 1 | 12 | 4 | 55 | 3 | 4 | 41 | 4. 487104 |
| 30 | 1 | 13 | 37 | 38 | 3 | 14 | 38 | 4. 487008 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. 6. Long. ☿ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 1 | 13 | 37 | 38 | 3 | 14 | 38 | 4. 487008 |
| 1 | 1 | 15 | 10 | 23 | 3 | 24 | 27 | 4. 486962 |
| 2 | 1 | 16 | 43 | 8 | 3 | 34 | 7 | 4. 486969 |
| 3 | 1 | 18 | 15 | 52 | 3 | 43 | 36 | 4. 487029 |
| 4 | 1 | 19 | 48 | 35 | 3 | 52 | 56 | 4. 487140 |
| 5 | 1 | 21 | 21 | 14 | 4 | 2 | 5 | 4. 487304 |
| 6 | 1 | 22 | 53 | 48 | 4 | 11 | 3 | 4. 487521 |
| 7 | 1 | 24 | 26 | 17 | 4 | 19 | 50 | 4. 487789 |
| 8 | 1 | 25 | 58 | 40 | 4 | 28 | 24 | 4. 488109 |
| 9 | 1 | 27 | 30 | 55 | 4 | 36 | 46 | 4. 488481 |
| 10 | 1 | 29 | 3 | 0 | 4 | 44 | 55 | 4. 488905 |
| 11 | 2 | 0 | 34 | 53 | 4 | 52 | 51 | 4. 489378 |
| 12 | 2 | 2 | 6 | 36 | 5 | 0 | 33 | 4. 489901 |
| 13 | 2 | 3 | 38 | 6 | 5 | 8 | 1 | 4. 490474 |
| 14 | 2 | 5 | 9 | 21 | 5 | 15 | 15 | 4. 491097 |
| 15 | 2 | 6 | 40 | 21 | 5 | 22 | 14 | 4. 491768 |
| 16 | 2 | 8 | 11 | 5 | 5 | 28 | 58 | 4. 492488 |
| 17 | 2 | 9 | 41 | 32 | 5 | 35 | 27 | 4. 493254 |
| 18 | 2 | 11 | 11 | 38 | 5 | 41 | 42 | 4. 494068 |
| 19 | 2 | 12 | 41 | 26 | 5 | 47 | 40 | 4. 494928 |
| 20 | 2 | 14 | 10 | 54 | 5 | 53 | 23 | 4. 495833 |
| 21 | 2 | 15 | 40 | 0 | 5 | 58 | 51 | 4. 496782 |
| 22 | 2 | 17 | 8 | 43 | 6 | 4 | 3 | 4. 497773 |
| 23 | 2 | 18 | 37 | 2 | 6 | 8 | 58 | 4. 498807 |
| 24 | 2 | 20 | 4 | 58 | 6 | 13 | 38 | 4. 499882 |
| 25 | 2 | 21 | 32 | 28 | 6 | 18 | 3 | 4. 500997 |
| 26 | 2 | 22 | 59 | 32 | 6 | 22 | 11 | 4. 502161 |
| 27 | 2 | 24 | 26 | 8 | 6 | 26 | 3 | 4. 503342 |
| 28 | 2 | 25 | 52 | 17 | 6 | 29 | 40 | 4. 504569 |
| 29 | 2 | 27 | 17 | 57 | 6 | 33 | 1 | 4. 505832 |
| 30 | 2 | 28 | 43 | 10 | 6 | 36 | 7 | 4. 507129 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign 7. Long. ☿ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. | |
|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | | |
| 0 | 3 | 28 | 43 | 10 | 6 | 36 | 7 | 4. | 507129 |
| 1 | 3 | 0 | 7 | 52 | 6 | 38 | 57 | 4. | 508458 |
| 2 | 3 | 1 | 32 | 3 | 6 | 41 | 32 | 4. | 509819 |
| 3 | 3 | 2 | 55 | 46 | 6 | 43 | 51 | 4. | 511209 |
| 4 | 3 | 4 | 18 | 56 | 6 | 45 | 56 | 4. | 512629 |
| 5 | 3 | 5 | 41 | 33 | 6 | 47 | 46 | 4. | 514078 |
| 6 | 3 | 7 | 3 | 38 | 6 | 49 | 21 | 4. | 515553 |
| 7 | 3 | 8 | 25 | 9 | 6 | 50 | 42 | 4. | 517052 |
| 8 | 3 | 9 | 46 | 9 | 6 | 51 | 48 | 4. | 518576 |
| 9 | 3 | 11 | 6 | 34 | 6 | 52 | 41 | 4. | 520121 |
| 10 | 3 | 12 | 26 | 25 | 6 | 53 | 20 | 4. | 521688 |
| 11 | 3 | 13 | 45 | 44 | 6 | 53 | 46 | 4. | 523276 |
| 12 | 3 | 15 | 4 | 28 | 6 | 53 | 59 | 4. | 524882 |
| 13 | 3 | 16 | 22 | 36 | 6 | 53 | 58 | 4. | 526505 |
| 14 | 3 | 17 | 40 | 10 | 6 | 53 | 45 | 4. | 528144 |
| 15 | 3 | 18 | 57 | 10 | 6 | 53 | 20 | 4. | 529798 |
| 16 | 3 | 20 | 13 | 35 | 6 | 52 | 43 | 4. | 531467 |
| 17 | 3 | 21 | 29 | 23 | 6 | 51 | 54 | 4. | 533148 |
| 18 | 3 | 22 | 44 | 37 | 6 | 50 | 54 | 4. | 534841 |
| 19 | 3 | 23 | 59 | 16 | 6 | 49 | 43 | 4. | 536543 |
| 20 | 3 | 25 | 13 | 19 | 6 | 48 | 21 | 4. | 538255 |
| 21 | 3 | 26 | 26 | 48 | 6 | 46 | 48 | 4. | 539975 |
| 22 | 3 | 27 | 39 | 42 | 6 | 45 | 6 | 4. | 541702 |
| 23 | 3 | 28 | 52 | 1 | 6 | 43 | 13 | 4. | 543434 |
| 24 | 4 | 0 | 3 | 45 | 6 | 41 | 11 | 4. | 545172 |
| 25 | 4 | 1 | 14 | 55 | 6 | 38 | 59 | 4. | 546914 |
| 26 | 4 | 2 | 25 | 30 | 6 | 36 | 39 | 4. | 548659 |
| 27 | 4 | 3 | 35 | 30 | 6 | 34 | 9 | 4. | 550406 |
| 28 | 4 | 4 | 44 | 56 | 6 | 31 | 32 | 4. | 552154 |
| 29 | 4 | 5 | 53 | 48 | 6 | 28 | 46 | 4. | 553902 |
| 30 | 4 | 7 | 2 | 8 | 6 | 25 | 52 | 4. | 555650 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. 8. Long. ☿ à 1 ✱ ♈ | | | | Inc. North. | | | Dif. à ☉ Curt. Logarithm. | |
|---|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | | |
| 0 | 4 | 7 | 2 | 8 | 6 | 25 | 52 | 4. | 555650 |
| 1 | 4 | 8 | 9 | 53 | 6 | 22 | 51 | 4. | 557396 |
| 2 | 4 | 9 | 17 | 4 | 6 | 19 | 43 | 4. | 559139 |
| 3 | 4 | 10 | 23 | 44 | 6 | 16 | 27 | 4. | 560881 |
| 4 | 4 | 11 | 29 | 49 | 6 | 13 | 5 | 4. | 562618 |
| 5 | 4 | 12 | 35 | 23 | 6 | 9 | 36 | 4. | 564352 |
| 6 | 4 | 13 | 40 | 25 | 6 | 6 | 1 | 4. | 566080 |
| 7 | 4 | 14 | 44 | 54 | 6 | 2 | 20 | 4. | 567801 |
| 8 | 4 | 15 | 48 | 52 | 5 | 58 | 33 | 4. | 569516 |
| 9 | 4 | 16 | 52 | 21 | 5 | 54 | 41 | 4. | 571225 |
| 10 | 4 | 17 | 55 | 17 | 5 | 50 | 43 | 4. | 572926 |
| 11 | 4 | 18 | 57 | 44 | 5 | 46 | 41 | 4. | 574619 |
| 12 | 4 | 19 | 59 | 59 | 5 | 42 | 33 | 4. | 576302 |
| 13 | 4 | 21 | 1 | 5 | 5 | 38 | 21 | 4. | 577977 |
| 14 | 4 | 22 | 2 | 2 | 5 | 34 | 4 | 4. | 579641 |
| 15 | 4 | 23 | 2 | 30 | 5 | 29 | 44 | 4. | 581295 |
| 16 | 4 | 24 | 2 | 31 | 5 | 25 | 19 | 4. | 582939 |
| 17 | 4 | 25 | 2 | 3 | 5 | 20 | 50 | 4. | 584570 |
| 18 | 4 | 26 | 1 | 5 | 5 | 16 | 18 | 4. | 586191 |
| 19 | 4 | 26 | 59 | 42 | 5 | 11 | 42 | 4. | 587801 |
| 20 | 4 | 27 | 57 | 52 | 5 | 7 | 3 | 4. | 589398 |
| 21 | 4 | 28 | 55 | 35 | 5 | 2 | 21 | 4. | 590983 |
| 22 | 4 | 29 | 52 | 52 | 4 | 57 | 36 | 4. | 592555 |
| 23 | 5 | 0 | 49 | 44 | 4 | 52 | 48 | 4. | 594113 |
| 24 | 5 | 1 | 46 | 9 | 4 | 47 | 57 | 4. | 595658 |
| 25 | 5 | 2 | 42 | 9 | 4 | 43 | 4 | 4. | 597188 |
| 26 | 5 | 3 | 37 | 47 | 4 | 38 | 8 | 4. | 598705 |
| 27 | 5 | 4 | 32 | 57 | 4 | 33 | 10 | 4. | 600207 |
| 28 | 5 | 5 | 27 | 48 | 4 | 28 | 11 | 4. | 601696 |
| 29 | 5 | 6 | 22 | 14 | 4 | 23 | 9 | 4. | 603169 |
| 30 | 5 | 7 | 16 | 16 | 4 | 18 | 5 | 4. | 604628 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. 9. Long. ☿ à ı ✱ ♈ | | | | Inc. North. | | | Dif. à ⊙ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 5 | 7 | 16 | 16 | 4 | 18 | 5 | 4. 604628 |
| 1 | 5 | 8 | 9 | 56 | 4 | 13 | 0 | 4. 606072 |
| 2 | 5 | 9 | 3 | 14 | 4 | 7 | 53 | 4. 607500 |
| 3 | 5 | 9 | 56 | 10 | 4 | 2 | 44 | 4. 608914 |
| 4 | 5 | 10 | 48 | 45 | 3 | 57 | 34 | 4. 610311 |
| 5 | 5 | 11 | 40 | 58 | 3 | 52 | 23 | 4. 611693 |
| 6 | 5 | 12 | 32 | 51 | 3 | 47 | 10 | 4. 613059 |
| 7 | 5 | 13 | 24 | 24 | 3 | 41 | 57 | 4. 614408 |
| 8 | 5 | 14 | 15 | 38 | 3 | 36 | 42 | 4. 615743 |
| 9 | 5 | 15 | 6 | 31 | 3 | 31 | 27 | 4. 617060 |
| 10 | 5 | 15 | 57 | 6 | 3 | 26 | 10 | 4. 618362 |
| 11 | 5 | 16 | 47 | 23 | 3 | 20 | 53 | 4. 619647 |
| 12 | 5 | 17 | 37 | 21 | 3 | 15 | 36 | 4. 620916 |
| 13 | 5 | 18 | 27 | 0 | 3 | 10 | 17 | 4. 622168 |
| 14 | 5 | 19 | 16 | 22 | 3 | 4 | 58 | 4. 623404 |
| 15 | 5 | 20 | 5 | 27 | 2 | 59 | 39 | 4. 624623 |
| 16 | 5 | 20 | 54 | 15 | 2 | 54 | 19 | 4. 625825 |
| 17 | 5 | 21 | 42 | 47 | 2 | 48 | 59 | 4. 627011 |
| 18 | 5 | 22 | 31 | 3 | 2 | 43 | 39 | 4. 628180 |
| 19 | 5 | 23 | 19 | 3 | 2 | 38 | 18 | 4. 629332 |
| 20 | 5 | 24 | 6 | 48 | 2 | 32 | 57 | 4. 630468 |
| 21 | 5 | 24 | 54 | 17 | 2 | 27 | 36 | 4. 631587 |
| 22 | 5 | 25 | 41 | 31 | 2 | 22 | 16 | 4. 632688 |
| 23 | 5 | 26 | 28 | 31 | 2 | 16 | 55 | 4. 633772 |
| 24 | 5 | 27 | 15 | 17 | 2 | 11 | 34 | 4. 634841 |
| 25 | 5 | 28 | 1 | 48 | 2 | 6 | 13 | 4. 635892 |
| 26 | 5 | 28 | 48 | 6 | 2 | 0 | 52 | 4. 636927 |
| 27 | 5 | 29 | 34 | 12 | 1 | 55 | 32 | 4. 637943 |
| 28 | 6 | 0 | 20 | 4 | 1 | 50 | 12 | 4. 638943 |
| 29 | 6 | 1 | 5 | 43 | 1 | 44 | 52 | 4. 639927 |
| 30 | 6 | 1 | 51 | 11 | 1 | 39 | 32 | 4. 640894 |

## A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign. 10. Long. ☿ à ı ✱ ♈ | | | | Inc. North. | | | Dif. à ⊙ Curt. Logarithm. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | |
| 0 | 6 | 1 | 51 | 11 | 1 | 39 | 32 | 4. 640894 |
| 1 | 6 | 2 | 36 | 26 | 1 | 34 | 13 | 4. 641844 |
| 2 | 6 | 3 | 21 | 30 | 1 | 28 | 54 | 4. 642777 |
| 3 | 6 | 4 | 6 | 22 | 1 | 23 | 35 | 4. 643693 |
| 4 | 6 | 4 | 51 | 3 | 1 | 18 | 17 | 4. 644592 |
| 5 | 6 | 5 | 35 | 33 | 1 | 13 | 0 | 4. 645474 |
| 6 | 6 | 6 | 19 | 53 | 1 | 7 | 43 | 4. 646340 |
| 7 | 6 | 7 | 4 | 1 | 1 | 2 | 26 | 4. 647188 |
| 8 | 6 | 7 | 48 | 0 | 0 | 57 | 10 | 4. 648019 |
| 9 | 6 | 8 | 31 | 50 | 0 | 51 | 55 | 4. 648834 |
| 10 | 6 | 9 | 15 | 31 | 0 | 46 | 40 | 4. 649632 |
| 11 | 6 | 9 | 59 | 1 | 0 | 41 | 26 | 4. 650412 |
| 12 | 6 | 10 | 42 | 23 | 0 | 36 | 13 | 4. 651177 |
| 13 | 6 | 11 | 25 | 35 | 0 | 31 | 0 | 4. 651924 |
| 14 | 6 | 12 | 8 | 39 | 0 | 25 | 48 | 4. 652655 |
| 15 | 6 | 12 | 51 | 35 | 0 | 20 | 37 | 4. 653369 |
| 16 | 6 | 13 | 34 | 23 | 0 | 15 | 26 | 4. 654066 |
| 17 | 6 | 14 | 17 | 3 | 0 | 10 | 17 | 4. 654745 |
| 18 | 6 | 14 | 59 | 36 | 0 | 5 | 8 | 4. 655410 |
| 19 | 6 | 15 | 42 | 2 | Sou. 0 | | 0 | 4. 656057 |
| 20 | 6 | 16 | 24 | 20 | 0 | 5 | 7 | 4. 656688 |
| 21 | 6 | 17 | 6 | 30 | 0 | 10 | 13 | 4. 657301 |
| 22 | 6 | 17 | 48 | 35 | 0 | 15 | 19 | 4. 657899 |
| 23 | 6 | 18 | 30 | 33 | 0 | 20 | 23 | 4. 658479 |
| 24 | 6 | 19 | 12 | 26 | 0 | 25 | 27 | 4. 659044 |
| 25 | 6 | 19 | 54 | 12 | 0 | 30 | 29 | 4. 659592 |
| 26 | 6 | 20 | 35 | 52 | 0 | 35 | 31 | 4. 660123 |
| 27 | 6 | 21 | 17 | 27 | 0 | 40 | 32 | 4. 660637 |
| 28 | 6 | 21 | 58 | 56 | 0 | 45 | 31 | 4. 661134 |
| 29 | 6 | 22 | 40 | 20 | 0 | 50 | 30 | 4. 661615 |
| 30 | 6 | 23 | 21 | 40 | 0 | 55 | 27 | 4. 662081 |

# *Tables of* MERCURY.

A Table of the Heliocentrick Place of *Mercury*.

| Mid. Anom. | Sign 11. Long. ☿ à 1 ✶ ♈ | | | | Inc. South. | | | Dif. à ☉ Curt. |
|---|---|---|---|---|---|---|---|---|
| | s | o | ′ | ″ | o | ′ | ″ | Logarithm. |
| 0 | 6 | 23 | 21 | 40 | 1 | 55 | 27 | 4. 662081 |
| 1 | 6 | 24 | 2 | 54 | 1 | 0 | 24 | 4. 662529 |
| 2 | 6 | 24 | 44 | 4 | 1 | 5 | 19 | 4. 662961 |
| 3 | 6 | 25 | 25 | 9 | 1 | 10 | 13 | 4. 663376 |
| 4 | 6 | 26 | 6 | 10 | 1 | 15 | 6 | 4. 663775 |
| 5 | 6 | 26 | 47 | 6 | 1 | 19 | 58 | 4. 664157 |
| 6 | 6 | 27 | 28 | 0 | 1 | 24 | 49 | 4. 664524 |
| 7 | 6 | 28 | 8 | 49 | 1 | 29 | 39 | 4. 664873 |
| 8 | 6 | 28 | 49 | 35 | 1 | 34 | 27 | 4. 665206 |
| 9 | 6 | 29 | 30 | 18 | 1 | 39 | 14 | 4. 665523 |
| 10 | 7 | 0 | 10 | 58 | 1 | 44 | 0 | 4. 665824 |
| 11 | 7 | 0 | 51 | 34 | 1 | 48 | 45 | 4. 666109 |
| 12 | 7 | 1 | 32 | 8 | 1 | 53 | 29 | 4. 666377 |
| 13 | 7 | 2 | 12 | 40 | 1 | 58 | 11 | 4. 666629 |
| 14 | 7 | 2 | 53 | 8 | 2 | 2 | 52 | 4. 666865 |
| 15 | 7 | 3 | 33 | 34 | 2 | 7 | 32 | 4. 667084 |
| 16 | 7 | 4 | 13 | 59 | 2 | 12 | 10 | 4. 667287 |
| 17 | 7 | 4 | 54 | 22 | 2 | 16 | 47 | 4. 667474 |
| 18 | 7 | 5 | 34 | 44 | 2 | 21 | 23 | 4. 667646 |
| 19 | 7 | 6 | 15 | 4 | 2 | 25 | 57 | 4. 667800 |
| 20 | 7 | 6 | 55 | 21 | 2 | 30 | 30 | 4. 667939 |
| 21 | 7 | 7 | 35 | 37 | 2 | 35 | 1 | 4. 668060 |
| 22 | 7 | 8 | 15 | 53 | 2 | 39 | 31 | 4. 668166 |
| 23 | 7 | 8 | 56 | 9 | 2 | 44 | 0 | 4. 668257 |
| 24 | 7 | 9 | 36 | 22 | 2 | 48 | 27 | 4. 668330 |
| 25 | 7 | 10 | 16 | 35 | 2 | 52 | 53 | 4. 668388 |
| 26 | 7 | 10 | 56 | 48 | 2 | 57 | 17 | 4. 668429 |
| 27 | 7 | 11 | 37 | 1 | 3 | 1 | 39 | 4. 668453 |
| 28 | 7 | 12 | 17 | 13 | 3 | 6 | 0 | 4. 668463 |
| 29 | 7 | 12 | 57 | 26 | 3 | 10 | 20 | 4. 668456 |
| 30 | 7 | 13 | 37 | 38 | 3 | 14 | 38 | 4. 668435 |

*The*

# *The Uses of the* ASTRONOMICAL TABLES, *in the Calculation of Eclipses*, &c.

BEfore I shew you the Method of the Calculation of the exact Time of the Eclipses of the Sun and Moon, it will be proper to premise these Observations by way of *Lemmata*; as Mr. *Whiston* hath done in his *Prælect. Astronom.*

1. That there is this great Difference between an Eclipse of the Sun and of the Moon: That a Lunar Eclipse is the *same entirely*, from what Part of the Earth soever it be look'd upon, and doth not receive any Alteration from the divers Position of Places on the Surface of the Earth; for where there is a real Loss or Deprivation of Light, 'tis all one if you look upon it from the Equator, or from the Poles; for the Beginning, End, and Quantity of the Eclipse of the Moon depends on real Causes, and not only on the different Position of the Observer. But in the Sun the Case is quite otherwise: A Solar Eclipse is not any real Deprivation or Loss of Light in him; 'tis only a local Interruption of the Sun's Light to some particular Places, occasioned by the Interposition of the Moon's Body. For in such Parts of the Earth as have the Centre of the Moon's Body interposed between them, and the Centre of the Sun, there may be had a *Total Solar* Eclipse; whereas in Regions lying at some Distance side-ways from thence, the Eclipse may be only *Partial*; and if they lye very remote, they may not see the Sun eclipsed at all. And therefore *Lunar* Eclipses are of the greatest Use in the finding the Longitude of Places, the Observation of those of the Sun being useless for that Purpose.

2. There are, universally considered, more *Solar* than *Lunar* Eclipses, but there are more of the *Moon* in any one particular Place; for since the Earth's *Disk* is much greater than the Disk of its Shadow seen at the Moon, it must needs be that the *Penumbra* of the Moon shall fall oftner into the broader Disk of the Earth while the Sun is eclipsed, than the narrower Moon can into the narrower Disk of the Earth's Shadow while she is eclipsed. But since the Eclipses of the Moon will be all observable in the same Place, as often as she is never so little above the Horizon of that Place; whereas such of the Sun only will be visible any where, as happen when the Moon is interposed between that particular Place and the Sun: 'Tis easily seen, that in particular Places *Lunar* Eclipses must be most frequent.

3. Total Eclipses of the Sun are very rare; so that if you consider them with regard to any particular Place, you will hardly have above two or three in the Compass of an hundred Years. The Reason of which is, that the Vertex or Point of the Conical Shadow of the Moon's Body doth fall beyond the Earth's Surface, and sometimes doth not quite reach it: Nor is that strange, when we take notice, that the Moon's apparent Diameter doth so little exceed that of the Sun, that it can't totally cover or obscure it, but only in some very Rare, Total, and Central Eclipses;



nor in every Central one neither; for if no Eclipse happen when the Sun is in his *Perigæum*, and the Moon in her *Apogæum*, the apparent Diameter of the Sun will exceed the Lunar one; and so the Eclipse will appear annular, or the Shadow of the Moon will be environed with a Ring of Light all round about it.

4. The Moon is never eclipsed by the very Shadow of the Earth it self, but only by that of the Earth's Atmosphere. This was a Proposition perfectly unknown to the Ancients, but is sufficiently apparent and manifest from the Consideration of Refraction.

For those Rays of Light which are next the Earth enter into its Atmosphere, and then go out of it again: But while they do thus pass out of a *Rarer Medium* into a *Denser*, they must by the known Laws of Refraction tend towards the Perpendicular; nor can it be otherwise when they go out of the Atmosphere again, for then they will recede from the Perpendicular; and as well in the former Case as in the latter, the Perpendicular being changed, they are inclined the same way; that is, towards the Axis. And from this double Refraction, when brought to Calculation, it appears that those Rays of the Sun, which pass near the Earth, are so *inflected*, as to concur in a Point long before they reach to the Distance the Moon is placed at.

5. In *Lunar* Eclipses, the Consideration of *Parallaxes* and *Refractions* hath no Place; but in *Solar* ones, tho' there be not much regard had to the *latter*, there must be the greatest to the *former*. The Reason whereof is, that with regard to Refraction and Parallax, the Shadow of the Earth, in the same Place of the Lunar Transit, is affected after the same manner as the Moon her self would be in passing thro' it, and so produces no Difference in the Calculation. And in like manner in Solar Eclipses, the Refraction of either the Solar or Lunar Light, at the same Elevation above the Earth's Horizon, is still one and the same; (as by late Observation hath been ascertained) as if both Luminaries had been at the same Distance from the Earth.

But with respect to the Parallax, the Case is to be deemed far otherwise: The Sun's Parallax, whether Horizontal, or in any Degree of Altitude, being much less than that of the Moon; and therefore must be accurately considered in the Calculation of Solar Eclipses.

6. The middle Time of Eclipses is not the very Moment of the Full or New Moon, but in or near that Place, where a Perpendicular let fall from the Centre of the Sun, or of the Shadow of the Earth to the Lunar Orbit, doth intersect it. For since the Direction of the Lunar Orbit is diverse from the Direction of the Ecliptick, making with it an Angle of at least five Degrees; and also since the exact Time of the full and new Moon's

is,

is, by Conſent of all Aſtronomers, obſerved to be in a Plane, not Normal to the Moon's Orbit, but to the Ecliptick, the neareſt Approach of the Centres, which is the very middle Moment of the Eclipſe, can't happen in the exact New or Full Moon; but a little before or after, according to the Moon's Latitude, and the Poſition of the Nodes, and in a Plane Normal to the Plane of the Lunar Orbit, and not to that of the Ecliptick.

7. The Inveſtigation and Calculation of Solar Eclipſes is much more difficult than that of the Lunar ones, becauſe the Parallaxes of the Sun and Moon are ſo very different; and alſo that in the Time of a Solar Eclipſe, according as the Altitude of the Luminaries above the Horizon is greater or leſs, they are very much changed; and during all the Time of the Eclipſe, are mutable and variable. Beſides the divers Poſitions of the Ecliptick in different Horizons, whether you conſider the Places of the Luminaries, as to Latitude or Longitude, do every where occaſion no ſmall Inequalities.

Theſe Things premiſed, I proceed to the Calculation of Eclipſes, beginning with thoſe of the Moon. And the firſt Work is, *To find the Time of the mean and true Syzygies.* Which is done thus:

1. Out of the Table of the mean Motions of the Moon from the Sun, (which you will find amongſt the other Aſtronomical Tables in this Vol.) write down the proper Numbers for their Time ſought, from the Columns of the Radical Year, the Intermediate Year, Month, *&c.* and then add them all into one Sum, which Sum ſubtract from an entire Circle or 12 Signs; and the remaining Numbers, either by themſelves, if you ſeek the Conjunction, or with the Addition of a Semicircle (or ſix Signs) if you deſire the Time of the Oppoſition, being turned into Time, will give the exact middle Moment of the Conjunction or Oppoſition ſought. That is, if you firſt ſubduct that Number which is next leſs than the given Number, and which is to be taken out of the Table of the mean Motions proper for Days, out of the ſaid given Number, and then ſeek for the Remainder in the ſame Table for the *Hours*, and ſubtract the Number there next leſs out of it, repeating the ſame Proceſs alſo for Minutes, Seconds, *&c* Then will the Day, with its annexed Hours, Minutes, Seconds, *&c.* of the mean Time of the Syzygy ſought, be moſt accurately determined. Unleſs indeed it be Leap-Year; for then the Day next *leſs* than it, with its proper Minutes, Seconds, *&c.* will be the exact Time of the Conjunction or Oppoſition required.

And having thus got the equable or *mean* Time of the *mean* Syzygies, both the *middle* and *true* Time of the true Syzygies may be thus found.

2. The next Work is to find the Sun's Longitude, or his true Place in the Ecliptick for the Time given. Which is done thus:

Seek the Time given in the left Hand Column of the Table of the Earth's mean Motions, and that not only for the Radical, but alſo for the Intermediate Years, with the Month, Day, Hour, Minute and Second: Write all theſe down in their Order, with the Tabular Numbers correſponding to them (which are called the *mean Motion* of the Earth and of the Perihelion) in a double Order, ſo that you may preſerve diſtinctly, not only the Signs, but alſo the Degrees and Minutes, and even the Seconds, as they ſhall occur.

Then add into one Sum, all the mean Motions of the Earth, of the Radix, of the Intermediate Years, of the Month, Day, Hour, Minute and Second, in order to obtain the Earth's mean Place, (or Sun's, if reckon'd in directly oppoſite Parts of the Ecliptick.) Then add the mean Motions of the Perihelion (taken from both the Tables) after the ſame manner together, that its *middle Place* alſo may be had for the Time given.

Next, ſubduct the *Place* or *Longitude* of the Perihelion before found, from the Earth's *mean Place,* and the Remainder will be the Earth's *mean Anomaly*; which is the Baſis and Foundation of all the ſucceeding Operations.

Then you may next gain the *Coequate Anomaly* of the Earth, or the true Place of the Earth, with regard to the Centre of the Sun: Thus, from the *Table of the Equations of the Earth's Orbit*, in which the Difference between the *True* and *Mean* Motions of the Earth are always given, ſeek the *middle Anomaly* of the Earth above found, on the Left Hand, if it be within the firſt ſix Signs; but on the Right, if it be in the ſix latter Signs; and find by the Rule of Proportion, the Quantity of the Equation anſwering thereunto; that is, not only that which the Table gives in whole Degrees, but alſo what correſponds to the Miuutes and Seconds of the *mean Anomaly*; as by the Rule of Three 'tis eaſy to do: Then will this entire Equation, *deducted* in the former ſix Signs from the mean Motion of the Earth, and *added* to it in the latter ſix, give the Earth's *true* Place; and that moſt exactly, if the Time at firſt given were the *mean Time:* But if, as it is moſt uſual, it were the Vulgar and Apparent, the Numbers found as above, muſt be corrected by the Equation of Time: Thus,

Conſult the *firſt Table of the Equation of the apparent Time*, (or that which is made for the Ecliptick Figure of the Earth's Orbit among theſe Tables, *N.* 1.) and there ſeek the Earth's mean Anomaly, either in the right or left Hand Column, (as above ſhewn) and write down thence the correſponding *Temporary Equation*, either to be added or ſubducted according as is there directed: Next go to the *latter Table of Equation*, or that which depends on the Inclination of the Equator and Ecliptick, and entring the Sun's Place in the Ecliptick, either at the Top or Bottom; againſt it, you have that proper Equation, either to be added or ſubtracted as occaſion requires. And thus having gotten theſe two Equations, if they are *both* to be *added*, or *both ſubtracted*, the abſolute Equation will be their *Sum*; but if they are different, it will be their *Difference*: And this abſolute Equation will help us to inveſtigate the Sun's Place at any given *apparent Time*, tho' at preſent it is done only as to the *middle Time.* For if out of the *Table of the Earth's Horary Motion*, accounted with reſpect to the *mean Anomaly*, you find (by the Rule of Proportion) the Earth's Motion correſponding to this *abſolute Equation*, and add it to, or *ſubtract* it from, as occaſion requires from the Sun's true Place before found; what reſults, will be the Sun's correct Place in the Ecliptick for the Time given. An Example will make all this plain.

Suppoſe

## *To find the Moon's true Place in the Heavens.*

Suppoſe you would have the Sun's Place in the Ecliptick for *October* 25. at one Hour, five Minutes, and thirty Seconds Afternoon, in the Year of Chriſt 1668 paſt.

*Note* 1. That the *Radix's* of the mean Motions in *Flamſtead*'s Tables, are accommodated to the Meridian of *London*, and deduced from the Noon of the Day immediately preceding the Kalands of *January*; and therefore, every Leap-Year, a Day muſt be added to the Time given; and ſince the Year before us in this Queſtion was Leap-Year, and the Month given *October* is at a diſtance from *February*, (and it will be the ſame in all Months after the laſt of *February*) you muſt reckon the Time, not the 25th but the 26th of *October*. Look then into the Table of the Earth's mean Motions for the Year 1661. (which is the next preceding *Radix*) where you find the Sun's Place to be 9 Signs, 20 Degrees, 25 Minutes, and 42 Seconds, and the *Perihelion* to be $3^s.7^o.6'.50''$.

Make a little Table, and write all things down thus:

| | | h. | ′ | ″ | |
|---|---|---|---|---|---|
| What is the Sun's Place *Oct.* 25. | | 1. | 5. | 30. | p. m. |
| In the apparent Time *A. D.* 1668? | | | | | |

| | Sun's Motion. | | | | Perihelion's Motion. | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | S. | o | ′ | ″ | S. | o | ′ | ″ | |
| 1661. | 9 | 20 | 25 | 46 | 3 | 6 | 35 | 0 | |
| 7. | 11 | 29 | 18 | 48 | | | 5 | 50 | |
| Biſſect. *Oct.* 26. | 9 | 24 | 42 | 30 | | | | 41 | |
| Hour 1. | | | | 2 | 28 | | | | |
| Min. 5. | | | | | 12 | 3 | 6 | 42 | 31 | Sum of all, and the Place of the Perihelion. |
| Seconds 30. | | | | | 1 | | | | |
| Sum of all | 34 | 14 | 29 | 45 | | | | | |
| Deduct | 24 | for 2 Circles. | | | | | | | |
| Remains | 7 | 14 | 29 | 45 | For the Sun's mean Motion. | | | | |
| Deduct | 3 | 6 | 41 | 31 | Being the Place of the Perihelion. | | | | |
| Remains | 4 | 7 | 48 | 14 | Which is the *mean Anomaly*. | | | | |
| Again from | 7 | 14 | 29 | 45 | The mean Motion. | | | | |
| Subduct | | 1 | 32 | 1 | The proper Equation found as above. | | | | |
| Remains | 7 | 12 | 57 | 44 | The Sun's Place. | | | | |
| Subtract again | | | | 40 | The proportionable Parts to be ſubtracted, as above ſhewn. | | | | |
| Remains | 7 | 12 | 57 | 04 | For the Sun's corrected Place. | | | | |

And thus may the Sun's Place be truly calculated for any Time aſſign'd.

## *To find the Moon's true Place in the Heavens.*

IN order by theſe Tables to calculate truly the Place of the Moon, which is much more intricate and troubleſome than the former; it will be proper previouſly to remember theſe Particulars about her Motion.

1. That her *very mean Motion* it ſelf is ſubject to ſome Variation; and according to the various Diſtance of the Earth from the Sun, which is called its Anomaly, (and belongs to the Moon as well as the Earth) is ſometimes compleated quicker and ſometimes ſlower: So that her middle menſtrual Motion is a little ſwifter in the *Aphelia*, and a little ſlower in the *Perihelia*.

2. Beſides, the Motions of the Moon her ſelf and of the *Apogæum*, (ſuch as we had in the Sun) here is to be conſidered peculiarly, the Retrograde Motion of the Nodes of the Lunar Orbit; and this Motion is to be *added*, where the former Motions were to be *ſubtracted* from the Place of the *Radix*, and *vice verſâ*.

3. The very Motion it ſelf of theſe Nodes is *unequable*; ſo that according to the different Poſition of the Line of the Nodes of the Moon's Orbit, with regard to the Sun, the Quantity of its Velocity is various and mutable, and therefore this *Inequality* muſt be *equated* before the Calculation can go on well.

4. The Eccentricity of the Moon's Orbit is ſubject to the greateſt Inequality; for in the ſame Poſition of the monthly Lunation, when the *Linea Apſidum* is in the Syzygies, the Eccentricity is much greater than when 'tis in the Quadratures: For the Moon doth not revolve in an Ellipſe, whoſe Figure is given in Specie, but in one perpetually changing, and whoſe Form is much more *oblong* in the Syzygies than in the Quadratures, when ſhe comes nearer to a circular Figure: And this Inequality or continual Variation of her Excentricity, and which can ſcarce be accurately determined,

mined, cauſes a very conſiderable Difficulty in Lunar Calculations.

5. The Motion of the *Apſis* is as unequal, if not more ſo, than that of the Excentricity; ſometimes Stationary, ſometimes Progreſſive, and ſometimes Retrograde.

6. The Moon in every Month moves faſter in the Syzygies, than ſhe doth in her Quadratures; and this Variation alſo muſt be equated, before the Calculation of the Moon's Motions can ſucceed well.

7. The Angle of Inclination of the Plane of her Orbit to that of the Ecliptick is alſo continually changing; and this too muſt be brought to an Equation, before the Place of this every way variable Planet can be exactly calculated. See Sir *Iſaac Newton*'s *Theory of the Moon*, in Vol. I.

The ſe Things being premiſed, let us attempt to *calculate the Moon's true Place in the Heavens for any given Moment of Time.*

1. Firſt, the Sun's *true Place*, his *mean Anomaly*, both the proper Parts of their correſponding Equation, and the *Abſolute Equation* thence ariſing, muſt be found by the Method above deſcribed, without which the Lunar Calculations will not be exact: For the *Lunar* Inequalities depend chiefly upon the Sun's Place; and without his mean Anomaly, the *mean Motions* of the Moon, and her other compound and irregular Motions, cannot be adjuſted. And indeed unleſs both theſe are had, the abſolute Equation of Time can't be obtained; which yet is ſo very neceſſary to be known, that nothing can be done without it: For the *given apparent Time* muſt firſt, by Means of this Equation, be reduced to the *mean Time*; the *mean Motions* in the Tables being accommodated to that, and not to the *apparent* Time.

2. From the Tables of the mean Motions of the Moon, of the Apogee, and of the Node, take out the *mean* Place of the *Radixes* in their ſeveral Columns; and then from the following Tables, write out alſo the *mean Motions* of the Moon and of the Apogee, for the proper Years elapſed from the Radix, and of the Month, Day, Hour, Minute and Second, placing them in Order, in two Columns (one for the Moon, another for the Apogee) and adding them up ſeverally into one Sum, as you ſee in the Example annexed to theſe Directions. By which means you will gain the *mean Place* of both the Moon and the Apogee for the *mean Time given.* It was ſaid before, that the *Radical Place* not only of the Moon and Apogee, but alſo of the Node, was to be placed in the firſt Series; but in the others, the intermediate mean Motions of the Node were deſignedly omitted: For altho' thoſe intermediate mean Motions, anſwering to the Year's diſtance from the Radical, and to the Month, Days, Hours and Minutes, are to to be taken out as was done in the reſt; and moreover to be collected into one Sum, as well as the *Radical* ones; yet becauſe the Motion of the Nodes (contrary to all the reſt) is always *Retrograde*, the intermediate Numbers are to be *ſubducted* from, not *added* to the Radical, in order by the Difference to find the true Place of the aſcending Node at the Time given. And having thus gotten the *mean* Places of the Moon, Apogee and Node, the next Work is,

3. To find their *true* Places. In order to which, let the Numbers anſwering to the *Sun's mean Anomaly* before found, be taken out of the Table of the *Phyſical Parts, to be added to, or taken from the Moon's mean Motion*; and if the Anomaly be leſs by ſix Signs than the mean Motion of the Moon, let thoſe Numbers be added to; but if it be greater by ſix Signs, let them be ſubtracted from the mean Motion of the Moon, and then you will gain her *correct mean Motion.*

To gain the true Place of the Apogee, ſubtract its mean Motion or Place from the Sun's *true* Place the Remainder will be what they call the *Annual Argument*: Which thus found, you muſt take out of *the Table of the Equation of the Moon's Apogee*, &c. the *Equation* correſponding to this annual Argument; and this either added to, or ſubtracted from (according as the Table directs) the middle Place of the Apogee will, by the Sum or Difference accordingly, give the *true* one for the Time given.

4. Out of the ſame Table take the Excentricity of the Moon's Orbit for the Time given; and if it be leſs than the mean Excentricity (in the Head of the next Table) ſubtract it thence; if greater, take the mean Excentricity from it, reſerving the Difference for other Aſtronomical Uſes.

5. That you may gain the Moon's Place yet nearer to the *true*, ſubduct the true Place of the Apogee of the Lunar Orbit from the *correct* mean Motion of the Moon (found in Art. 3.) and note the remaining Numbers, for they will ſhew you the *mean Anomaly of the Moon*: Which as ſoon as you have obtained, carry to the *Table of the Equations of the Moon's Centre*, and thence (making a Proportion when there is occaſion for it) take out two Equations, as well that which belongs to the mean Excentricity, as that which anſwers to the greateſt, if the Excentricity before found be one of the greater; or that which anſwers to the leaſt, if the former Excentricity be one of the leſſer; and find the Difference of theſe two Equations, by carefully ſubtracting the leſſer from the greater. This being rightly done, you may by the Rule of Three thus find the Parts proportional. Say, as the Difference between the greateſt or leaſt Excentricity, and the mean one, is to the Difference of the two Equations laſt found: : So is the Difference between the mean and the true Excentricity, to the proportionable Parts ſought. Which being thus found, if they are either added to, or ſubducted from, as occaſion requires, the *mean Equation*; the Sum or Difference will give the true Equation of the Lunar Orbit, to be added to, or taken from the Moon's mean correct Place, according as the Title directs, and by this means you will obtain the *Moon's equated Place.* And yet with all this Pains, you have not gotten the Moon's Place ultimately correct; but only ſuch a Place of her, as is ſuppoſed to be without the Buſineſs of *Reflection* or *Variation*, (and alſo ſetting aſide the Conſideration of Latitude) a Matter perfectly unknown to the Ancients both in Name and Nature. But you muſt go farther thus:

6. Subtract the Sun's true Place from this *equated Place* of the Moon, and the Difference will be *the Diſtance of the Moon from the Sun*, but yet not exactly true. Wherefore out of the Table of the Variation of the Moon, take the Numbers anſwering to this Difference or Diſtance between the Sun and Moon, and they will give the true Quantity of the *Variation*, as the laſt and conſummate Equation.

Equation. Which Equation if it be added to, or taken from the Moon's equated Place, according as Occaſion requires, the Sum or Difference will give you what hath been ſo long ſought, *The true Place of the Moon in her proper Orbit.* The next thing to be done, is to gain her true Place, with Reſpect to the Ecliptick, both in Longitude and Latitude. In Order to which,

7. Subſtract the mean Place of the Node (which was before found) from the true Place of the Sun; the Remainder is the Sun's Diſtance from the Node, which having gotten out of the Table of the Equations of the Node, take the Equation proper to the Diſtance, which being added or ſubſtracted according to the Title of the Table, will give the *true Place of the Node* for the Time given. And becauſe not only the Equation of the Node, but even the mutable Inclination of the Limit, or of the Plane of the Moon's Orbit to the Ecliptick, is Proportional to this Diſtance; take alſo from the ſame Table, the various Inclination of the Limit, or the Numbers expreſſing the Exceſs above the leaſt Inclination (five Degrees) out of the proper Column; that ſo having gained the true Place of the Moon's Node, and the Equation of the Limit, you may the better obtain the Moon's Longitude and Latitude for the Time given.

8. Take then this true Place of the Node, from the true Place of the Moon in her proper Orbit, before determined, the Remainder is what they call the *Argument of Latitude:* And out of the Table of the *Reduction and Exceſs* of the Inclination of the Orbit, take the proper Number correſponding to ſuch Reduction or Exceſs: And ſay by the Rule of Three, As the greateſt Increment of the Limit (in Minutes of Degree) is to the Exceſs given; ſo is the preſent Increment of the Inclination of the Limit (*viz.* above five Degrees) to the Parts Proportional required; which Parts thus found, added to the ſimple Reduction, ſhall give a *Reduction true and perfect*, which being after the Manner of an *Equation*, added to, or taken from the Moon's true Place in her proper Orbit; will give her *Longitude*, or her true Place in the Ecliptick.

9. And this Longitude of the Moon being obtained, you muſt thus proceed to ſeek her Latitude.

From the *Table of the Moon's Latitude*, which not only ſhews her ſimple Latitude, (ſuppoſing the leaſt Inclination to be of five Degrees only) but alſo the Parts Proportional to be added to it, when 'tis near a third of a Degree or 18 Minutes more, Out of this Table I ſay, take her *ſimple Latitude* anſwering to the Moon's Argument of Latitude, with the Parts Proportional to be added to it, and then ſay by the Rule of Proportion, As the greateſt Increment of theſe Minutes, is to the preſent Increment: : ſo is the Exceſs of the Inclination of the Orbit above the leaſt Inclination before found, to the Parts Proportional; and thoſe added to the *ſimple Latitude* of the Moon, will give her *true Latitude* from the Ecliptick.

And theſe Directions are ſufficient for finding the Moon's true Place, both in her proper Orbit, and in the Ecliptick; and both as to Longitude and Latitude, at leaſt according to *Horrox*'s *Theory*. But there are yet behind ſome other Enquiries of no contemptible Conſideration, which muſt be purſued to compleat the true Theory of this every way changeable Planet. As firſt, to find the Quantity of the Moon's Horizontal Parallax for any Time aſſigned. 2. Her apparent Diameter. 3. Her true Horary Motion in either Syzgy; and the Knowledge of theſe, is very neceſſary for the exact Calculation of the Eclipſes of the Luminaries. Wherefore let us next go on thus.

10. To find the true Horary Motion of the Moon in either of the Syzgies, out of the *Table of the Moon's Horary Motions correſpondent to the mean Anamoly*, take out the proper Numbers when the Eccentricity is greateſt and leaſt, and note the Difference; then ſeek the true Eccentricity of the Moon's Orbit, in the very Moment of the Syzgy (according as directed in Number 5 above) and obſerve well the Difference between that, and the *leaſt Eccentricity* of all; then work thus according to the Rule of Proportion. As the Difference between the greateſt and the leaſt Eccentricity, is to the Difference of the Horary Motions now found: : ſo is the Difference between the preſent and the leaſt Eccentricity, to the Parts Proportional; which Parts ſo found, if *added* to the Horary Motion correſponding to the leaſt Eccentricity, when 'tis *leſs* than the Horary Motion belonging to the greater Eccentricity, or *ſubſtracted* when 'tis *greater*; will give the true Horary Motion of the Moon, both with regard to the Sun, and alſo to the Ecliptick, in the very Moment of the Syzgies. And from this, taking the Horary Motion of the Sun (above found) you will have the Horary Motion of the Moon from the Sun.

And when thus the Reaſon and Method of finding the Moon's *Horary Motion* is known, that of determining her *Horizontal Parallaxes*, and *apparent Diameters* will be ſo too, the Reaſon of both being one and the ſame.

# *The Calculation of Eclipses.*

IN order to make the Nature of Eclipses, their several Phænomena, and the Calculation of the Times of their Appearances more clear and intelligible, it may be useful (with Mr. *Whiston*) to premise these following Preparatory Propositions.

1. That the Moon is a Body perfectly Opake, having no Manner of Light of her own, nor a Power of transmitting the Light she receives from the Sun.

2. That the Earth and Moon are both Bodies very little, in Comparison with the Bulk of the Sun, as appears from their several Diameters: That of the Sun being about half a Degree; whereas that of the Earth is not above a Third of a Minute, and that of the Moon scarcely a Fourth of the Diameter of the Earth, if they were both to be seen from the Sun.

3. Wherefore the Figure of the Shadow in both a Solar and Lunar Eclipse must be conical, and terminating in a Point.

4. The *Mucro* or *Vertex* of this Cone of Shadow in either Eclipse, falls short of any of the other Planets; which therefore can never be concerned in these Deficiencies of Light.

5. Were the Plane of the Lunar Orbit coincident with that of the Ecliptick, there would be a total and central Eclipse of each Luminary in every *Sudation*; and the *Lunar* Eclipses would be visible all over those Parts of the Earth, whose Horizon she is above: But the *Solar Eclipse* only to those Parts of the Earth directly opposite to the Sun and Moon at that Moment, which is the very Moment of the Syzgy: And consequently to determine these Eclipses *then*, we need only calculate *that*.

6. But because there is for the most Part, an Inclination, or Angle of a little more than five Degrees, made between those two Planes; it will be plain that Eclipses can only happen at those Full and New Moons, in which she is in or near the *Nodes*, or the Points of Intersection of the two Orbits: And this happens usually in every *Lunation*. Wherefore were the *Lunar Nodes immoveable* (with respect to the Sun) there would be even now, an Eclipse of each Luminary, in every Synodical Month.

7. And because for the producing an Eclipse, not only the *Access* of the Moon to the Nodes is necessary, but also *such an Access* as shall happen at the time of any of the *Syzgies*, or at either New or Full Moon, 'tis plain, that the Eclipses of the Luminaries can *only* happen at those Times of the Year, in which the Syzgies are in or near the Nodes.

8. Wherefore there will be, for the most Part, four notable Eclipses, or such as shall be visible and conspicuous to some or other of the Inhabitants of the Earth, every Year. Two Solar, and two Lunar. For since for many Days together, the Sun's Place is once in every Year, but a little distant from the Northern Node: and then after about a Fortnight, (for the same Time) as near to the Southern Node of the Moon, there must happen (generally) two Syzgies, during each of these Accesses of the Sun to the Node, and consequently at each Syzgy, there must be an Eclipse.

Having thus in Part prepared the Way for the Calculation of Eclipses by these Preliminary Considerations; the Work it self will follow by Degrees. And first in Order,

## *To calculate an Eclipse of the Moon.*

YOU must proceed thus, *To find the Time of the mean and true Syzgies.*

1. From the Table of the mean Motion of the Moon from the Sun, take out the proper Numbers for the radical Year, and the present Year, and Month, and writing them down, add them up into one Sum; which Sum take out from an entire Circle or 12 Signs: Then if you seek for the *Conjunction*, the remaining Numbers alone, or with the Addition of six Signs or half a Circle if you want the *Opposition*, being turned into Time, will give you the *mean Moment* of the *Conjunction or Opposition sought*; that is, if first you deduct (out of the next Table of the mean Motion for *Days*) the Number which is next less than the given one, from that given Number; and so do also out of the *Columns for Hours, Minutes, Seconds, &c.* for then the Day with its Hours, Minutes, Seconds, &c. so found shall be the accurate *mean Time* of the *mean Syzgies*, provided it be not Leap-Year: For if it be, you must take the Year that is next less with its Months, Days, Hours, Minutes, Seconds, &c. adjusted as before.

And thus having got the mean or equable Time of the *mean* Syzgy, you may by the following Method, find the *mean* and *true* Time of the *true Syzgies*.

2. First find the *Longitude* of the Sun in the Ecliptick, and of the Moon in her Orbit, as hath been before shewn: Then if the Places of the Sun and Moon agree in Longitude exactly, which very rarely happens; or if they are diametrically opposite, then both the *mean* and *true* Syzgies do both happen at the same Moment of Time: But if, as it will most Times happen, they be not the same, the *Difference* between them must be *noted*, and *turned* into *Time*, in order to find the *true* Syzgies, thus.

Write

3. Write down the true Horary Motion of the Sun, corresponding to the mean Anomaly (found above) and from the same Tables do the same by the Moon; then substract the Sun's Horary Motion from the Moon's, the remaining Numbers will shew the Horary Motion of the Moon from the Sun, or what she gains in one Hour. Then say by the Rule of Three, As the *Motion* of one Hour, is to that one Hour, or to 60 Minutes in Time :: so is the Difference of Longitudes, or the Distance of the Sun from the Moon, to the Interval or Space between the *mean* and *true* Syzygy; which Space of Time, if the Moon hath not yet overtaken the Sun, must be added to the mean time of the Syzygy; but if she be gone pass'd him, it must be taken from the mean Syzygy, and the *Sum* or Difference will be the *true Syzygy*, to a Moment.

But two Things must here be noted, that this Matter may be truly understood. (1.) That the Moon's mean Anomaly should not be entred in the Table of the Horary Motions, till 'tis first augmented by half its Distance from the Sun, if the Moon have not yet overtaken him; but if she hath, then the Anomaly must be lessen'd as much. For since the Reason of bringing the Anomaly to that Table, is only to shew with what Velocity the Moon hath attained, or will attain her Distance from the Sun; 'tis plain her Horary Motion is to be taken neither in the Beginning nor End of that Interval, when it may be quicker or slower, but when 'tis at a *mean* in the middle. (2.) The Interval between the *mean* and *true* Syzygy, seldom exceeds 12 Hours, never 14, as by Astronomical Computations is apparent.

4. Having thus found the *mean* Time of the true Syzygy, the true Place of the Sun in the Ecliptick, and of the Moon in her Orbit, must be found (as above directed) corresponding thereunto, together with the Moon's true Latitude from the Ecliptick agreeable to the Moment of the true Syzygy, as hath been already shewn. Then

5. From the *mean* Time thus found, an Equation may be formed to find the *Apparent* thus; Get (as is above shewn) the *absolute Equation of Time*, either *adjectitious* or *ablatitious* by help of the *Sun's mean Anomaly*; and contrary to its Title, add it to, if it be ablatitious, or substract from, if adjectitious, the *mean Time* now found: By which means the *apparent Time* of the true Syzygies will be gained.

6. Having thus obtained the *true* Moment of *apparent Time* of the true Conjunction and Opposition, there are yet two things more to be done, before we can advance any farther; *i. e.* to know the Moment of the *apparent Time*, in which the *Centres* of the Luminaries are at their *least Distance*, and at what Moment of the *same* Time the Syzygies happen in the *Ecliptick*.

There is usually a great Difference between the neareſt Approach of their Centres, and the Moment of the full or new Moon, and therefore between those Moments of Time, and the Time of the true Syzygy in the Moon's Orbit, accounting from the Beginning of *Aries*. For the Time of the Ecliptical full or new Moon, in a Plane Normal to the Ecliptick: The Time of the neareſt Approach of their Centres, in a Plane nearly Normal to the Lunar Orbit: The *Apparent* Time of the Syzygy in the Lunar Orbit, where the Arches drawn from the Beginning of *Aries*, to the Centres of the Sun and Moon, are equal, is observed to happen in a Plane Normal, neither to the Ecliptick, nor the Moon's Orbit, but in an intermediate one between both. The half therefore of the Excess or Defect of the least Distance of their Centres in the Ecliptical Syzygy, is nearly equal to the Difference between the Time of the full or new Moon in the Lunar Orbit, and that in the Ecliptical Orbit, and consequently to the least Difference of their Centres, and this *half Difference* is called the *Reduction*; which if *taken from* the Time of the true Syzygy, accounted from the Beginning of *Aries*, will give the Moment of the Ecliptical Syzygy; if *added to it*, the Moment of the neareſt Approach of their Centres.

To get this Reduction by the Astronomical Tables, note the true Horary Motion of the Moon from the Sun (or Earth) in the Front of the Table, and in the Column under it, and over-against the *Argument of Latitude* placed in the Side, you will find the Reduction sought, to be used, as is just now shewn.

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## *To determine the* Time *and the* Duration, *and other Circumstances of the Eclipses of the Luminaries: The first and chief Thing to be done, is to find the* least Distance of their Centres.

FOR whether there will be any Eclipse or not; and if one, what its *Quantity, Duration, &c.* will be, can only be known this Way.

Now this *least Distance* is always equal to the *Moon's Latitude*, in the apparent Time of the Syzygy, in her proper Orbit. This *Latitude* therefore, at the Time of the Opposition in a Lunar Eclipse must be first sought, as hath been above shewn: And then the next Work will be, to calculate *the Magnitude or Semidiameter of the Earth's Shadow, in the Place of its Transit over the Moon.*

Which being compared with the least Distance of their Centres, will account for the chief Phænomena of Lunar Eclipses. As for Instance,

1. If from the Sum of the Sun's and Moon's Horizontal Parallaxes, you take the apparent Semidiameter of the Sun; the Difference will be the *apparent Semidiameter of the Earth's Shadow*, in the Place of its *Transit* over the Moon, as is

plain from the Diagram of *Hipparchus (vid. Whiſton Aſtronom. p.* 62.) Wherefore the Horizontal Parallaxes of the Sun and Moon, for the ſeveral Degrees of the Anomaly, being given from the Aſtronomical Tables, and alſo the apparent Semidiameters; it will be eaſy to determine *the Magnitude of the Earth's Shadow.*

2. The apparent Semidiameter of the Shadow being thus found, add to it the apparent Semidiameter of the Moon: If their Sum exceed the *leaſt Diſtance of the Centres* before found, there will be at leaſt a Partial Lunar Eclipſe. But if it be leſs than the leaſt Diſtance between the Centres, the Moon will not be at all obſcured by the Terreſtrial Shadow.

3. Next ſubſtract the apparent Semidiameter of the Moon, from that of the Shadow: And if the Difference be *equal* to the *ſaid leaſt Central Diſtance*, there will be a *total Eclipſe of the Moon*; but *ſine mora*, as they ſay, that is, the Moon will begin to emerge out of the Shadow, as ſoon as ever ſhe is *totally* obſcured. If this *Difference* be *leſs* than the Diſtance aforeſaid, only ſome Parts of the Moon's Body will be covered: But if it be greater, the Eclipſe will not only be *total*, but *cum mora*; that is, the Body of the Moon will remain perfectly covered for *ſome time.*

4. In order to find the *Quantity of the Eclipſe*, eſpecially in *Partial* ones, (which Quantity is commonly eſtimated by Digits and 60th Parts of Digits; for the Moon's Diameter is ſuppoſed to be divided into 12 Parts or Digits, and each Digit into 60 equal Parts) *From the Sum of the apparent Semidiameters of the Shadow, and of the Moon*, ſubſtract the *leaſt Diſtance of the Centres, and then the Difference or Remainder, reduced to Digits by the Rule of Proportion, will give the Quantity of the Eclipſe*: Therefore ſay, As the Meaſure of the Lunar Semidiameter in Degrees and Parts is the *ſame* in Digits :: that is 60, ſo ſhall that Difference which anſwers to the Quantity of Obſcuration in Degrees and Parts, be to the ſame, accounted in Digits and Parts.

5. *To find the Angle of Incidence*, proceed thus; As the *Sum* of the apparent Semidiameters of the *Shadow*, and of the *Moon*, is to *Radius*: : ſo is the leaſt Diſtance between their Centres, to the Coſine of the Angle of Incidence, which therefore will be found; as alſo, its Equal, the *Angle of the Exit.* But ſince in total Eclipſes, not only theſe two Angles of *Incidence* and *Exit*, but alſo that of *total Immerſion and Emerſion* is to be conſidered, you muſt next proceed to find it. Which this Proportion gives,

6. As the *Difference* of the *apparent Semidiameters* of the *Shadow* and of the *Moon*, is to *Radius:* ſo is the *leaſt Diſtance of the Centres* to the Coſine of the Angle of Immerſion. Wherefore the Quantity of the Eclipſe being known, you will have the Angle of *Incidence* and *Immerſion.*

7. *To find the Mora or Time of the Duration of a Lunar Eclipſe.*

Say, As *Radius* to the Sine of the Angle of Incidence: : ſo is the Sum of the apparent Semidiameters of the Shadow and of the Moon, to the *Semi-mora*, or half the Duration of the Eclipſe.

8. *To find the Duration of the abſolute Darkneſs in a total Lunar Eclipſe.*

Say, As Radius to the Sine of the Angle of Immerſion: : ſo is the Difference of the apparent Semidiameters of the Shadow and Moon to the Motion of the *Semi-mora*, or the Duration of abſolute Darkneſs. I ſay the Motion of the *Semi-mora*, becauſe the Motion of the Moon during that Space of Time, or the Line that ſhe deſcribes during this *Semi-mora*, or half Space of Time in which the abſolute Darkneſs continues, is rather meant, than the *Mora* or Space of Time it ſelf. But if you would have it expreſs'd in Time; ſay, As the Horary Motion of the Moon from the Sun, is to an Hour or 60 Minutes in Time:: ſo is the *Motion of the Semi-mora* in the abſolute Darkneſs, to the half Time of its continuance: And thus the *middle Moment* of the Eclipſe is found.

9. *To find the Moment of the Beginning and End of a Lunar Eclipſe.*

From or to the middle Moment of the Eclipſe, take or add the Semi-duration, and you muſt have the Beginning and End. And if from or to the middle Moment you take or add the *Semi-mora* of abſolute Darkneſs, you will have the Beginning and End of that Darkneſs.

And thus have you a Calculation of a Lunar Eclipſe, not very difficult, if compared with that of a Solar one, and free from the Trouble of Parallaxes and Refractions. *An Example follows.*

# *A Calculation of the Moon's Place for* April 5. 1707. *at* $1^h.\ 46^m.\ p.\ m.$

| | | | Mid. Motion ☾ | | | | Apogæum. | | | | Retrogr. Node. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | S. | o | ′ | ″ | S. | o | ′ | ″ | S. | o | ′ | ″ |
| | | | | | | | | | | | 4 | 27 | 24 | 20 |
| Radix | | 1701 | 10 | 15 | 19 | 50 | 11 | 8 | 18 | 20 | 3 | 26 | 1 | 29 |
| Years since | | 6 | 2 | 9 | 28 | 55 | 8 | 4 | 5 | 44 | 0 | 5 | 1 | 51 |
| April, | Days | 5 | 5 | 21 | 45 | 27 | 0 | 10 | 35 | 2 | 0 | 0 | 1 | 43 |
| | Hours | 13 | 0 | 7 | 8 | 14 | 0 | 0 | 3 | 37 | 3 | 0 | 0 | 6 |
| | Minutes | 46 | 0 | 0 | 25 | 15 | 0 | 0 | 0 | 13 | | | | |
| Mean Motion | | Sum | 6 | 24 | 7 | 41 | 7 | 23 | 2 | 56 | 4 | 1 | 5 | 9 |
| | | | | | | | | | | | 0 | 26 | 19 | 11 |
| Sun mean Anomaly | | | 9 | 17 | 43 | 41 | 0 | 26 | 14 | 57 | 0 | 26 | 14 | 57 |
| Parts Physical | | Subtr. | 0 | 0 | 10 | 53 | Sun's true Place. | | | | Sun's true Place. | | | |
| Middle Place correct | | | 6 | 23 | 56 | 48 | | | | | | | | |
| Apogæum Subtr. | | | 7 | 14 | 42 | 23 | 5 | 3 | 12 | 1 | 11 | 26 | 14 | 57 |
| Mean Anomaly | | | 11 | 9 | 14 | 25 | Annual Argum. | | | | Sun's Dif.fr. Node | | | |
| Equation add | | | 0 | 2 | 21 | 0 | | | | | | | | |
| Equated Place in the Orbit | | | 6 | 26 | 17 | 48 | 8 | 20 | 33 | | 0 | 0 | 5 | |
| True Place of the Sun | | | | 26 | 14 | 57 | Equation Subtr. | | | | Equation add. | | | |
| Moon's Distance from the Sun | | | 6 | 0 | 2 | 51 | | | | | | | | |
| Variation add | | | 0 | 0 | 0 | 1 | | | | | | | | |
| True Place in the Orbit | | | 6 | 26 | 17 | 49 | | | | | | | | |
| Node Subtr. | | | 0 | 26 | 19 | 16 | | | | | | | | |
| Argument of Latitude | | | 5 | 29 | 58 | 53 | | | | | | | | |
| Reduction add | | | 0 | 0 | 0 | 0 | | | | | | | | |
| True Place in the Ecliptick | | | 6 | 26 | 17 | 49 | | | | | | | | |
| True North Latitude | | | 0 | 0 | 0 | 8 | | | | | | | | |
| Former Equation add | | | | | 7 | 15 | | | | | | | | |
| Latter Equation subtract | | | | | 7 | 39 | | | | | | | | |
| The Dif. is Equation now add | | | | | 0 | 24 | | | | | | | | |

Take this from the upper Number there remains.

Sun's true Place.

Sun's Distance from the Node.

Equation add.

| | S. | o. | ′ | ″ |
|---|---|---|---|---|
| The true Place of the Apogæum | 7 | 14 | 42 | 23 |
| Node | 0 | 26 | 19 | 16 |
| | | 5 | 18 | 0 |
| Inclination of the Limit | | 66850 | | |
| The greatest Eccentricity | | | | |
| True | | 62131 | | |
| Mean | | 55237 | | |
| Difference | | 0·6894 | | |
| Difference between the mean and the greatest. | | 11613 | | |

Wherefore the apparent Times of the Eclipse will be thus,

| | | | |
|---|---|---|---|
| Beginning | 11 | 42 | 42 |
| Middle | 13 | 40 | 9 |
| End | 15 | 37 | 36 |

| | ′ | ″ |
|---|---|---|
| The Horary Motion of the Moon | 29 | 56 |
| Of the Sun | 2 | 26 |
| Horary Motion of the Moon from the Sun | 27 | 30 |

As 1650″. 60′ : : 172. $6\frac{1}{4}$. Wherefore the Difference of Time to be subducted, is $6\frac{1}{4}$.
And therefore the middle of the Eclipse will be 13 h. 39′. 45″

| | | |
|---|---|---|
| The Moon's Horizontal Parallax | 54′. | 48″. |
| The Sun's add | | 10 |
| Sum | 54 | 58 |
| The Sun's Semidiameter Subtr. | 16 | 01 |
| Remains Semidiameter Shadow | 38 | 57 |
| Moon's Semidiameter | 14 | 52 |
| Sum | 53 | 49 |

Then say 27. 5 : 60′ : : 53, 8 : 117 $\frac{7}{12}$ = 1h. 57′. $\frac{7}{12}$″. Wherefore the
Duration of the Eclipse, is 3h. 55′.
Beginning 11h. 42m. 18″.
End 15h. 37m. 12″.

*To*

## *To Calculate the Eclipſe of the Sun.*

IN order to which, let it be premiſed, 1. That this Eclipſe of the Sun is *improperly* ſo call'd, and may with much more Juſtneſs take the Name which ſome of our Modern Aſtronomers have given it, when they call it an *Eclipſe of the Earth*; for ſo in reality it is, the Sun by no means being deprived of his Light, but only ſome Parts of our Earth loſe theirs, by being within the Shadow of the Moon's Body, when it happens to be interpoſed between them and the Sun.

To illuſtrate this the better, let us *ſuppoſe* the Earth for a Time deprived of its diurnal Rotation round its Axis, while the Moon freely revolves round us. And ſuppoſe the Moon to be in the very Nodes, and ſo without any Latitude: Then 'tis plain that the Centre of the Moon, being in the Plane of the Ecliptick, directly interpoſed betwen the Centres of the Sun and Earth, will occaſion a Central Eclipſe of the Sun, to ſuch People as inhabit the Earth's Equator; which will be *total*, if in that Place the apparent Diameter of the Moon *exceed that* of the Sun, but if it *fall ſhort* of it, as is moſt uſual, then the Eclipſe will be *annular*.

2. But if at the Time of the Eclipſe, the Moon be not in the *very Node*, but a little Diſtance from it; then the Centre of the Moon's Shadow will not deſcribe the Ecliptick, nor any *great* Circle on the Earth, but a *leſſer Circle*, or a Chord of a great Circle in the *Plane* of the *Disk*.

3. The Figure of the *true* Line or Path, which the Centre of the *Penumbra* and Shadow deſcribes on the Spherical Surface of the Earth, is not exactly Circular, but a Portion of a Curve *more* or *leſs regular*, according to the Motion of the Earth and the obliquity of its Incidence.

4. The Moon's *true Parallax*, to be eſtimated in a Vertical Circle, here puts on the form of other Parallaxes, and makes a Difference, not only in a Vertical Circle, but even in thoſe of Longitude and Latitude; So that on this Account, the apparent Longitude and Latitude of the Moon, do very much vary, and render the *exact* Calculation of Solar Eclipſes very difficult.

5. However there hath been a Geometrical Method found out by Sir *Chriſtopher Wren*, Mr. *Flamſted* and Mr. *Halley*, to avoid this tedious and precarious way of Parallactick Calculation, and of delineating a Solar Eclipſe by Scale and Compaſs. See *Flamſted's Doctrine of the Sphere, in Sir Jonas More's Mathematicks*. Vol. I.

## *To determine the Moment of the Beginning and Ending, and the Duration of a Solar Eclipſe.*

1. FROM the Moon's Horizontal Parallax, ſubſtract the Solar, the Remainder will be the *Semidiameter of the Sun's Disk*. Then collect into one Sum, the *Horizontal* Semidiameters of the Sun and Moon, which Sum will be equal to the Semidiameter of the whole *Penumbra* of the Moon, from whence a Solar Eclipſe ariſes.

2. To the Semidiameter of the *Disk*, add *that* of the *Penumbra*; and if the Moon's Latitude at the Moment of the true Conjunction in her proper Orbit be *leſs* than that *Sum*; there will be, ſomewhere on the Earth, an Eclipſe of the Sun: But if it be *greater*; there will be no Eclipſe at all. And if the Moon's Latitude be, alone, *leſs* than the Semidiameter of the Disk, then the Centre of the Shadow will fall upon the Earth, and ſo cauſe ſomewhere a *Central* Solar Eclipſe, but if it be *greater*, there will be only a *Partial* one.

3. From the Semidiameter of the Earth's Disk, take that of the *Penumbra*, and Note the Remainder carefully; for if the Latitude of the Moon, in the Time of the Syzygy in her proper Orbit, be *leſs* than ſuch Remainder; then will the whole *Penumbra*, at the middle Moment of the Eclipſe, be confined within the Circumference of the Earth's Disk; but if otherwiſe, it will not be ſo. And if by Multiplication, you reduce all theſe Quantities to *Seconds*, you will have the *Angles of Incidence* as they are call'd; that is, the Diſtances of the Points where the *Penumbra* touches the Disk in its Ingreſs and Egreſs; and alſo the Point where, in the middle Time between both, the Centre of the *Penumbra* enters into, and goes out of the *Disk*.

For theſe Diſtances being given in Angles, from the Velocity of the Monthly Motion of the Moon from the Sun, there may, by the Rule of Three, be found the Space of Time proper to each Diſtance; that is, the whole Duration of the Eclipſe will be given, and of the abſolute Darkneſs, and alſo the Time of the *Mora* of the *Penumbra* within the Earth's Disk, as will appear below.

4. From the Latitude of the Moon at the Time of the Conjunction in her own Orbit (which, as hath been ſaid above, is the ſame with the leaſt Diſtance of the Centres ſo often mentioned) you

may find these Angles of Incidence, of the Immersion and Emersion of the Centre, by these Analogies.

As the Sum of the Semidiameters of the Terrestrial Disk, and of the *Penumbra*, is to Radius :: so is the Moon's Latitude, or the least Distance of their Centres, to the Cosine of the Angle of Incidence: And then,

As the Semidiameter of the Earth's Disk is to Radius : : so is the Moon's Latitude, to the Cosine of the Angle of the Immersion of the Centre of the *Penumbra*. And

As the Difference between the Semidiameters of the Terrestrial Disk, and of the *Penumbra*, is to Radius : : so is the Moon's Latitude, to the Cosine of the Angle of the total Immersion.

And since in the *Egress* of the *Penumbræ*, the Angles are equal to those in the *Ingress*, the same Numbers will express both.

5. Having thus gained the Cosine of these Angles, and consequently, the Angles themselves; you must next investigate the Motion of the Moon corresponding to each of the Angles respectively. By saying,

As Radius is to the Sine of the Angle of Incidence :: so is the Sum of the Semidiameters of the *Penumbra* and the Earth's Disk, to the Motion of half the Duration of the whole Eclipse; And,

As Radius to the Sine of the Angle of Immersion of the Centre : : so is the *Semidiameter of the Disk*, to the Motion of half the Duration of Central Eclipses. And again,

As Radius to the Sine of the Angle of total Immersion : : so is the Difference between the Semidiameters of the *Disk* and *Penumbra*, to the Motion of half the *Mora*, or continuance of the *Penumbra* within the Disk.

6. And when the Motions are thus found, you may gain the corresponding Times by this Analogy: As the horary Motion of the Moon from the Sun, is to one Hour, or 60 Minutes : : so is the Motion of half the Duration, ( whether belonging to the Angle of Incidence, to the Angle of the Immersion of the Centre, or to the Angle of the whole Immersion ) to the Space of Time corresponding to each Motion respectively.

And having thus gained *these Intervals of Time*; if you add them to, or take them from, the middle Moment of the Eclipse, you will obtain the *Moment of Time*, in which is the Beginning and End of the Eclipse Central or other; the Beginning and End of the *Mora* of the Centre of the *Penumbra* universally, for *that Place* where you are, or for the Meridian of that Place for which your Tables were calculated; which *Time*, by the Consideration of the Difference of Meridians or Longitudes of Places, may easily be accommodated to any other Place.

And thus may the general *Phænomena* of Solar Eclipses be accounted for and calculated. Their *more particular Affections* may be obtained from the following Considerations, and Methods of Investigation. But let us premise,

1. That in that very Place, where the *Penumbra* first touches and enters the Earth's Disk, the Inhabitants will see the Beginning of the Eclipse, in the uppermost Point of the Sun's vertical Diameter, or in the upper Extremity of the Limb. ( 2.) In that Place where the *Centre of the Penumbra* enters the Earth's Disk, the Spectators will see a Central Eclipse of the Sun. ( 3.) But in that Place where the *whole Penumbra* is first received or contained within the Disk, there the End of the Eclipse will be observed, at the lower End of the Sun's vertical Diameter. (4.) Where the *Path of the Centre of the Penumbra*, in the Meridian Circle intersects the Earth's Axis; and where it intersects the *Axis* of the Ecliptick in the Nonogesimal Degree, or the Point that is most elevated above the Horizon, there a Central Eclipse will be visible. (5.) In that Place where the *Penumbra* begins to emerge out of the Earth's Disk, the Eclipse will begin in the *Western* Luminary, in the nadir Point of his vertical Diameter. (6.) In that Place where the Centre of the *Penumbra* goes out of the Limb, a total Eclipse will be visible in the Sun in the *West*.

7. But where the Centre of the *Penumbra* goes out of the *Disk*, there will be the perfect End of the Eclipse, which will go off in the Zenith Point of the Sun's vertical Diameter.

These are the general Phænomena of Solar Eclipses; only you may observe, that by Reason the Menstrual Motion is swifter than the Diurnal, they will always begin from the *West*, and so will proceed on from *West* to *East*, during the whole Time of the Eclipse.

Before I quite leave this Affair, it will be proper and useful to acquaint the Reader briefly with Mr. *Flamstede*'s late invented Method of representing Solar Eclipses by a Geometrical Construction, because 'tis free from all the Embarasment of Parallaxes, and in some Cases hath the Advantage of Calculation.

Suppose then a Plane to touch the Moon's Orbit, and which shall be posited so as that it shall be at right Angles to the Line which corrects the Centres of the Sun and Moon; and that through this Plane, innumerable right Lines be drawn from the Centre of the Sun, to any Circles upon the Earth's Surface, then will these Lines so drawn, project the terrestrial Sphere, and its Circles on that Plane; so that an Eye placed in the Sun, would observe the Earth and its Annual and Diurnal Motion, as if all were transacted in *that Plane*: Just as we who live on this Earth, observe the Sun and Moon, and their various Motions and Changes, as if performed in Circles of the Sphere projected on a Plane.

From such a Projection therefore of the Earth's Spherical Surface, there will arise in that Plane a Circle for a Base, which will be nearly equal to a great Circle on the Earth, and which is called the *Earth's Disk*, and will be every where Normal to the Plane of the Ecliptick. From its Centre, suppose a right Line drawn both ways, representing the Earth's Axis, and which according to the different Seasons of the Year, will be variously inclined to the Plane of the Ecliptick, which will be represented by one of the Diameters of the Disk; for the Parallelism of the Earth's Axis, by reason of its various Position to the aforesaid Plane, will make three unequal Angles. Let there be imagined also in the same Plane, innumerable Eclipses to be described by the Diurnal Motion or Rotation of any Point on the Earth's Superficies, these will be the *Elliptical Paths* of the several *Vertexes*, as they are called; by each of these, the Situation of any particular Place is determined, and distinguished from all other in this given Plane. Whence, it will follow, that

if

if in Solar Eclipses, you can (within the Plane of this Disk) find the Lines and Paths which the Moon her self touches or describes; you may find also the very Places on our Earth which will be then eclipsed by the Interposition of the Moon's Body.

Having then gained by the Precepts above given, the *least Distance* between the Centres of the Earth (or of the Disk) and of the *Penumbra*, and the Distance of this Line *of the least Distance*, from the Axis of the Ecliptick, described or drawn on the Plane aforesaid; let there be drawn thereto, in the Plane of the Disk a perpendicular from the Point of that least Distance, that Line will shew the *Path of the Centre of the Penumbra*, as it transits the Disk; of which you have a Calculation above given, with regard to the Angles of Incidence, of the *Immersion of the Centre*, and of the *total Immersion*. In this right Line, or in this *Path of the Centre of the Penumbra*, note the Hours of your Meridian, with the Quarters, Minutes, &c. (if there be occasion) corresponding to the *Phænomena* of the Eclipse, found as above by Calculation; and let the Hours, &c. also be noted in the *Elliptick Path* of your particular Place, which must be delineated in this Plane; so that each Hour, and each particular part of every Hour, may determine the very Point where *your Place* described by that Ellipsis, is at that Moment of Time. And having thus given these Moments of Time in the *Rectilinear Path of the Centre of the Penumbra*, and in the *Elliptick Path* of your particular Place, you may by Scale and Compass construct the Phænomena of the Eclipse, as they will appear in your particular Place; thus, Take from the same Scale of equal Parts, by which you drew all the rest, the Semidiameter of the *Penumbra*, and moving one Point of the Compasses along the *Path of the Penumbra*, direct the other towards the *Path of the Place*. If you find it will not reach to it so as to touch it, you may conclude there will be no *Eclipse of the Sun in your particular Place*; but if it doth either touch it, or reach over it, there will be an Eclipse; a *Partial* only, if it touch; a *Total* one, if it reach over the Elliptick Path; the beginning of which Eclipse will be at that Hour, or part of an Hour, where the Compasses Legs being carried along *both Paths*, do mark out the same Time in *each Path*: In like manner, the *middle* of the Eclipse will be found to be at that Moment of Time, which the Legs of the Compasses (being opened still at the same Distance, and now carried Parallel to the Axis of the Ecliptick in your particular Place,) will be at that Moment of Time, which shall be markt out both in the *Paths of the Penumbra*, and in the Path of your particular Place. See *farther in Mr.* Flamstede's *Doctrine of the Sphere in Sir* Jona. Moor's *Math.* Vol. I.

For the Calculation of the Eclipses of the Satellites of *Jupiter*, See *Jupiter* in Vol. II.

## A Table of the Latitudes of many of the most Eminent Places on the Earth; together with their Differences of Meridians in Time and of Longitude in Degrees, accounted from the Meridian of Her Majesty's *Royal Observatory* at *Greenwich*, near *London*.

*Note*, Those Places Markt thus * having been determined by Celestial Observations; the rest have been corrected by their help.

| Places Names. | Latitude D. | M. | Diff. of Merid. H. | M. | Diff. of Longit. D. | M. | |
|---|---|---|---|---|---|---|---|
| *Acapulco* in *Mexico* | 17 | 30 | 7 | 05 | 106 | 15 | W |
| *Agra* the *Mogul's Court* | 28 | 30 | 5 | 33 | 83 | 15 | E |
| * *Aleppo* in *Syria* | 37 | 20 | 2 | 25 | 36 | 15 | E |
| * *Alexandria* in *Egypt* | 31 | 07 | 2 | 12 | 33 | 00 | E |
| * *Amiens* in *France* | 49 | 54 | 0 | 09 | 2 | 15 | E |
| * *Amsterdam* | 52 | 21 | 0 | 19 | 4 | 45 | E |
| * *Antwerp* | 51 | 10 | 0 | 17 | 4 | 15 | E |
| * *Avignon* | 43 | 51 | 0 | 18 | 4 | 30 | E |
| *Babylon* | 34 | 30 | 3 | 14 | 48 | 30 | E |
| *Barbadoes* | 13 | 30 | 3 | 53 | 58 | 15 | W |
| *Barcelona* | 41 | 26 | 0 | 10 | 2 | 30 | E |
| * *Batavia* | 6 | S 15 | 6 | 43 | 100 | 45 | E |
| * *Bayon* | 43 | 29 | 0 | 06 | 1 | 30 | W |
| *Bengal* | 21 | 56 | 6 | 21 | 95 | 15 | E |
| *Bergen* in *Norway* | 61 | 00 | 0 | 32 | 8 | 00 | E |
| * *Bononia* in *Italy* | 44 | 30 | 0 | 47 | 11 | 45 | E |
| * *Boston* in *New-England* | 42 | 25 | 4 | 42½ | 70 | 37 | W |



* *Prest*

| | Places Names. | Latitude D. | M. | Diff. of Merid. H. | M. | Diff. of Longit. D. | M. | |
|---|---|---|---|---|---|---|---|---|
| * | *Breſt* in *France* | 48 | 23 | 0 | 18 | 4 | 30 | W |
| * | *Bourdeaux* | 44 | 50 | 0 | 02 | 0 | 30 | W |
| | *Cadiz* in *Spain* | 36 | 16 | 0 | 30 | 7 | 30 | W |
| * | *Calis* in *France* | 50 | 57 | 0 | 07 | 1 | 45 | E |
| | *Camboia* in *India* | 10 | 20 | 7 | 12 | 108 | 00 | E |
| * | *Canea* in *Crete* | 35 | 29 | 1 | 36½ | 24 | 07 | E |
| | *Candia* | 35 | 18 | 1 | 41 | 25 | 15 | E |
| * | *Cape Bon Eſperance* | 34 S | 15 | 1 | 19 | 19 | 45 | E |
| * | *Cape Comerin* | 8 | 00 | 5 | 13 | 78 | 15 | E |
| * | *Cape Virde* at the *Iſle of Goree* | 14 | 43 | 1 | 09 | 17 | 51 | W |
| * | *Cayenne Weſt-Indies* | 4 | 56 | 3 | 26 | 15 | 30 | W |
| * | *Cayro* | 30 | 04 | 2 | 17 | 34 | 15 | E |
| | *Ceylon* | 7 | 50 | 5 | 33 | 83 | 15 | E |
| * | *Cheuſan China* | 30 | 00 | 8 | 06 | 121 | 30 | E |
| | *Cochin Eaſt-Indies* | 9 | 25 | 5 | 03 | 75 | 45 | E |
| | *Conimbra Portugal* | 40 | 30 | 0 | 39 | 9 | 45 | W |
| * | *Conſtantinople* | 41 | 07 | 2 | 07 | 31 | 45 | E |
| * | *Copenhagen Denmark* | 55 | 40 | 0 | 50 | 12 | 30 | E |
| | *Corvo Inſula* | 40 | 03 | 2 | 06 | 31 | 30 | W |
| | *Cracow Poland* | 50 | 10 | 1 | 18 | 19 | 30 | E |
| | *Cuſco* in *Peru* | 12 S | 25 | 4 | 55 | 73 | 45 | W |
| * | *Dantzick* in *Poland* | 54 | 22 | 1 | 16 | 19 | 00 | E |
| * | *Diep* in *Normandy* | 49 | 56 | 0 | 04 | 1 | 00 | E |
| * | *Dublin* in *Ireland* | 53 | 12 | 0 | 28 | 7 | 00 | W |
| * | *Dunkirk Flanders* | 51 | 01 | 0 | 09 | 2 | 15 | E |
| | *Durazzo* in *Dalmatia* | 41 | 58 | 1 | 21 | 20 | 15 | E |
| * | *Edinborough* in *Scotland* | 55 | 57 | 0 | 12 | 3 | 00 | W |
| * | *Embden* | 53 | 05 | 0 | 30 | 7 | 30 | E |
| | *Fero Inſula* | 28 | 05 | 1 | 13 | 18 | 15 | W |
| | *Fez* | 33 | 10 | 0 | 24 | 6 | 00 | W |
| * | *Florentia* | 43 | 41 | 0 | 47 | 11 | 45 | E |
| | *Frankford* on the *Main* | 50 | 04 | 0 | 33 | 8 | 45 | E |
| | *Geneva* | 46 | 22 | 0 | 26 | 6 | 30 | E |
| | *Genoa* | 44 | 27 | 0 | 39 | 9 | 45 | E |
| * | *Ghent* | 51 | 01 | 0 | 15 | 3 | 45 | E |
| | *Greenwich* at the Obſervatory | 51 | 28½ | 0 | 00 | 0 | 00 | |
| | *Goa* in *India* | 15 | 30 | 4 | 55 | 73 | 45 | E |
| * | *Goes* in *Zealand* | 51 | 30 | 0 | 16 | 4 | 00 | E |
| * | *Guataloupa* | 14 | 00 | 4 | 09½ | 62 | 30 | W |
| * | *Grenoble* | 45 | 16 | 0 | 24 | 6 | 00 | E |
| * | *Hamburgh* | 53 | 41 | 0 | 42 | 10 | 30 | E |
| | *Havre de Grace* | 49 | 30 | 0 | 00½ | 0 | 07 | E |
| | *Heidelburgh* | 49 | 20 | 0 | 36 | 9 | 00 | E |
| | *Hoaignan* in *China* | 33 | 35 | 7 | 56 | 119 | 00 | E |
| * | *Jamaica Port Royal* | 17 | 40 | 5 | 04 | 76 | 00 | W |
| | *Ingolſtad* | 48 | 40 | 0 | 46 | 11 | 37 | E |
| * | *Inſpruck* | 47 | 15 | 0 | 47 | 11 | 45 | E |
| * | *Kebreck New France* | 47 | 00 | 4 | 40 | 70 | 00 | W |
| * | *Koningsberg* in *Pruſſia* | 54 | 43 | 1 | 22 | 20 | 30 | E |
| | *Leghorn* | 43 | 18 | 0 | 51 | 12 | 45 | E |
| | *Liege* | 50 | 40 | 0 | 24 | 6 | 00 | E |
| * | *Leipſick* | 51 | 19 | 0 | 53 | 13 | 15 | E |
| | *Lima Peru* | 12 S | 20 | 5 | 24 | 81 | 00 | W |
| * | *Lintz Auſtria* | 48 | 16 | 1 | 00 | 15 | 00 | E |
| * | *Lions France* | 45 | 45 | 0 | 20 | 5 | 00 | E |
| * | *Lisbon Portugal* | 38 | 50 | 0 | 42 | 10 | 30 | W |
| * | LONDON | 51 | 32 | 0 | 0½ | 0 | 05 | E |
| * | *Macao China* | 22 | 13 | 7 | 44 | 116 | 30 | E |
| | *Madagaſcar Bay of Terra del Gada* | 19 S | 29 | 2 | 58 | 44 | 00 | W |

| Places Names. | Latitud. D. | M. | Diff. of Merid. H. | M. | Diff. of Longit. D. | M. | |
|---|---|---|---|---|---|---|---|
| *Madrid Spain* | 40 | 10 | 0 | 13 | 3 | 15 | W |
| * *Majorca* | 39 | 35 | 0 | 10 | 2 | 30 | E |
| * *Malacca India* | 2 | 42 | 6 | 40 | 100 | 00 | E |
| * *Martinico Island* | 14 | 44 | 4 | 04 | 61 | 00 | W |
| * *Marseiles* | 43 | 20 | 0 | 21½ | 5 | 22 | E |
| *Messina* in *Sicily* | 38 | 21 | 1 | 06 | 16 | 30 | E |
| * *Mexico* | 20 | 06 | 6 | 49 | 102 | 10 | W |
| *Munchen Bavaria* | 48 | 58 | 0 | 47 | 11 | 45 | E |
| * *Montpelier* | 43 | 36 | 0 | 15 | 3 | 45 | E |
| * *Muscow* | 55 | 34 | 2 | 35 | 38 | 45 | E |
| * *Namur* | 50 | 25 | 0 | 20 | 5 | 00 | E |
| *Nangasack Japan* | 32 | 53 | 8 | 31 | 127 | 45 | E |
| * *Nancy Lorrain* | 48 | 39 | 0 | 27 | 6 | 45 | E |
| * *Nants* | 47 | 13 | 0 | 06½ | 1 | 36 | W |
| *Naples* | 41 | 05 | 1 | 03 | 15 | 45 | E |
| * *Narbon* | 43 | 15 | 0 | 09 | 2 | 15 | E |
| *Narsinga* | 18 | 15 | 5 | 34 | 83 | 30 | E |
| * *Nice Provence* | 43 | 38 | 0 | 29 | 7 | 15 | E |
| * *Ningpo* or *Liampo China* | 29 | 58 | 8 | 01 | 120 | 15 | E |
| * *Noremberg* | 49 | 29 | 0 | 49 | 12 | 15 | E |
| *Olinda Brasile* or *Pernambuck* | 7 | S 48 | 2 | 20 | 35 | 00 | W |
| * *Oxford* | 51 | 44½ | 9 | 05 | 1 | 15 | W |
| *Ozaca Japan* | 35 | 05 | 8 | 52 | 133 | 00 | E |
| * *Padua* | 45 | 31 | 0 | 45 | 11 | 15 | E |
| * *Paris* | 48 | 50 | 0 | 09 | 2 | 15 | E |
| * *Pekin China* | 39 | 55 | 7 | 51 | 117 | 45 | E |
| * *Poudicherri* | 11 | 54 | 5 | 21 | 80 | 15 | E |
| * *Prague Bohemia* | 50 | 40 | 0 | 58 | 14 | 30 | E |
| * *Ratisbon* | 48 | 59 | 0 | 49 | 12 | 15 | E |
| *Reggio* in *Italy* | 42 | 15 | 0 | 55 | 13 | 45 | E |
| * *Rhodes* | 36 | 42 | 2 | 12 | 33 | 00 | E |
| * *Rochel* | 46 | 10 | 0 | 05½ | 1 | 20 | W |
| *Rome* | 41 | 51 | 0 | 52 | 13 | 00 | E |
| * *Rostock* | 54 | 10 | 0 | 51 | 12 | 45 | E |
| * *Roterdam* | 51 | 55 | 0 | 17 | 4 | 15 | E |
| *Salamanca Spain* | 41 | 12 | 0 | 16 | 4 | 00 | W |
| * *Sevil* | 37 | 36 | 0 | 26 | 6 | 30 | W |
| * *Siam* in *India* | 14 | 18 | 6 | 43 | 100 | 45 | E |
| * *Smirna* in *Ionia* | 38 | 28 | 1 | 49 | 27 | 15 | E |
| *Spahan Persia* | 36 | 14 | 4 | 20 | 65 | 00 | E |
| *Stockholm Sweden* | 58 | 50 | 1 | 10 | 17 | 30 | E |
| *Syracusa Sicily* | 37 | 04 | 1 | 01 | 15 | 15 | E |
| *Tangier* | 35 | 55 | 0 | 25 | 6 | 15 | W |
| *Tidore* | 00 | 36 | 6 | 37 | 99 | 15 | E |
| *Toledo Spain* | 39 | 46 | 0 | 14 | 3 | 30 | W |
| * *Thoulon France* | 43 | 06 | 0 | 23 | 5 | 45 | E |
| * *Tripoly* in *Barbary* | 32 | 54 | 0 | 52 | 13 | 00 | E |
| * *Tubing Germany* | 48 | 34 | 0 | 37 | 9 | 15 | E |
| * *Valentia Spain* | 39 | 30 | 0 | 03 | 0 | 45 | E |
| *Venice* | 45 | 18 | 0 | 50 | 12 | 30 | E |
| * *Vienna* | 48 | 22 | 1 | 09 | 17 | 15 | E |
| *Upsal* | 59 | 00 | 1 | 12 | 18 | 00 | E |
| * *Uraniburg* | 55 | 54 | 0 | 51 | 12 | 45 | E |
| * *Utrecht* | 52 | 05 | 0 | 20 | 5 | 00 | E |
| * *Wirtemberg Saxony* | 51 | 53 | 0 | 52 | 13 | 80 | E |
| *Wolfenbuttle* | 52 | 11 | 0 | 44 | 11 | 00 | E |
| *York* | 54 | 00 | 0 | 04 | 1 | 00 | W |

*Note*, That those Places against which the S is placed in the Column of Latitudes, are South of the *Equator*; and all the other North.

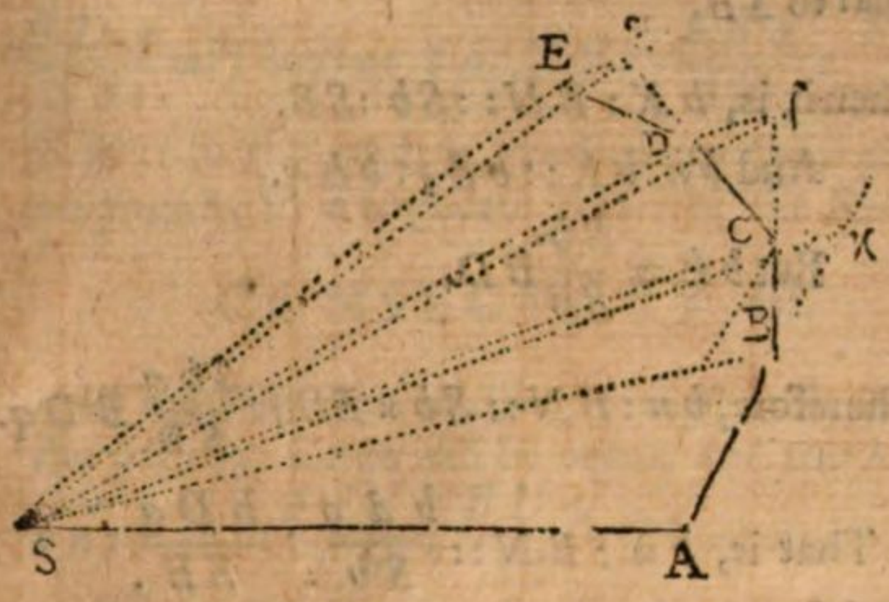
ASTRO-

ASTRONOMY, in order to prepare the Way for the right underſtanding of this noble Science, as it now ſtands in the Writings of the modern Aſtronomers, who have revived and demonſtrated the *Ancient Pythagorean Syſtem of the World*: And beſides thoſe neceſſary Precognita of the Doctrine of the Sphere, *its Projection in Plano, and the Spherick Trigonometry* (which every one ought to know that will purſue this Study;) I ſhall here (from Mr. *Hayes's Fluxions*, p. 291, *&c.*) give you ſuch *Phyſical* and *Mechanical* Propoſitions, as will qualify you to obtain a ſufficient Knowledge of the Doctrine contained in the preſent Books of Aſtronomy.

## PROP. I.

*The Area's which Bodies (ſuppoſe any Planets or Comets) revolving about an immoveable Center, (as ſuppoſe the Sun in S) deſcribe by the Rays drawn to the ſame, are Proportional to the Times of Deſcription, and are all in the ſame immoveable Plain.*

Let the Time be divided into equal Parts, and ſuppoſe in one of them, a Body deſcribes the Space *A B* (by a Power which it has to move in the right Line *A x* from *A* towards ×) in the next Moment of Time, if nothing hindred, it would move from *B* to *x*, deſcribing the Line *B x* equal to *A B*, ſo




that drawing the Rays *A S*, *B S*, *x S* to the immoveable Center *S*, the Areas *A S B* and *B S x* deſcribed, would be equal: But when the Body comes to *B*, let a Force in *S* attract the ſame, and by one ſingle but ſtrong Impulſe, make the Body deviate from the right Line *B x*, and move in the right Line *B C*; draw *x C* Parallel to *B S*, interſecting *B C* in *C*, then at the End of the ſecond Moment of Time, the Body will be found in *C*, in the ſame Plain with the Triangle *A S B*; join *S C* and the Triangle *S B C*, becauſe of the Parallels *S B* and *C x*, will be equal to the Triangle *S B x*, and conſequently it will alſo be equal to the Triangle *S A B*: In like Manner, if the Central Force (or *Vis Centripeta*) act ſucceſſively in *C*, *D*, &c. and make the Body in ſucceſſive Moments of Time deſcribe the Lines *C D*, *D E*, &c. they will be in the ſame Plain, and the Triangle *S C D* will be equal to the Triangle *S B C*, and *S D E* will be equal to *S C D* = *S B C*. Whence it is manifeſt that the Body revolving about an immoveable Center in an immoveable Plain, deſcribes equal Areas in equal Times; and by Compoſition, the Area *S A C S* is to the Area *S A E S*, as the Time which the Body takes to deſcribe *that*, is to the Time it takes to deſcribe *this*.

Let the Number of the Triangles be increaſed and their Breadth diminiſhed *in infinitum*, then the Perimeter *A B C D E* will be a Curve Line, and conſequently the *Vis Centripeta* which perpetually draws back the Body from off the Tangent of this Curve, acts continually; and the Areas *S A C S*, *S A E S* Proportional to the Times of their Deſcription, will alſo in this Caſe be Proportional to the ſame Times. *Q. E. D.*

### *CONSECTARY* I.

If a Body or Planet revolving in the Curve *A B C*, be attracted by a Central Force in *S*, or gravitate towards the Sun there; and if the Body deſcribe the infinitely little Portions of the Curve *A B* and *B C* in equal Times, then the infinite little Triangles *A S B*, *B S C* will be equal; and if on the Center *S*, and with the Radii *S A*, *S B*, the little Arches *A b*, *B c*, be deſcribed, then the Triangle *S A B* or *S A b* = ½ *S A* × *A b*, and the Triangle *S B C* is = ½ *S B* × *B c*; therefore it is, ½ *S A* : ½ *S B* :: *S A* : *S B* :: *B c* : *A b*; that is, the infinitely little Arches *A b*, *B c*, are Proportional to the Radii *S A*, *S B*.

### *DEFINITION* I.

The Center of Attraction is that Point to which the revolving or moving Body is attracted or impelled by the Force or Impetus of Gravity; thus the Sun is ſuch in the reſpect of the primary Planets, and the Earth in reſpect of the Moon.

### *DEF.* II.

*Paracentric Motion of Impetus* is ſo much as the revolving Body approaches nearer to, or recedes farther from the Center of Attraction; thus if *S* be the Center of Attraction, and if a Body in *A* move to *B*, then *S B* — *S A* = *B b*, is called the Paracentric Motion of that Body.

### *DEF.* III.

*Circular Velocity* of a Body is meaſured by the Arch of a Circle; thus if a Body in *A* move to *B*, or *b*, its Circular Velocity is meaſured by the Arch of the Circle *A b* deſcribe on the Center of Attraction *S*, and the Circular Velocity of a Body moving from *B* to *C* is meaſured by the Circular Arch *B C*.

### *DEF.* IV.

*Conatus Excuſſorius* is meaſured by a Line let fall from a Point infinitely near to another Point, Perpendicular to a Line drawn to touch the Curve in that other Point: whence it is manifeſt that the *Conatus Excuſſorius Circulationis*, or *Conatus Centrifugus* may be expreſs'd by *B N* the verſed Sine of the Angle of Circulation *C S N* (or by *c k*, becauſe the Difference between the Radii *S C*, *S B* is incomparably little) for the verſed Sine is equal to a Tangent drawn to the other End of the Arch.

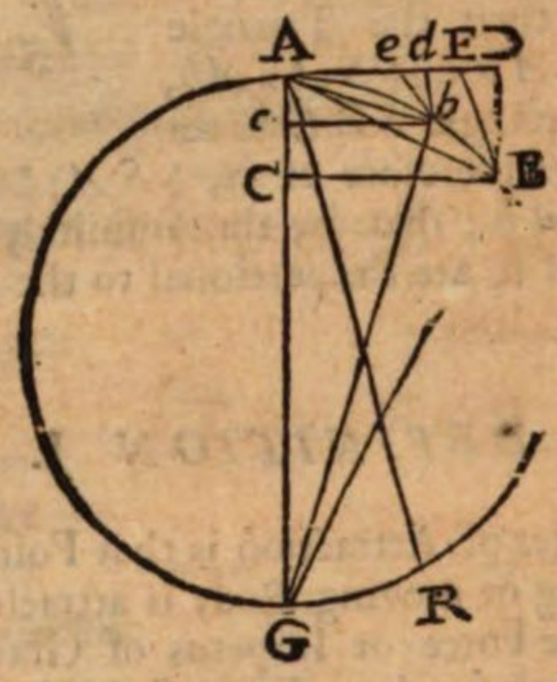
### *DEFIN.* V.

*Solicitatio Paracentrica Gravitatis vel Levitatis*, or the *Paracentric Solicitation* of Gravity or Levity, is expreſs'd by the right Line $AL$, drawn from the Point $A$, Parallel to the Ray $SB$ (infinitely near $SA$) until it interſect the Tangent $BL$.

### LEMMA I.

*The verſed Sines of infinitely little Arches are in a duplicate Ratio of the Chords of the ſaid Arches.*

Let the right Line $AD$ touch the Circle $ABG$ in $A$, then $DAB$ is the Angle of Contact; Let $AB$ be an infinitely little Arch, $AB$ the Chord, and $AC$ the verſed Sign thereof, I ſay $AC$ or $BD$ is as the Square of $AB$; that is, if another infintiely little Arch $Ab$ be taken, then the verſed Sine $Ac$ (or $bd$): Verſed Sine $AC$ (or $BD$):: $Abq : ABq$.




Draw the Diameter $AG$, and draw the Lines $GB$, $Gb$; then by the Property of the Circle, we have $ABq = AC \times AG$ and $Abq = AG \times Ac$; whence it is, $ABq : Abq :: AC \times AG : Ac \times AG :: AC : Ac :: BD : bd$.

Now when the Points $B$, $b$, are infinitely near the Point $A$, then the Chords $AB$, $Ab$, are equal to the Arches $AB$, $Ab$, and conſequently the Verſed Sines $AC$, $Ac$, or the Subtenſes of the Angle of Contact $BD$, $bd$, are in a duplicate Ratio of the conterminal Arches $AB$, $Ab$.

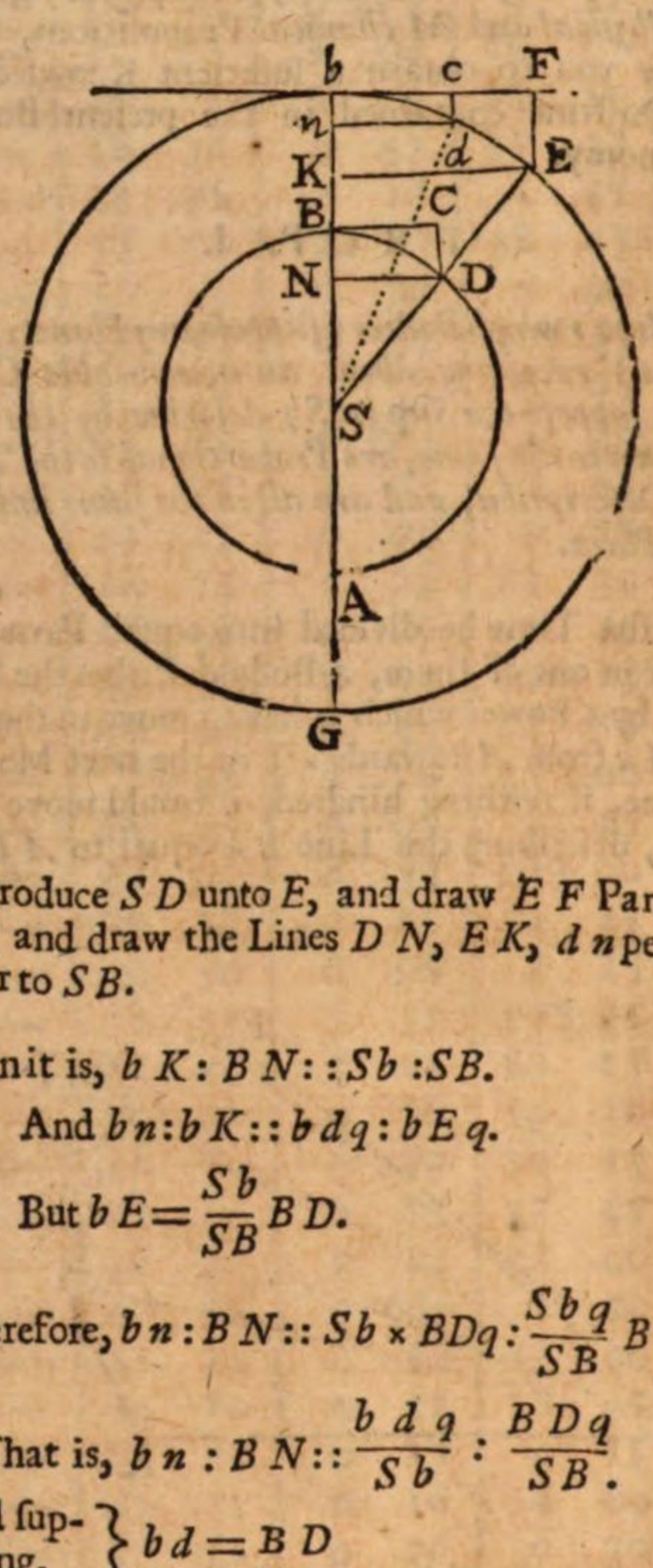
And if the Lines $BE$, $be$, ſubtend the Angle of Contact $DAB$, and be Parallel to any Line (leſs than the Diameter $AG$) drawn within the Circle, as $AR$, then the Lines $BE$, $be$, will be as the Squares of the conterminal Arches $AB$, $Ab$, for $BD : bd :: BE : be :: ABq : Abq$.

### *COROLLARY.*

The Subtenſes of the Angles of Contact of Curves, whoſe Curvature in the Point of Contact is the ſame with that of ſome Circle (or when the Difference between them is incomparably little) are in a duplicate Ratio of the conterminal Arches.

### LEMMA II.

In unequal Circles $ABD$, $GbE$, if the infinitely little Arches $BD$, $bd$ be equal, then the verſed Sines $BN$, $bn$ of theſe Arches will be reciprocally Proportional to the Radii $SB$, $Sb$.




Produce $SD$ unto $E$, and draw $EF$ Parallel to $Sb$, and draw the Lines $DN$, $EK$, $dn$ perpendicular to $SB$.

Then it is, $bK : BN :: Sb : SB$.

And $bn : bK :: bdq : bEq$.

But $bE = \frac{Sb}{SB} BD$.

Therefore, $bn : BN :: Sb \times BDq : \frac{Sbq}{SB} BDq$.

That is, $bn : BN :: \frac{bdq}{Sb} : \frac{BDq}{SB}$.

And ſuppoſing. } $bd = BD$

We have $bn : BN :: SB : Sb$. *Q. E. D.*

### PROP. II.

*The* Conatus Centrifugi *(or* Vires Centripetæ*) of Bodies revolving in equal Circles, with an equable Motion, are in a duplicate Ratio of their Velocities.*

The *Conatus Centrifugus* is equal to the verſed Sine of the Angle of Circulation, and the verſed Sines of Arches infinitely little are in a duplicate Ratio of the Chords of thoſe Arches; that is, in a duplicate Ratio of the Arches themſelves, and the Velocities (the times being ſuppoſed equal) are as the Arches, therefore the *Conatus Centrifugi* are in a duplicate Ratio of the Velocities.

## CONSECTARY I.

If two Bodies $B$, $b$, revolve in unequal Circles, $A B D$, $G b E$, and describe the Areas $S B D$, $S b d$; then the *Conatus Centrifugi* (or *Vires Centripetæ*) $D C$, $d c$, will be in a Ratio compounded of the duplicate Ratio of the Velocities directly, and the simple Ratio of the Radii inversely.

For if the Radii be equal, the *Conatus Centrifugi* are as the Squares of the Velocities; and if the Velocities be equal, the *Conatus Centrifugi* are reciprocally as the Radii; therefore if neither the Radii nor the Velocities be equal, the *Conatus Centrifugi* are in a Ratio compounded of the Rationes of the Squares of the Velocities directly, and of the Radii inversely.

This *Corollary* is demonstrated more universally, in one of the Steps of the Second Lemma; for it is there, $b n : B N :: \frac{b d q}{S b} : \frac{B D q}{S B}$.

## CONSECTARY II.

And if the Bodies $B$, $b$, describe the equal Areas $B S D$ and $b S d$ in equal times (that is, if $S B \times B D = S b \times b d$, then $b d : B D :: S B : S d$) then the Velocities $B D$ and $b d$ will be reciprocally as the Radii, and the Squares of the Velocities will be as the Squares of the Radii inversely, whence the proportion $b n : B N :: \frac{b d q}{S b} : \frac{B D q}{S B}$ will become $b n : B N :: \frac{S B q}{S b} : \frac{S b q}{S B} :: \overline{S B}^2 : \overline{S B}|^3$, that is, the *Conatus Centrifugi* are reciprocally in a triplicate Ratio of the Radii.

## CONSECTARY III.

If the Velocities be directly as the Radii, then the periodic Times will be equal, and the Analogy $b n : B N :: \frac{b d q}{S b} : \frac{B D q}{S B}$ will become $b n : B N :: S b : S B$; that is, the *Conatus Centrifugi* are proportional to the Radii.

## CONSECTARY IV.

If the Bodies $B$, $b$, describe the Arches $B D$, $b d$ in equal Times, then the periodic Time of $b$ will be to the peroidic Time of $B$, as $\frac{S b}{b d}$ is to $\frac{S B}{B D}$; because the Times are directly as the Spaces and reciprocally as the Velocities; and because $b n : B N (:: d c : D C) :: \frac{b d q}{S b} : \frac{B D q}{S B} :: \frac{S B}{B D q} : \frac{S b}{b d q}$ :: (Multiplying by $S B \times S b$) $\frac{S B \times S B q}{B D q} : \frac{S B \times S b q}{b d q}$. Therefore the *Vires Centripetæ* are in a Ratio compounded of the Rationes of the Radii directly, and the Spaces of the periodic Times inversely.

## CONSECTARY V.

And if the Squares of the periodic Times be as the Radii, that is, if $\frac{S b q}{b d b} : \frac{S B q}{B D q} :: S b : S B$, then it will be $b n : B N :: \frac{S b \times S B q}{B D q} : \frac{S B \times S b q}{b d q}$ :: (by substitution) $S b \times S B : S b \times S B$; that is, the *Vires Centripetæ* are equal; and because $\frac{S b}{b d q} = \frac{S B}{B D q}$, therefore $\surd S b : \surd S B :: b d : B D$; that is, the Velocities are in a Subduplicate Ratio of the Radii. *Et vice versa.*

## CONSECTARY VI.

And if the Squares of the periodic Times be as the Squares of the Radii, that is, if $\frac{S b q}{b d q} : \frac{S B q}{B D q} :: S b q : S B q$, then it will be $b n : B N :: \frac{S b \times S B q}{B D q} : \frac{S B \times S b q}{b d q}$ :: (by substitution) $S b \times S B q : S B \times S b q :: S B : S b$; that is, the *Vires Centripetæ* (or *Conatus Centrifugi*) are reciprocally as the Radii; and because (in this Supposition) $S B q \times \frac{S b q}{b d q} = S b q \times \frac{S B q}{B D q}$, therefore $B D = b d$; that is, the Velocities are equal: *Et vice versa.*

## CONSECTARY VII.

If the Squares of the periodic Times be as the Cubes of the Radii, that is, if $\frac{S b q}{b d q} : \frac{S B q}{B D q} :: \overline{S b}|^3 : \overline{S B}|^3$. Then it will be $b n : B N :: \frac{S b \times S B q}{B D q} : \frac{S B \times S b q}{b d q} :: S B \times \overline{S B}^3 : S B \times \overline{S b}^3 :: S B q : S b q$; that is, the *Vires Centripetæ* are reciprocally in a duplicate Ratio of the Radii; and because $\frac{S B}{b d q} = \frac{S b}{B D q}$, therefore $\surd \overline{S B} : \surd \overline{S b} :: b d, B D$; that is, the Velocities are reciprocally in a subduplicate Ratio of the Radii: *Et vice versa.*

## SCHOLIUM.

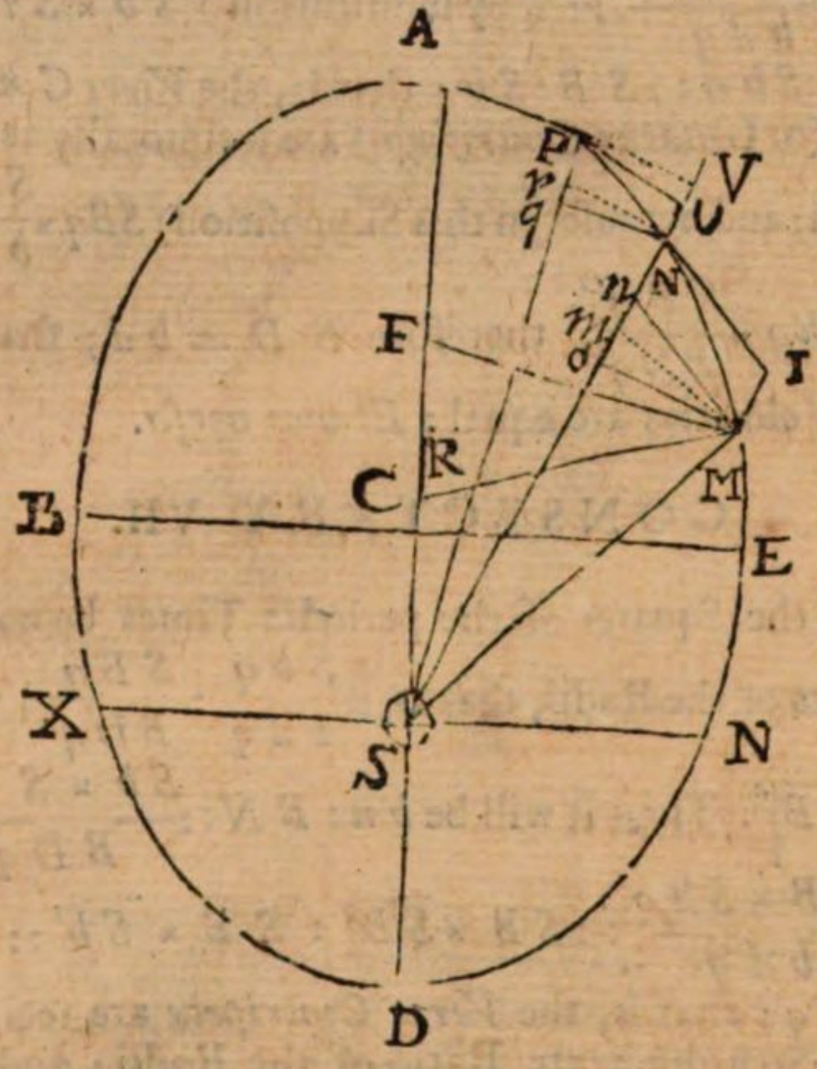
And because it is found by Observation, that the Squares of the periodic Times of Planets, are as the Cubes of their Distance from the Sun; and that in equal Times they describe equal Areas about the Sun: Therefore it is manifest, that the Sun is the Centre of all the Planetary Motions; and that the *Vis Centripeta* (or Force of Gravity) of one Planet, is to the *Vis Centripeta* of another Planet, as the Square of this Planet's Distance from the Sun, is to the Square of that Planet's Distance from the Sun.

It is also evident that those Planets which are nearest the Sun move swiftest, for the Velocity of one Planet is to the Velocity of another Planet, as the Distance of this Planet from the Sun is to a mean Proportional between the Distances of this and that Planet from the Sun.

## PROP. III.

*If the Area which a Body, revolving about an immoveable Center, deſcribes by Rays drawn to the ſaid Centre, be proportional to the Times of Deſcription, the Elementum or infinitely little Increment or Decrement of the Paracentric Impetus is equal to the Difference or Sum of the* Paracentric Solicitation ( Solicitation *of Gravity, or the Impreſſion made by the Action of Gravity or Levity, or any ſuch like Cauſe ) and twice the* Conatus Centrifugus, viz. *to the Sum, if it be the Solicitation of Levity; or to the Difference, if the Paracentric Solicitation ariſe from the Action of Gravity.*

From the Points P and M, draw the Lines P *v*, M *o* perpendicular to S N; then becauſe the Triangles P S N, N S M are equal, ( the times being ſuppoſed equal ) therefore ( becauſe




the Baſe S N is common to both ) the Altitudes P *v*, M *o* are equal; take N *n* = L M, and draw M *n* parallel to L N; then the Triangles P N *v*, M *n o* will be equal and ſimilar, and P N = M *n*, and N *v* = *o n*; again in the Right Line S N ( produced if need be ) take S V = S P, and S *m* = S M, then is N V the Difference between the Radii S P, and S N, and M *m* is the Difference between the Radii S N and S M; now N V is = ( N *v* ) *n o* + V *v*; and N *m* is = N *n* + *n o* = *o m*, therefore N V — N *m* = V *v* + *m o* — N *n* = to the differentio-differential, or infinitely little Increment or Decrement of the Paracentric Velocity, = 2 *m o* — N *n* ( becauſe V *v* and *m o*, the verſed Sines of two Angles and Radii, whoſe Difference is incomparably little, are equal.) Now the Difference between the Radii S P, S N, and S N, S M, expreſſes the Paracentric Velocity, and their Difference again is the infinitely little Increment or Decrement of the ſaid Paracentric Velocity; and *m o* or V *v* is equal to the *Conatus Centrifugus Circulationis*, and N *n* is = to the Solicitation of Gravity; therefore the Elementum of the Paracentric Velocity is equal to the Difference between twice the *Conatus Centrifugus* ( 2 *m o* ) and the ſimple Solicitation of Gravity ( N *n* ) or ( which may be proved in like manner ) to the Sum of twice the *Conatus Centrifugus*, and the ſimple Solicitation of Levity.

## CONSECTARY I.

Hence it appears, that if the Solicitation of Gravity prevail, then N V — N *m* will be Negative, that is, N *m* will be greater than N V, and the deſcenſive Paracentric Velocity increaſes, and the aſcenſive decreaſes. But if twice the *Conatus Centrifugus* prevail, then N V — N *m* will be poſitive, and the aſcenſive Paracentric Velocity increaſes, and the deſcenſive decreaſes.

## CONSECTARY II.

If the Elementum, or infinitely little Increment or Decrement of the Paracentric Velocity be given, the Solicitation of Gravity or Levity may be found; for the *Conatus Centrifugus* is always given, ( by *Conſ.* 2. *Prop.* 2.) it being conſtantly in a triplicate Reciprocal Ratio of the Radii.

## PROP. IV.

*The Angles which a Planet deſcribes about the Sun, in equal Times, are reciprocally in a duplicate Ratio of the Radii.*

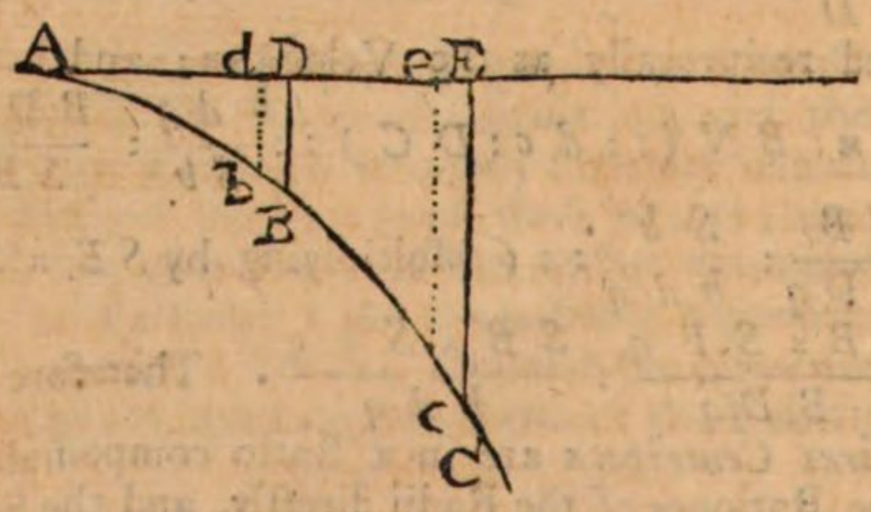
The Circular Velocities are in a Ratio compounded of the Rationes of the Angles and Radii, jointly; therefore the Angles are in a Ration compounded of the direct Ratio of the Circular Velocities, and the reciprocal Ratio of the Radii: But becauſe in equal Times the Areas are equal, ( *Conſ.* 2. *Prop.* 2. ) therefore the Circular Velocities are reciprocally as the Radii, and conſequently the Angles are reciprocally in a duplicate Ratio of the Radii.

And ſuch are the apparent Diurnal Motions of the Planets obſerv'd from the Sun ( for Days, in ſuch Caſes, are Parts of Time little enough, eſpecially in Planets more remote from the Sun ) which are almoſt reciprocally as the Squares of their Diſtances from the Sun; ſo that a Planet, in a given Element of Time, deſcribes but the fourth Part of that Angle, which it would deſcribe at half its preſent Diſtance from the Sun.

## LEMMA III.

*The Spaces which a Body deſcribes in the beginning of its Deſcent, are in a duplicate Ratio of the Times.*

Let the Right Line A E be divided into an infinite Number of equal Parts *d* D, *e* E, &c. repreſenting equal Moments of Time; and draw



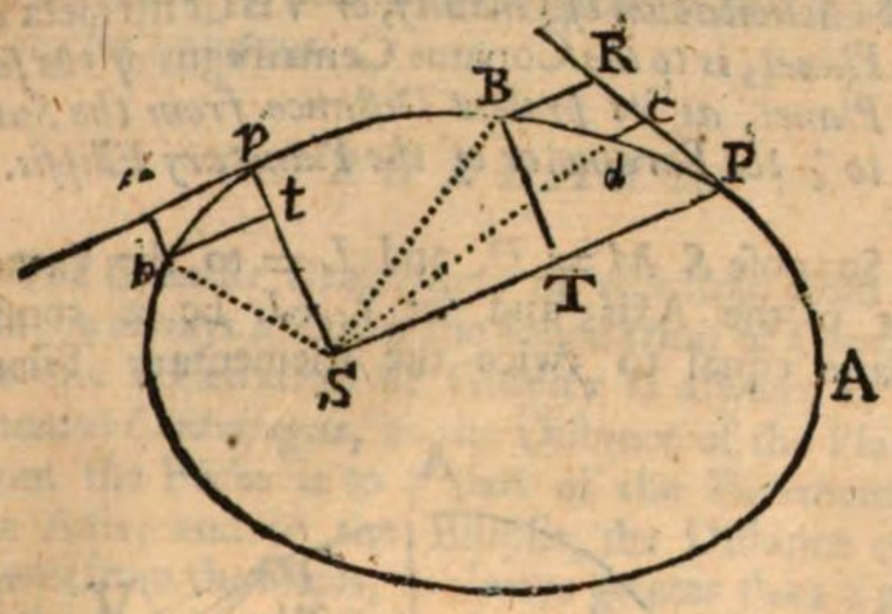

the Ordinates B D, E C, &c. proportional to the Velocities of the heavy Body, at the end of the Times repreſented by A D, and A E, and deſcribe the Curve A B C. Now becauſe the Space which a Body deſcribes, is proportional to the Time of Deſcription, and the Velocity jointly;

it is evident, that the Space which the heavy Body describes in the Moment of Time $D\,d$, is proportional to the Rectangle $D\,b$; and the Space which the same heavy Body describes in the Moment of Time $E\,e$, is proportional to the Rectangle $E\,e$: Whence the Space which the Body describes in the Time $A\,D$, is to the Space it describes in the Time $A\,E$, as the Curvilineal Space $A\,D\,B$, is to the Curvilineal Space $A\,E\,C$, but when the Body begins to descend, the Ordinates $D\,B$, $E\,C$ are indefinitely near the Point $A$; in which Case the trilineal Figures $A\,D\,B$, $A\,E\,C$ become rectilineal similar Triangles, the indefinitely little Portions $A\,B$, $B\,C$ being in the same streight Line. Now the Areas of similar Triangles are in a duplicate Ratio of the Homologous Sides; that is, the Area $A\,B\,D$: Area $AEC$:: $A\,D\,q$ : $A\,E\,q$; therefore the Spaces which a heavy Body describes in the Beginning of its Descent, are in a duplicate Ratio of the Times. *Q. E. D.*

## PROP. V. *Problem* I.

*If a heavy Body revolving in the Periphery of a Curve, about an immoveable Centre, describe Areas proportional to the Times; 'tis required to find the Law of the* Vis Centripeta *tending to the said Centre.*

Suppose a Body P to be projected in the Line P R from P towards R, and let the Body at the same Time be attracted by a Force in S, so




that by a Motion compounded of the projectile and attractive Forces, it describe the Curve A P $p$; and let the Line P R touch the said Curve in P; draw S P, and assume any Point B in the Curve indefinitely near P; and draw B R parallel to S P, and B T perpendicular to $S\,P$; assume another Point $p$ in the Curve; and draw $S\,p$, the Tangent $p\,r$ and $r\,b$ parallel, and $b\,t$ perpendicular to $S\,b$, and suppose the Body describes the Arches $P\,d$, $p\,b$ in equal Times; and draw $d\,c$ parallel to $SP$: Then the Ratio of the *Lineola Nascens* $B\,R$ to the *Lineola Nascens* $b\,r$, is compounded of the Rationes of $B\,R$ to $d\,c$, and of $d\,c$ to $b\,r$: But (*Lem.* 1. and *Cor.*) $B\,R$ is to $d\,c$, as the Square of the Arch $PB$, is to the Square of the Arch $P\,d$; and because the Arches $P\,B$, $P\,d$ are indefinitely little, they are proportional to the Triangles $PSB$, $PS\,d$; (*Lemma* 3.) that is, they are proportional to the Times the Body takes to describe them, or to the Times which the Body takes to describe the Arches $P\,B$, $p\,b$, and consequently $B\,R$ is to $d\,c$, as the Square of the Time which the Body takes to describe the Arch $P\,B$, is to the Square of the Time it takes to describe the Arch $p\,b$; again, because $P\,d$ and $p\,b$ are suppos'd to be described in equal Times, therefore $d\,c$ is to $b\,r$, as the *Vis Centripeta* in $P$ is to the *Vis Centripeta* in $p$; whence it is evident that $B\,R$ is to $b\,r$ in a Ratio compounded of the Rationes of the Squares of the Times in which the Arches $P\,B$, $p\,b$ are described, and of the *Vis Centripeta* in $P$ to the *Vis Centripeta* in $p$; that is, (because the Times of describing the Arches $PB$, $pb$, are proportional to the Triangles $PSB$, $pSb$, or to the Rectangles $SP \times BT$, $Sp \times bt$.)

$$BR : br :: V \times SPq \times BTq : v \times Spq \times btq.$$

And by division $\frac{BR}{SPq \times BTq} : \frac{br}{Spq \times btq} :: V : v.$

Or $\frac{Spq \times btq}{BR} : \frac{SPq \times BTq}{BR} :: V : v.$

That is, the *Vis Centripeta* in $P$ is as the Solid $\frac{SPq \times BTq}{BR}$ inversely.

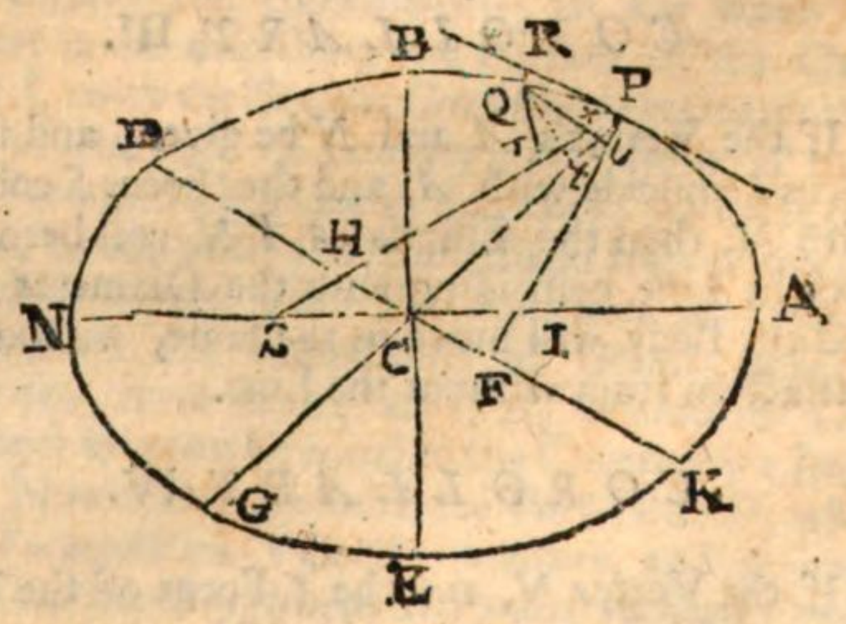
This may be more briefly demonstrated thus: If the Times be equal, $B\,R$ is as the *Vis Centripeta*; and if the *Vis Centripeta* be given, then $B\,R$ (*Prop.* 1. *Lem.* 3.) is as the Square of the Times; and if neither the Times nor the *Vis Centripeta* be equal, then $B\,R$ is (supposing $V$ = to the *Vis Centripeta* in $P$, and $T$ = to the Time of Description) as $V\,T$, therefore $V$ is as $\frac{BR}{T}$; and because the Time is as the Area $PS\,B$, or as the Rectangle $S\,P \times B\,T$, therefore $V$ is as $\frac{BR}{SPq \times BTq}$ directly, or as $\frac{SPq \times BTq}{BR}$ inversely. *Q. E. D.*

### *COROLLARY.*

Hence if any Figure, as $A\,P\,p$, be given, and the Point $S$, to which the *Vis Centripeta* tends; then the Value of the Solid $\frac{SPq \times BTq}{BR}$ may be determined from the Nature of the Figure; and consequently the Law of the *Vis Centripeta*, which is reciprocally as the said Solid, may be found.

## PROP. VI. *Problem* II.

*If a Body revolve in the Periphery of an Ellipsis; 'tis required to find the Law of the* Vis Centripeta, *tending to the Focus of the Ellipsis.*




Let $A\,B\,D$ be the Ellipsis, and $S$ the *Focus* to which the *Vis Centripeta* tends. Draw the Axis $A\,N$;

$AN$; and $AN$, the Conjugate Diameter $BE$; draw the Line $PR$ touching the Curve in any Point ($P$) and draw the Diameter $PG$, the Conjugate Diameter $DK$, $PF$ perpendicular to $DK$, and $Qv$ parallel to $PR$: Draw $SP$ interfecting $DK$ in $H$, and interfecting $Qv$ in $x$; and draw $QR$ parallel to $SP$. Then (*Hayes*, *Art.* 51.) $PH = AC$; draw $QT$ perpendicular to $SP$; and fuppofe the Parameter of the Axis $\left(\frac{2BCq}{AC}\right) = L$. Then,

$L \times QR : L \times Pv :: QR : Pv :: Px : Pv ::$
$PH : PC :: AC : PC.$

$L \times Pv :: Gv \times Pv :: L : Gv.$

$Gv \times Pv : Qv\,q :: CPq : CDq.$

And becaufe $Qv\,q$ is $= Qx\,q$, when $Q$ is infinitely near $P$. Therefore,

$Qx\,q\,(= Qv\,q) : QTq ::$ (by fimilar Triangles) $HPq\,(= ACq) : PFq ::$ (*Hayes*, *Art.* 60.) $CDq : CBq$.

And multiplying the refpective Terms of thefe Analogies into one another, there will arife this;

$L \times QR : QTq :: L \times AC \times CPq : Gv \times CBq \times CP.$

*Viz.* $L \times QR : QTq :: 2BCq \times CPq : Gv \times BQC \times CP.$

$L \times QR : QTq :: 2PC : Gv.$

But when the Point $Q$ is indefinitely near $P$, then $2PC = Gv$.

Whence $L \times QR = QTq$.

And multiplying both fides of the Equation by $\frac{SPq}{QR}$, we fhall have $L \times SPq = \frac{SPq \times QTq}{QR}$. (*Cor. Prop.* V.) Therefore the *Vis Centripeta* is reciprocally as $L \times SPq$; and becaufe $L$ is a determinate Quantity, therefore the *Vis Centripeta* is reciprocally as the Square of ($SP$) the Diftance of the Body in $P$ from the Centre of Attraction $S$. *Q. E. I.*

### COROLLARY I.

The Parament of the Axis ($L$) is equal to $\frac{QTq}{QR}$.

### COROLLARY II.

If the Centre of Attraction $S$, and the adjacent Vertex $N$, be fuppos'd immovable, and if the other Foci $I$ approach nearer and nearer to $S$, and at laft coincide with the fame, then the Body will revolve in the Periphery of a Circle, and the Law of the *Vis Centripeta* will be the fame as in the Ellipfis.

### COROLLARY III.

If the Vertex's $A$ and $N$ be given, and if the Focus $I$ coincide with $A$, and the Focus $S$ coincide with $N$, then the Ellipfis $APN$ will become a ftreight Line coinciding with the Diameter $AN$, and the Body will move in the fame, without any Attraction from without the Line.

### COROLLARY IV.

If the Vertex $N$, and the (Focus of the Ellipfis, or) Centre of Attraction $S$ be given; and if the other Focus $I$ be at an infinite Diftance from $S$; then the Ellipfis $NPA$ will degenerate into a Parabola, and the *Vis Centripeta* in $P$ will be as the Square of the Diftance $NP$ inverfively.

### COROLLARY V.

The fame things being fuppos'd, if the Focus $I$ be at more than an infinite Diftance from $S$; that is, if it fall on the contrary Side of $N$ in refpect of $S$, then the Body will move in the Curve of an Hyperbola, and the *Vis Centripeta* will be reciprocally as the Square of the Diftance from the Focus $S$.

### COROLLARY VI.

If the Focus $I$ and the Vertex $A$ be given; and if the Centre of Attraction $S$ be fuppos'd at an infinite Diftance from $I$, then the Curve $AP$ will be a Parabola, and the *Vis Centripeta* will be the fame in every Point of the Curve; and contrarily, if a Body moving at firft in a ftreight Line, be attracted to a Centre at an infinite Diftance from the fame, then that Body will move in the Curve of a Parabola, and the Centre of Attraction will be in the Axis of the Parabola, at an infinite Diftance from the Vertex.

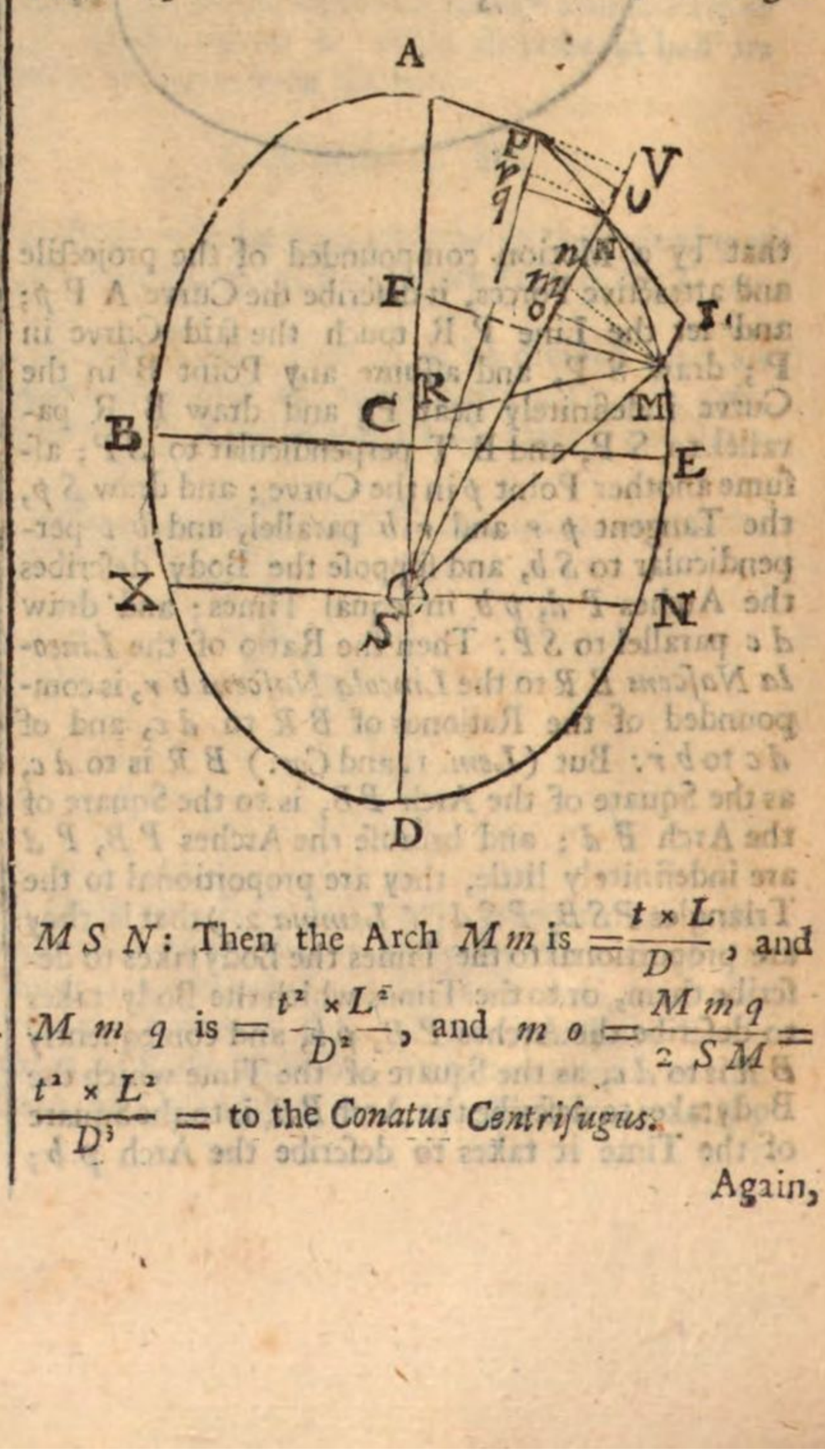
### SCHOLIUM.

*It may be obferv'd that the* Paracentric Solicitation of Gravity, *and the* Vis Centripeta, *are Terms fignifying the fame thing.*

## PROP. VII.

*The Solicitation of Gravity, or* Vis Centripeta *of a Planet, is to the* Conatus Centrifugus *of the fame Planet, as its prefent Diftance from the Sun is to* $\frac{1}{2}$ *the Parameter of the Planetary Ellipfis.*

Suppofe $SM = D$, and $L =$ to the Parameter of the Axis; and let $t \times L$ be a conftant Plane equal to twice the Elementary Triangle




$MSN$: Then the Arch $Mm$ is $= \frac{t \times L}{D}$, and $Mmq$ is $= \frac{t^2 \times L^2}{D^2}$, and $mo = \frac{Mmq}{2SM} = \frac{t^2 \times L^2}{D^3}$ = to the *Conatus Centrifugus*.

Again,

Again, the Solicitation of Gravity is as $D^2$ inverſely, or as $\overline{M\,m}\Big|^2$, or $\frac{t^2 \times L^2}{D^2}$ directly, or as (dividing by the invariable Quantity $\frac{1}{2}\,L$) $\frac{2 \times t^2 \times L}{D^2}$ directly. Whence 'tis evident that the Solicitation of Gravity is in the *Conatus Centrifugus*, as $\frac{2 \times t^2 \times L}{D^2}$ is to $\frac{t}{2}\frac{\times L^2}{D^3}$, or as $D$ is to $\frac{1}{4}\,D$; and becauſe $\frac{1}{4}\,L$ is an invariable Quantity, the Rationes of the Solicitation of Gravity to the *Conatus Centrifugus* are proportionable to the Diſtances of the Planet from the Sun.

## PROP. VIII.

*The greateſt Aſcenſive or Decenſive paracentrick Velocity of a Planet, is when the Diſtance of the Planet from the Sun is equal to $\frac{1}{2}$ of the Parameter of the Axis of the Ellipſis.*

Draw $S\,W$ perpendicular to the Axis $A\,D$, I ſay the greateſt Paracentrick Velocity is in $W$ or $X$. For the Solicitation of Gravity is to the *Conatus Centrifugus*, as $D$ is to $\frac{1}{4}\,L$; and the Solicitation of Gravity is to twice the *Conatus Centrifugus*, as $D$ is to $\frac{1}{2}\,L$; and becauſe $S\,W = D$ is $= \frac{1}{2}\,L$, therefore in the Point $W$ (or $X$) the Solicitation of Gravity, is equal to twice the *Conatus Centrifugus*: and (by *Prop.* 3.) conſequently the Fluxion of the Paracentrick Velocity is $= 0$: Whence it is evident, that if on $S$ as a Centre, a Circle be deſcrib'd with a Radius $= \frac{1}{2}$ the Parameter of the Axis, it will cut the Orbit of the Planet in two Points $W$ and $X$, in which the greateſt Paracentrick Velocity happens.

### *COROLLARY.*

The *Conatus Centrifugus* of receding from the Sun, is always leſs than the Solicitation of Gravity; for the Solicitation of Gravity is always to the *Conatus Centrifugus*, as the Diſtance of the Planet from the Focus is to $\frac{1}{4}$ part of the Parameter of the Axis; and in the Ellipſis, the Diſtance of a Planet from the Focus, is always greater than $\frac{1}{4}$ part of the Parameter of the Axis. Therefore, *&c.*

## PROP. IX.

*The* Impetus *which a Planet acquires (during the whole time of its Motion) by the continued Attraction of the Sun, are proportional to the Angles of Circulation; that is, as the Angles of apparent Motion from the Sun.*

I ſay, That *Impetus* which a Planet acquires, as it moves from $A$ to $P$, is to the *Impetus* which it acquires, moving from $A$ to $M$, as the Angle $A\,S\,P$ is to the Angle $A\,S\,M$: For the Increments of thoſe Angles (*Prop.* 4.) are reciprocally as the Squares of the Radii or Diſtances; that is (*Cor. Prop.* 5.) as the Solicitations or Impreſſions of Gravity: Therefore the Sum of theſe is proportional to the Sum of thoſe; that is, the Sum of all the *Impetus* or Impreſſions of Gravity acquir'd from A to P, is to the Sum of all the Impreſſions of Gravity acquir'd from $A$ to $M$, as the Angle at $A\,S\,P$ is to the Angle $A\,S\,M$.

### *COROLLARY.*

Hence in the Point $W$ (in which an Ordinate to the Axis drawn through the Focus $S$, interſects the Ellipſis) the *Impetus* which a Planet hath acquired ſince it deſcended from the Aphelion, is equal to half the *Impetus* acquir'd from the Aphelion to the Perihelion; and in the ſaid Point $W$, the Diſtance of the Planet from the Sun is $= \frac{1}{2}$, the Parameter of the Axis of the Figure.

And the *Impetus* which a Planet, deſcribing any Arch of its Orbit, acquires, is to the *Impetus* acquir'd in a Semi-revolution, as the Angle of apparent Motion is to two right Angles; the *Impetus* here meant is that impreſs'd by Gravity or Attraction, ſimply conſider'd by themſelves, the contrary *Impetus* ariſing from the *Conatus Centrifugus* not being conſidered.

## PROP. X.

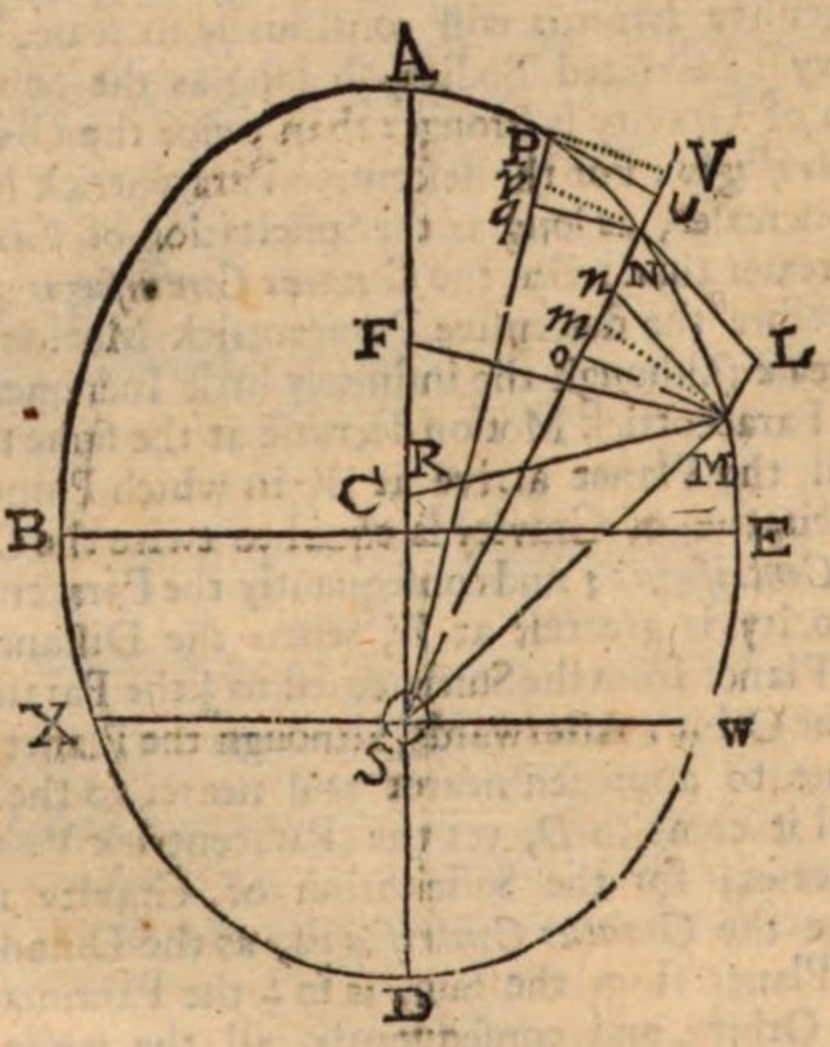
*To explain the Motion of a Planet through the whole Revolution; and to ſhew how a Planet approaches to, and again recedes from the Sun,* Alternis Vicibus.

If a Planet be at its greateſt Digreſſion from the Sun, or in the Aphelion $A$, the *Conatus Centrifugus* and the Solicitation of Gravity, are leſs than if it were nearer to the Sun. But at that Diſtance, *viz.* in the Aphelion $A$, the Solicitation of Gravity is greater than twice the *Conatus Centrifugus*, (becauſe $S\,A$, the Diſtance of the Aphelion from the Sun, is greater than $\frac{1}{2}$ the Parameter $S\,W$) therefore the Planet will deſcend towards the Sun in the Curve Line $A\,P\,M\,D$, and (*Prop.* 3.) the deſcenſive *Impetus* will continually increaſe, as in heavy accelerated Bodies, ſo long as the Solicitation of Gravity is ſtronger than twice the *Conatus Centrifugus*: For the deſcenſive Paracentrick Motion increaſes, as long as the Solicitation of Gravity is greater than twice the *Conatus Centrifugus*; and therefore the deſcenſive Paracentrick Motion will increaſe (although the infinitely little Increment of the Paracentrick Motion decreaſe at the ſame time) until the Planet arrive at $W$, in which Point the Solicitation of Gravity is equal to twice the *Conatus Centrifugus*; and conſequently the Paracentrick Velocity is greateſt at $W$, when the Diſtance of the Planet from the Sun is equal to $\frac{1}{2}$ the Parameter of the Orbit: Afterwards, although the Planet continues to approach nearer and nearer to the Sun, until it come to $D$, yet the Paracentrick Velocity decreaſes; for the Solicitation of Gravity is to twice the *Conatus Centrifugus*, as the Diſtance of the Planet from the Sun, is to $\frac{1}{2}$ the Parameter of the Orbit; and conſequently, all the while the Planet is in deſcribing the Portion of the Orbit $W\,D\,X$, twice the *Conatus Centrifugus* is greater than the Solicitation of Gravity; and from $W$ to $D$ the Paracentrick Velocity decreaſes; which it continues to do, until the Centrifugal Impreſſions collected into one, from the Aphelion $A$, preciſely deſtroy all the Impreſſions of Gravity collected into one, from the Aphelion $A$, or until the Centrifugal Impetus be equal to the Centripetite Impetus. Now this happens in the Perihelion $D$, where the Paracentrick Velocity vaniſhes, and in which the *Conatus Centrifugus* and Solicitation of Gravity are equal and contrary, ſo that the Planet cannot approach nearer the Sun than it is in this Point $D$.

Afterwards, the Motion being continu'd: As the Planet hath hitherto approached to, ſo now it begins to recede from the Sun in the Focus *S*, and endeavours to move from *D* by *X* towards *A*. For twice the *Conatus Centrifugus*, which began to exceed the Solicitation of Gravity in *W*, continues to prevail from *D* to *X*; and therefore, ſeeing the Planet begins to move (as it were anew) from *D* to *X*, the former contrary Impetus (mutually deſtroying each other) the Centrifugal Paracentrick Velocity increaſes from *D* to *X*, but the Increment thereof, or the Impreſſion decreaſes, until the Planet arrive in *X*, where the Solicitation of Gravity is equal to twice the *Conatus Centrifugus*; therefore the greateſt Centrifugal Paracentrick Velocity is in *X*; from *X* to *A*, the Solicitation of Gravity prevails above twice the *Conatus Centrifugus*; and conſequently, the Centrifugal Paracentrick Velocity decreaſes, until the Planet arrive in the Aphelion *A*, in which point the *Conatus Centrifugus* and Solicitation of Gravity become equal and contrary, and conſequently mutually deſtroy each other: And thus the Planet returns to *A*, from whence it departed, and begins and finiſhes new Revolutions ſucceſſively, and without Interruption.

## CONSECTARY I.

Hence we have ſix remarkable Points in the Elliptic Orbit of a Planet, *viz.* four obvious, *A* the Aphelion, *D* the Perihelion; *E* and *B* the mean Diſtances (for *S B* or *S E* is = ½ the tranſverſe Axis *A D*, and conſequently an Arithmetical Mean between *S A* and *S D*, the greateſt and leaſt Di-




greſſion of a Planet from the Sun) and two more, *viz. W* and *X*, being the Extremities of the Parameter of the Orbit applied to the Axis in the Focus *S*, which Points happen in the greateſt aſcenſive or deſcenſive Paracentrick Velocity.

## CONSECTARY II.

The Impetus which a Planet acquires by the Action of Gravity from *A* to *W* is equal to half the Impetus which it acquires in its deſcent from *A* to *D*, and the Impetus acquir'd from *A* to *W* is = to that acquir'd from *W* to *D*; for the Impetus are proportional to the Angles of apparent Motion, and the Angles *A S W* and *W S D* are right Angles.

## CONSECTARY III.

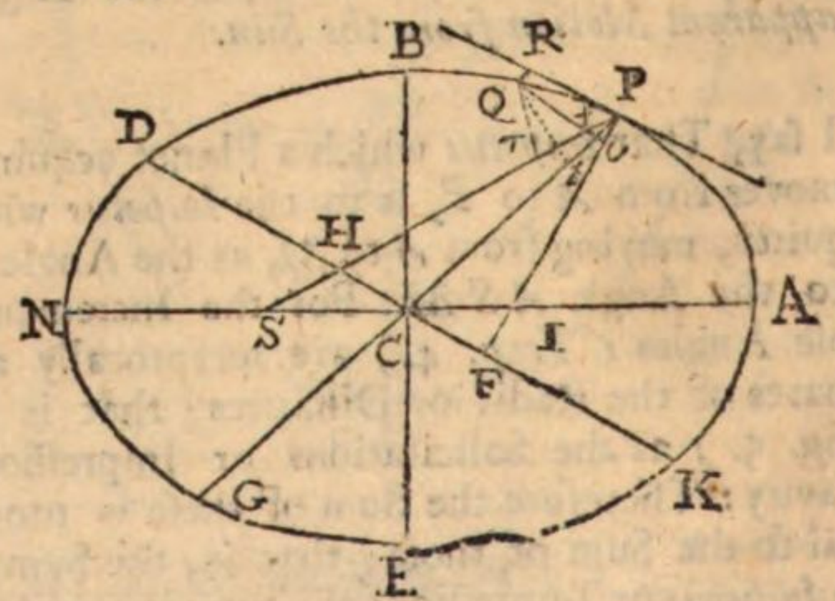
Hence to determine the Species of the Planetary Ellipſis; the Focus of the Ellipſis *S* is given; and the Point *A* where the Planet is when the Sun begins to attract it, being ſuppoſed at the greateſt Diſtance of the Planet from the Sun, the remoter Vertex of the Ellipſis is alſo given, and the proportion between the Solicitation of Gravity, or Force of Gravity, wherewith the Sun begins to attract the Planet in *A*, and the *Conatus Centrifugus* in the ſame Point *A* being known; the principal Parameter of the Orbit *W X*, or an Ordinate applied to the Axis in the Focus *S*, may be found. For *S A* (given) is to *S W* (= ½ the Parameter of the Orbit) as the Force of Attraction in *A* is to twice the *Conatus Centrifugus*, and if ¼ the Parameter be ſubſtracted from *S A*, the greateſt Diſtance of the Planet from the Sun, the remainder will be to *S A*, as *S A* is to *S D*; therefore *A D* the tranſverſe Axis of the Ellipſis is alſo given: Whence the Planetary Ellipſis may be deſcrib'd.

## CONSECTARY IV.

A Planet will deſcribe a Circle when the Solicitation of Gravity, and twice the *Conatus Centrifugus* are equal at the Beginning of the Attraction; for in that Caſe they will remain equal, there being no Cauſe to make the Planet approach nearer to, or recede farther from the Centre of Attraction about which it revolves; but when in the Beginning the Force of Attraction and twice the *Conatus Centrifugus* are unequal (provided the ſimple *Conatus Centrifugus* be always leſs than the Attraction) then the ſaid Planet will deſcribe an Ellipſis; and if the Force of Attraction prevail, the Point where the Motion begins, is the Aphelion; or if twice the *Conatus Centrifugus* prevail, then the ſaid Point is the Perihelion.

## PROP. XI.

*If ſeveral Bodies revolve round a common Centre, and if the* Vires Centripetæ *be reciprocally as the Squares of their Diſtances from that Centre, then in Ellipſes, the Squares of the periodic Times will be as the Cubes of the tranſverſe Axes of the Ellipſes.*




Reaſſume the Symbols in *Prop.* 6. then the Parameter of the Axis of the Figure *L* (*Prop.* 6. *Cor.* 1.)

is $= \frac{QTq}{QR}$, when the Point $Q$ is infinitely near $P$, and if the Times be equal, then $QR$ is directly as the *Vis Centripeta*, or reciprocally as (the Square of the Distance) $SPq$; therefore $L$ is as $QTq \times SPq$; that is, the *Latus Rectum* ($L$) is as the Square of the Area $QT \times SP$; and the Area $QT \times SP$, or $\frac{1}{2} QT \times SP$ is in the ſubduplicate Ratio of the Parameter ($L$.)

And if the periodic Times be equal, the Areas of the Ellipſes, are in a ſubduplicate Ratio of the Parameters; and if the Parameters be equal, the Areas are proportional to the periodic Times; and if neither the Parameters nor the periodic Times be equal, then the Areas of the Ellipſes are in a Ratio compounded of a ſubduplicate Ratio of the Parameters, and the ſimple Ratio of the periodic Times; therefore the periodic Times are in a Ratio compounded of the direct Ratio of the Areas, and the reciprocal ſubduplicate Ratio of the Parameters. Now the Areas of unequal Ellipſes, are (*Art.* 105. *Hayes* N° 4.) in a ſubduplicate Ratio of the Parameters, and the ſubduplicate Ratio of the Cubes of the tranſverſe Axis jointly. Therefore the periodic Times are in a Ratio compounded of the ſubduplicate Ratio of the Parameters directly, the ſubduplicate Ratio of the Cubes of the tranſverſe Axes directly, and the ſubduplicate Ratio of the Parameters inverſely; that is, the periodic Times are in a ſubduplicate Ratio of the Cubes of the tranſverſe Axes, and conſequently the Squares of the periodic Times are proportional to the Cubes of the tranſverſe Axes. *Q. E. D.*

## *COROLLARY.*

The Squares of the periodic Times of Bodies revolving in Ellipſes, are as the Cubes of their Diſtances from the (Focus of the Figure or) Centre of Attraction.

Books on this Subject of Aſtronomy of more immediate and neceſſary Uſe are ſuch as theſe,

*Gregory*'s Aſtronomy *Lat.* in *Fol.*

*Flamſtede*'s Doctrine of the Sphere at the end of Sir *Jonas Moor*'s 1 Vol. of Mathem.

*N. Mercator*'s Aſtronomy, *Lat. Lond.* 1676. 8*vo.*

*Gaſſendus*'s Aſtronomy.

Biſhop *Ward*'s Aſtronomy.

*Tacquet*'s Aſtronomy, in his *Opera Math.*

*Halley*'s Catalogue of the *Southern* Stars. *Oxon* in 4*to.*

An Eſſay concerning the Cauſes of the Celeſtial Motions, in the *Leipſick* Acts of *Feb.* 1689. by G. G. *Leibnitz.*

*Kepleri Epitome Aſtronomiæ Copernicanæ.*

*Wing*'s *Harmonicon Cæleſte.*

*Street*'s *Aſtronomia Carolina.*

*Jer. Horrocci Op. Poſthuma.*

*Bayeri Uranometria.*

*Bullialdi Aſtronom. Philolaica.*

*Hugenii Syſtem. Saturnianum.*

*Whiſton*'s *Prælectiones Aſtronomicæ.*

ATHENATORIUM, in Chymiſtry, is a thick Glaſs Cover (or Head) fixt to a Cucurbite in ſome Kinds of Sublimations.

ATMOSPHERE. From what hath been ſhewn in *Vol.* I. under this Word, it appears to be plainly impoſſible to account for ſo great a Rarefaction and Condenſation as is diſcovered to be in the Atmoſpherical Air, without the Suppoſition of the Particles of Matter being endued with a *Repelling* or *Levitating Force*, whereby they mutually avoid one another, till they come within the Diſtance where the *attractive Force* begins. See *Attraction.* For as the Learned Mr. *Halley* obſerves, at the cloſe of his Propoſition about the Heights of the mercurial Cylinder, at any Elevation above the Earthy Surface. See *Phil. Tranſ. N.* 187. It ſeems a *very hard Queſtion, that the Texture or Compoſition of Parts can be* capable of ſo great an Expanſion and Contraction as is found to be in the Air, and can ſcarce be accounted for, from comparing it to *Wooll*, or ſuch like Spungy Bodies.

ATTAINTED, in the common Law is uſed particularly for ſuch as are found guilty of ſome Crime or Offence, eſpecially Felony or Treaſon: But a Man is alſo ſaid to be attainted of *Diſſeiſin. Weſt.* 1. *c.* 24. and 36. and 3. *Ed.* 1. A Man is attainted two Ways; by *Appearance* or by *Proceſs*. *Attainder* by *Appearance*, is either by *Confeſſion*, *Battel*, or by *Verdict*. *Attainder* by *Confeſſion* is when a Man pleads *Guilty*, and doth not put himſelf upon his Country for Tryal. A Man is *attainted* by *Battel*, when being appealed by another, and chuſing the Combat rather than the Jury, he is vanquiſht; and he is *attainted* by *Verdict* when he is found Guilty by a Jury.

ATTAINDER by *Proceſs*, is otherwiſe called *Attainder* by *Default* or *Utlary*, and is where a Perſon flieth and is not found, after he hath been three Times publickly called in the Country, and at laſt is Outlawed by Default.

ATTENDANT, in Law is uſed in this Senſe, for one that oweth a Duty or Service to another; or after a ſort dependeth upon another. *v. gr.* There is a Lord, Meſne and Tenant. The Tenant holdeth of the Meſne by a Penny, the Meſne holdeth over by two Pence. The Meſne releaſeth to the Tenant all the Right he hath in the Land, and the Tenant dies: Then ſhall his Wife be endowed of the Land, and be *Attendant* to the Heir of the third part of the Penny, and the third part of the two Pence, for ſhe ſhall be endued of the beſt part of the Poſſeſſion of her Huſband. They ſay alſo, that where the Wife is endowed by the Guardian, ſhe ſhall be *Attendant* to her Heir at his full Age.

ATTITUDES, in Painting or Sculpture, are the proper Poſtures that the Figure ſhould be placed in, ſo as agreeably to anſwer the Deſign of the Piece.

ATTRACTION. Sir *Iſaac Newton* at the end of the *Latin* Edition of his excellent Book of Opticks, *Qu.* 22. ſhews that of thoſe Bodies which are of the ſame Nature, Kind, and Virtue, by how much leſs any Body is than another, the *greater* is its *attractive Force*, in proportion to its Magnitude. Thus 'tis found that the *Magnetick Attraction* is ſtronger in a *ſmall* Loadſtone, in proportion to its Weight, than in a *larger*: For the Particles of ſmall Magnets, being nearer one to another, can more eaſily combine or join their Forces into one. Wherefore the *Rays of Light*, being the leaſt of all Bodies that we know, muſt needs have the *greateſt* and *ſtrongeſt attractive Force*; and how very ſtrongly thoſe Particles do attract, may be collected by the following Calculation. The *Attraction* of a Ray of Light, with regard to the Quantity of its Matter, is to the *Gravity* which any projected Body hath, in proportion to the Quantity of Matter in that Body :: in a *Ratio* compounded of the Velocity of a Ray of Light, to the Velocity of that projected Body, and of the Flex-

ure or Curvature of the Line which the Ray deſcribes in the place of its Refraction, to the Curvature or Flexure of the Line which the ſaid projected Body deſcribes. That is, ſuppoſing the Inclination of the Ray, to the refracting Surface be the ſame with that of the Horizon. And from this Propoſition he Calculates that the *Attraction* of the Rays of Light is above 1000000000000000 a Thouſand Millions of Millions of Times greater than the Force of *Gravity* on the Earth's Surface, according to the Quantity of matter in each; and ſuppoſing Light to come from the Sun thither in about ſeven or eight Minutes. And in the very point of Contact of the Rays, their attracting Force may be yet much greater.

Now ſuch a prodigious Force of *Attraction* in the Rays of Light cannot but have wonderful Effects in thoſe Particles of Matter, with which they are joyned in the Compoſition of Bodies; and muſt cauſe that thoſe Particles attract one another, and that they are moved variouſly among themſelves.

'Tis very probable therefore that the *ſmall Particles of Bodies* have certain *Virtues*, *Powers* or *Forces*, by which at a ſmall Diſtance they may act not only on the *Rays of Light* to *Refract*, *Reflect* or *Inflect* them, but alſo mutually on one another, in order to produe *moſt of the Phænomena in Nature*. 'Tis very well known that ſome Bodies do thus act on one another by the *Attractions* of *Gravity*, *Magnetiſm* and *Electricity*: And theſe Examples ſhew what the *Reaſon and Order of Nature is*, and make it very probable that there may be yet ſome *other Attractions*, for Nature is very uniform and agreeable to it ſelf.

Now the *Attractions* of *Gravity*, *Magnetiſm* and *Electricity*, extend themſelves to conſiderable Diſtances, and therefore are commonly obſerved and taken notice of by every one. But 'tis very poſſible that there may be many *others* alſo, which are contain'd in ſuch narrow Limits, and performed within ſuch a little Diſtance, as yet to have eſcaped all our Obſervations.

For when Salt of Tartar runs *per deliquium* or, diſſolves into an Oil as the Chymiſts call it, 'tis very probable that it is occaſion'd by ſome *Attraction* which is mutual between the Particles of the Salt, and thoſe of Water, which rove up and down in the Air in the Form of Vapour; and the Reaſon why common *Salt*, *Nitre* and *Vitriol*, don't run thus *per deliquium*, is becauſe they are without any ſuch Attractions; and when Salt of Tartar hath drawn as much Water out of the Air as its Quantity will bear, it draws no more, becauſe when it's Saturated, the Attraction is at end. It muſt be alſo from its attractive Force, that the Water thus imbibed by the Salt, *cannot be ſeparated from it in Diſtillation, but by a very violent Heat*; whereas, Water will uſually diſtill off with a very eaſy Heat, from other things. 'Tis much the ſame thing with *Oil of Vitriol*, which till it is Saturated with it, attracts the Moiſture of the Air in very conſiderable Quantity, and afterwards parts with it with great Difficulty. And when Oyl of Vitriol and Water beiug mingled together in the ſame Veſſel, grow ſo hot, as it is known they will do, it appears plainly by that Heat, that a very great Motion is excited in the Particles of the two Liquors; and from that Motion it appears that their Particles in mingling Coaleſce with a great Force and Impetuſioty, and conſequently attract or gravitate towards one another with an accelerated Motion. Thus alſo when *Aqua fortis*, Spirit of *Vitriol* or *Nitre*, or any other corroſive *Menſtruum* diſſolves Filings of Iron or any other Metal with Heat and Ebullition; 'tis plain that the Acid Particles of the *Menſtruum* attract and ruſh upon thoſe of the Metal with a very great Force, enter into their Pores with violence, and disjoyn or ſeparate the ſmall Corpuſcles of which the Metal is compoſed, one from another; tho' the Particles of the Acid *Menſtruum* are drawn off at firſt when they are made by a moderate Heat, yet after their Union they with the Parts of the Metal, cannot be drawn off as yet by Diſtillation, but by a moſt intenſe and violent Heat.

When Spirit of *Vitriol* poured upon common *Salt* or *Nitre*, makes an Ebullition and Coaleſces with the Salt; and when after this, if the Compoſt be diſtilled, a Spirit of Salt or Nitre will be drawn off much eaſier than without ſuch a Mixture; it ſhews plainly that the *Fixt Alkali* of the Salt *Attracts* the Acid Spirit of the Vitriol much more ſtrongly than it doth its own Spirit, and becauſe it cannot detain them both, it parts with its own Spirit freely. When Oil of *Vitriol* is diſtill'd from an equal Weight of *Nitre*, and from both is drawn off a *Compound Spirit of Nitre*, and that Spirit is poured upon half its Weight of Oil of *Cloves*, of *Caraway-Seed*, or any ponderous Oil diſtill'd from vegetable or animal Bodies, or upon Oil of *Turpentine*, mix'd with a little Balſam of *Sulphur* to thicken it; when in any of theſe Mixtures an actual Flame will be produc'd, 'tis apparent that the Particles of the Spirit and Oil muſt ruſh towards one another with a ſtrong accelerated Motion, and ſtruggle and fight with a moſt violent Force and *Impetus*. 'Tis the ſame thing when that compound Spirit is poured upon well rectified Spirit of *Wine*, for a Flame will immediately ariſe on their Mixture. The *Pulvis fulminans*, as they call it, which is compos'd of *Sulphur*, *Nitre* and Salt of *Tartar*, goes off with a more quick and violent Exploſion then even *Gun-powder* it ſelf. The Acid Spirits of the *Sulphur* and the *Nitre* ruſhing together with ſuch Violence, that all the Parts of the Powder are rarified, as it were, at once and all together.

Thus alſo common crude and impure *Brimſtone* it ſelf, if it be powder'd and mingled with an equal Weight of Filings of *Iron* or *Steel*, and with a little Water be made up into thick Paſte, like Dough, the *Sulphur* will act ſo upon the *Iron*, that in five or ſix Hours time, the Maſs will grow ſo hot as not to bear handling, and at laſt will plainly burn and emit a Flame. Now from all theſe Experiments, and from the Conſideration of the great Quantity of *Sulphur* that there is in the Earth, and of the great Heat of the inner Parts of it, from the hot *Springs*, the burning *Volcanos*, the *Fire Damps* and burning *Exhalations* that are found in the Bowels of the Earth; from the Conſiderations of *Earthquakes*, *Whirlwinds*, and the wonderful Convulſions that the Sea is ſometimes put into; we may underſtand, That the Particles of Bodies, before at Reſt (and 'tis the ſame thing alſo in all Fermentations, *&c.*) may be and are put into moſt violent Motions, by ſome Principle of very great Force and Activity, which yet doth not diſcover it ſelf till the Parts *approach* and *come very near* one another; but that they do then *attract* one another with great Force and Rapidity, and thereby produce their wonderful Effects.

Again, when *Oil of Tartar per deliqnium* is poured upon the Solution of any Metal, there is a *Precipitation* of the Metalline Particles produc'd, which

which all fall down to the Bottom of the Veſſel; From whence it appears, That the Particles of the Liquor are more ſtrongly *attracted* by thoſe of the Oil of *Tartar* than by thoſe of the Metal, and by that *Attraction* are precipitated down from the Liquor: So alſo when a Solution of *Iron* in *Aqua Fortis* will diſſolve *Cadmia*, and precipitate its *Iron*; or when a Solution of *Copper* will diſſolve *Iron*, and let go the *Copper* (*ſee depart*) &c. this ſeems to prove plainly, that the Acid Particles are more *ſtrongly attracted* by thoſe of the Metal that they diſſolve, than by *thoſe* of *that* which is let go. When we find that thoſe Menſtruums which will diſſolve one Kind of Metal or mix'd Body, won't touch another, it muſt be attributed to the *Attraction* that there is between the Particles in ſome Caſes, and there being *no ſuch* in the other. And in the general it is owing to this Principle, that *Heat*, according to *Ariſtotle*'s Definition of it, *doth congregate or gather together homogeneous Things, and ſeparate thoſe which are of a different Nature*: After this he ſhews how on *this Principle*, and by the Help of *Chymical Analyſes*, to come to the Knowledge of what Kind of Parts natural Bodies are compoſed.

The Reaſon why Drops of Water, or other liquid Body uſually put on a ſpherical Form, he ſaith, is alſo from the *mutual Attraction* of their Parts; after the ſame Manner as the Earth and Seas make one round Body by the *mutual Attraction* or *Gravitation* of their Parts.

And becauſe when Metals are diſſolv'd in Acids, they attract but a ſmall Portion of the Menſtruum to them, therefore he concludes, that their Force of Attraction extends but a *very little Way*. And as in *Algebra*, when affirmative Quantities vaniſh and terminate, their negative begin: So in *Mechanicks*, where *Attraction* ceaſes to exert it ſelf, a Kind of *repelling Force* ſhould ſucceed; and that there is in Nature ſuch a *Force*, ſeems to follow from the *Reflection* and *Inflection* of the Rays of Light; for in both theſe Caſes, the Rays are repelled from Bodies without the immediate Contact of the *reflecting* or *inflecting* Body. And the ſame Thing ſeems concludable from the Emiſſion of Light; for a Ray of it, as ſoon as it is ſhaken out of the lucent Body by the vibrating Motion of its Parts, and is got without the Sphere of its Attraction, is propelled with a very great Degree of Velocity; aud the ſame Force which in Reflection ſerves to *repel* the Ray, now ſerves to *emit* it.

The *Production of Air and Vapours* doth alſo ſhew, that there is a *repelling Force*; for thoſe Particles which are forced out of the Bodies by Heat or Fermentation, as ſoon as ever they are out of the Sphere of the Attraction of theſe Bodies, do immediately recede from it, and from another with a great Force, and do avoid coming together again; ſo that ſometimes they take up above a Million of Times the Space which they did before, when they were in the Form of a Denſe Body, which is ſo very great a *Contraction* and *Expanſion* as is hardly conceivable, if the Particles of the Air be only *elaſtical*, *ramoſe* and *coiled* up one within another, like the Tendrels of Vines, or Springs of Watches, as ſome have imagin'd: Nor indeed, will any other Hypotheſis account for this wonderful Phænomenon, but this of their being endu'd with a repelling Force, by which they mutually avoid one another, as well as the Bodies from whence they at firſt came.

ATTRIBUTIVE *Juſtice*: See *Juſtice*.

AVERCORN, was anciently a *reſerved Rent in Corn* paid to Religious Houſes by their Tenants or Farmers.

AVOIR DU POIS, in *French* ſignifies to be of juſt Weight; but in Law 'tis taken in two Senſes, for a peculiar Kind of Weight of ſixteen Ounces to the Pound, and thereby diſtinguiſh'd from *Troy* Weight, whoſe Pound hath but twelve Ounces: And alſo ſuch Merchandize and Goods as are weighed by this Weight, and not by *Troy* Weight, as *Pitch*, *Tarr*, *Roſin*, *Wax*, *Fleſh*, *Tallow*, *Cheeſe*, *Soap*, *Hemp*, *Flax*, *Coppper*, *Tin*, *Lead*, *Steel*, *Iron*, &c. Mr. *Ward* ſaith, he found that 1 Pound *Avoir du pois* was exactly 14 Ounces, 11 Peny-Weights, 15½ Grains *Troy*: And he ſaith, he can find no Law for the Introduction of this Weight, nor at what Time it came into Uſe, which it ſeems to have done only by Cuſtom. *See* Weights *in* Vol. I.

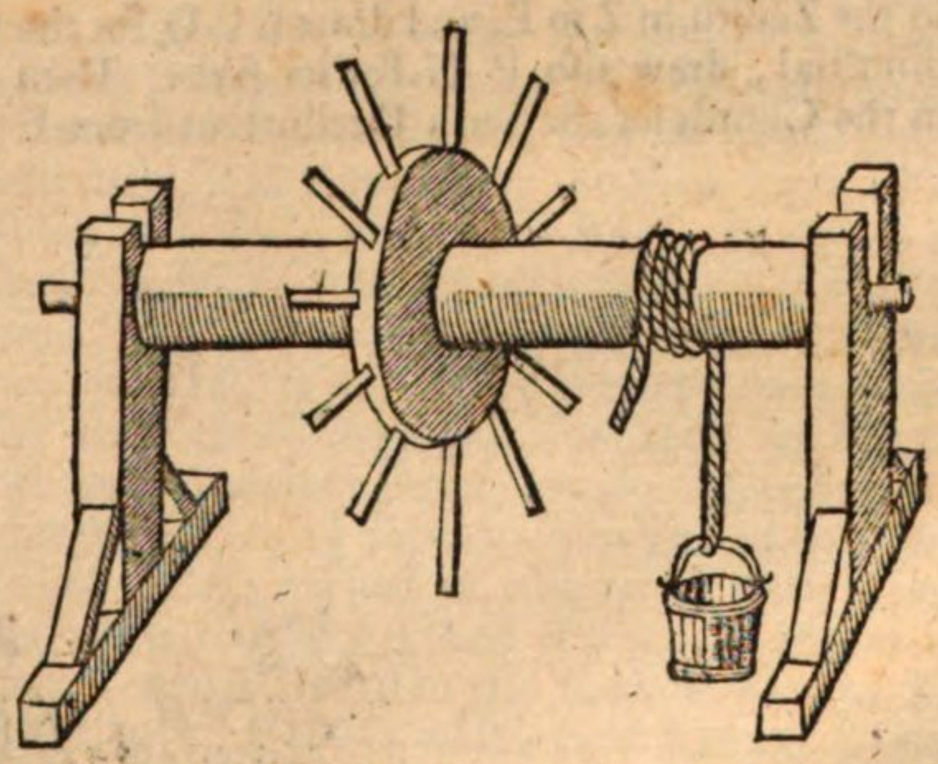
AURELIA, is a Term uſed by the *Natural Hiſtorians* for the firſt apparent Change of the *Eruca* of any Inſect: 'Tis the ſame with what ſome Writers call *Nympha*.

AURISCALPIUM is an Inſtrument to clean the Ears.

AURORA *Borealis* is a white Pyramidal Glade of Light, which Dr. *Childry*, Mr. *Caſſini* and Mr. *Derham* have mentioned as appearing like the Tail of a Comet in the Northern Hemiſphere of the fix'd Stars.

AUXILIUM *ad filium Militem faciendum & ad filiam maritandam*, was a Writ formerly directed to every County, where the King or other Lord had Tenants, to levy of them a reaſonable Aid towards the knighting of his Son, and Marriage of his Daughter; but this is now utterly taken away by a Statute made 12 *Car.* 2. *c.* 24.

AXIS *in Peritrochio*. See its Deſcription in *Vol.* I.



In this Inſtrument, and all ſuch like, (as all Crane-wheels, Mill-wheels, &c. the *Vis Matrix*, which is to ſuſtain or lift up any Weight, need only be to ſuch Weight as the *Perimeter* of the Axis A B is to *that* of the *Tympanum* or *Peritrochium* C D; and then there will be an *Æquilibrium*.

From the Fabrick of the Engine, 'tis plain, that the Weight *W* is at every Revolution of the Axis rais'd ſo much, as is the Girt of the Axis; and conſequently the larger the Axis, the *quicker* riſes the Weight (with a Proportionable Power) but yet the *harder*: and the leſs the Axis is, the *ſlower* riſes the Weight, but the eaſier.

Wherefore

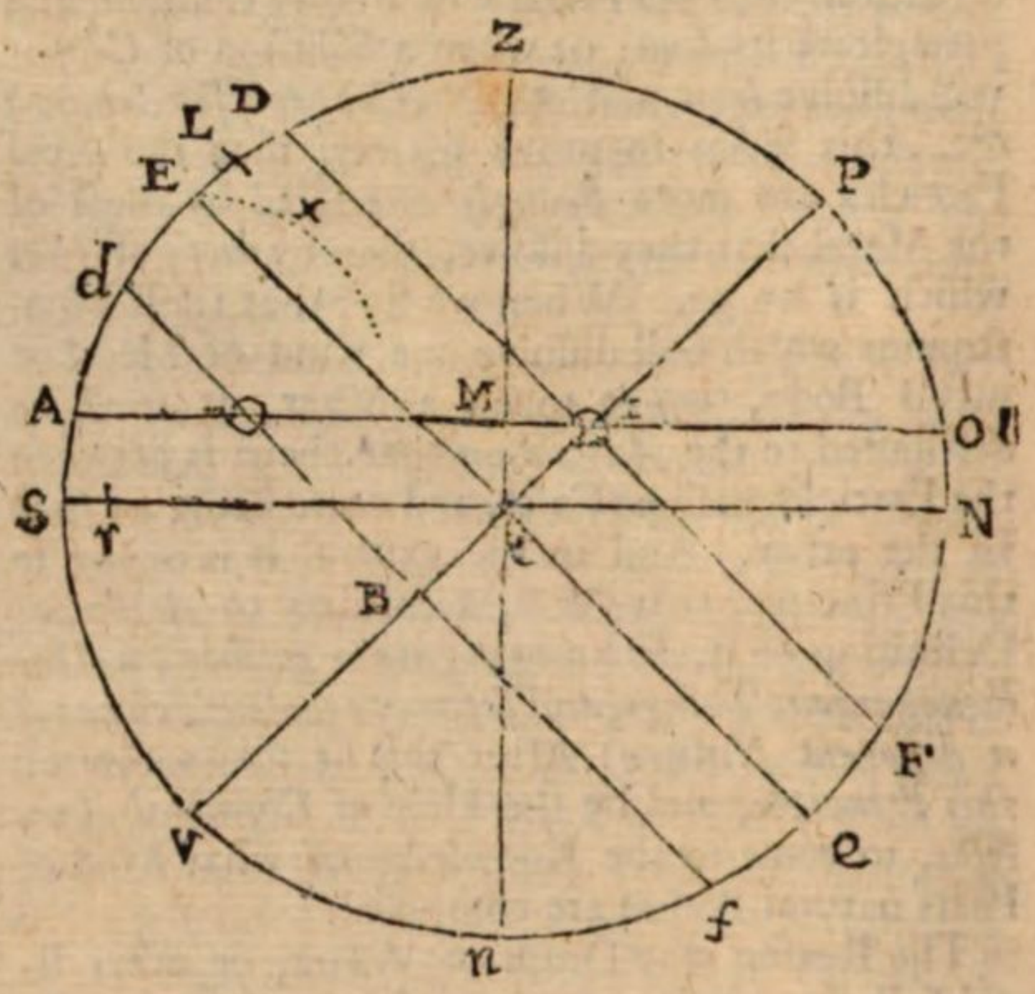
Wherefore if the Weight be to the Power, as the Perimeter of the *Peritrochium* is to the *Perimeter* of the Axis, then will the Velocity of the Power to that of the Weight, be as the Weight to the Power; and consequently the Moment of the Power will be equal to that of the Weight. Wherefore 'tis plain, that the greater the Perimeter or outermoſt Wall, the longer the Stick or Lever D C: Or on the other, the leſſer the Diameter of the Axis, the eaſier will the ſame Force move the Weight aſſigned.

AYDE, in Law, is where a particular Proprietor is impleaded, and not being able to defend the Thing for which he is ſo impleaded, he *prayeth ayde* of ſome better able: which is done two Ways, 1. In a *Plea real*, and *Tenens petit auxilium de* A B *ſine quo reſpondere non poteſt.* 2. In a *Plea perſonal*, and then the Defendant, *petit auxilium ad manutenendum Exitum.*

AYEL is a *Writ* which lies where the Grand-father (called by our common Lawyers *Beſayel*, it ſhould be *Beſayeul*) was ſeized in his Demeſne, as of Fee of any Lands and Tenements in Fee Simple, the Day that he died, and a Stranger abaſeth and entereth the ſame Day, and diſpoſſeſſeth the Heir.

ASIAMENTA, *Eaſements*, in Grants of Conveyance and Demiſe did include any Liberty of Paſſage, Hich-way, Water-courſe, or other cuſtomary Benefit for the Eaſe and Accommodation of the Owners or Inhabitants of any Houſe, or the Tenants of any Land. *Kennet's Gloſſary.*

AZIMUTH *of the Sun.* To find it readily by projecting Part of the Analemma, having the Latitude of the Place, and the Sun's Declination and Altitude: With 60 of the Chords draw the Circle P E Z for the Solſtitial Colure or Meridian of their Place, and croſs it in the Center with the 2 Lines Z *n* and S N, at right Angles to another for the *Azimuth* of E and N, and for the Horizon of the Place. Set the Latitude from N to P, ſo ſhall P be the Pole of the World: and ſet it alſo from the Zenith in Z to E, and draw E C Q for the Equinoctial, draw alſo P U for its Axis. Then from the Chords ſet the Sun's Declinrtian from E to D, and from Q to F, if it be North Declination; or from E to *d*, and from Q to *f*, if it be South, and draw the reſpective Parallel to the Equinoctial D F, or *d f:* Then ſet the Sun's Altitude from S to A, and from N to O, and draw




the Parallel to the Horizon, A O, where this Interſects, the Parallel of Declination will be the Repreſentation of the Sun's Place, as at ⊙ 1 in Summer, or ⊙ 2 in Summer. Fit then the Sector to the Radius A M, and M O, or M ⊙ 1, or M ⊙ 2 ſhall be to that Radius, the Sine of the Sun's Azimuth from the Eaſt or Weſt Southwards, according to the Time of either Before or Afternoon.

If no Sector be at Hand, you may meaſure the Azimuth on the Chords to the Radius of the Diagram thus; Set M A from the Center C to *r* in C S, on which Point *r*, as a Center, with the Extent M O 2 ſtrike above the Arch *x*; for then a Ruler laid from C the Center, juſt to touch the Convexity of the Arch *x*, will cut the Limb in L, and then L S meaſur'd on the Chords, will give you the Degrees of the Azimuth.

BABYLONISH *Hours*. The *Babylonians*, *Perſians*, and *Syrians*, *&c.* accounted their 24 Hours of the natural Day to begin from Sun-riſing, and to continue till the Sun ſetting of the next Day. Wherefore Hours thus accounted, and thus put in (as is common) among the Furniture of Dials, are in Dialling called the *Babyloniſh Hours*.

BACK *and Bottom Nails*, are ſuch as are made with flat Shanks that they may hold faſt, and yet not open the Grain of the Wood. They are uſed for nailing Boards together for Coolers, for Gutters to ſave Water under the Eaves of a Houſe, or for any Veſſel made with Planks or Boards, and deſign'd to hold the Liquors.

BALDACHIN, in Architecture, is a Building in Form of a Canopy or Crown ſupported by Pillars, often ſerving for the Covering of an Altar. Some alſo call the Shell over a Door by this Name and pronounce it *Baldaquin*.

BALLISTERS, are a Row of ſmall Pillars which ſupport a Rail. They are ſometimes called *Banniſters*, and are placed on Stairs, and in the Front of Galleries, Balconies, *&c.*

BANK, is a Carpenter's Term for a Piece of Firwood unſlit from 4 to 10 Inches Square, and of any Length.

BANNERET, was anciently a Knight made in the Field with the Ceremony of cutting off the Point of his Standard, and making it as it were a Banner. And this was accounted ſo Honourable a Knighthood, that they were allowed to diſplay their Arms in the Field in the King's Preſence as Barons do. They were next to Barons in Dignity. *Henry* VIIth made divers *Bannerets* upon the Corniſh Rebellion, *A.D.* 1495: See *Selden*'s *Titles of Honour*, *Camden*'s *Britannia*, Sir *Tho. Smith*, *Lib. de Rep. Angl. c.* 18.

BARBICAN, is a Term in Architecture taken from the *French*, and ſignifies any Outwork belonging to a great Building.

BARCO-*Longo*, is a ſmall, low, long, ſharp built Veſſel without a Deck, going with Oars and Sails; much uſed in *Spain*.

BARGAIN *and Sale*, in Law, is a Contract made of Mannors, Lands, Tenements, Hereditaments, and other things, transferring the Property thereof from the *Bargainor* to the *Bargainee*. The Author of the new Terms of the Law ſaith, it ought to be for Money, *&c.* and that the Fee-ſimple paſſeth thereby, though it be not ſaid in the Deed, *To have and to hold, the Land to him and his Heirs*; and though there be no *Livery & Seiſm* made by the Vender, ſo it be by Deed, indorſed, ſealed, and enrolled either in the County where the Land lies, or within one of the Courts of Record at *Weſtminſter*, and this within 6 Months after the Date of the Deed: According to 27 *H.* 8. *c.* 16.

BARK, or *Barque*, is a Veſſel with 3 Maſts, *viz.* Main-maſt, Fore-maſt, and Mizen-maſt, and carrying uſually about 200 Tuns.

BAROMETER. In *Phil. Tran. N.* 292. there is a pretty Experiment of Mr. *Hawksbee*, to ſhew the Cauſe of the Deſcent of the Mercury in the Barometer in Storms, to be the collateral Preſſure or Current of Wind on the Surface of the ſtagnant Mercury in the Ciſtern, which abates the Force of the Perpendicular Preſſure, or the uſual Gravity of the erect Column of Air, equal in Baſe to the Oriſice of the Tube.

BAROMETER *Portable*, is one that can be ſafely and conveniently carried about from Place to Place, without the Danger of ſpilling the Mercury out of the Ciſtern, or letting the Air get in at the Bottom of the Tube, or of the Mercury included in the Tube, breaking the Top of it off by the Motion it will be put into by being carried from one Place to another. You may prevent the two former Inconveniencies by tying ſome gentle Leather faſt over the Brim of the Ciſtern, which muſt be of Glaſs or cloſe grained Wood; and muſt have a Neck or Hollow round the Outſide of the Brim to tie on the Cover of Leather. And the laſt may be remedied, by either a way to ſcrew or ſqueeze the included Mercury quite up to the Top of the Tube, ſo that the Tube in its Carriage from Place to Place ſhall be always full; or elſe by pinching the Head of the Tube at about an Inch from the Top, ſo as to make it there have a very narrow Neck, not ſo big as a Straw: By which Means the Force of the Mercury ſtriking againſt the Top, will be very much bridled, and therefore the Tube ſecured from having its Top broken off.

BARON hath divers Significations: Firſt, 'Tis uſed for a Degree of Nobility next to a Viſcount. Some of our Hiſtorians ſay, that ſoon after the Conqueſt, all *Barons* came to Parliament, and ſat as Peers in the upper Houſe of courſe; but they being then very numerous, it grew an Order and a Cuſtom, that none ſhould come, but ſuch as the King thought fit to Call by *Writ*, which *Writ* ran then, *pro hac vice tantum*. But this State of the Nobility being very precarious, and depending ſolely on the Prince's Pleaſure, they at length got a ſurer hold, and obtained of the King Letters Patents; and theſe were called *Barons by Patent* or Creation, whoſe Poſterity are now *Lords of Parliament*. And *Cowel* ſaith, there are nevertheleſs Barons by Writ, as well as by Letters Patents; and that thoſe are diſtinguiſhed from theſe by having their own Sirnames annexed to the Title of Lord; whereas Barons by Patent are named by their Baronies. The Original of Barons by *Writ*, *Camden* refers to *Henry* 3. and Barons by Patent or Creation commenced in the Time of *Rich* 2. To theſe *Segar* (*Norroy*) adds a third Kind of Baron, which he calls *Baron by Tenure*; and ſuch are the Lords the Biſhops, who, by virtue of Baronies annexed to their Biſhopricks, ſit in the upper Houſe and are called Lords Spiritual.

BARON is alſo an Officer, as *Baron of the Exchequer*, of which the Principal is called *Lord Chief Baron*, and three others in that Court are his Aſſiſtants.

There are alſo *Barons* of the *Cinque Ports*, which are two Members of the Houſe of Commons choſen at each Port, and at the two Ancient Towns of *Winchelſea* and *Rye*.

BARON is alſo uſed for the Husband in Relation to the Wife; which two in Law, are called *Baron and Feme*.

The

The Chief Magiſtrates alſo of the City of *London*, before they had a Lord Mayor, were called *Barons*.

Ever ſince the Reign of *William* the Conqueror, the Biſhops hold their Temporaries *per Baroniam*; and by that are obliged to attend the King in Parliament.

Sir *W. Temple*, in his Eſſay on *Heroick Virtue*, ſays, that Baronies were originally the *larger* Shares of the Lands of conquer'd Countries, which the Northern Invaders (ſuch as the *Goths*, &c.) uſed to divide among their Generals and Chief Commanders; as the *ſmaller* Shares divided amongſt the Soldiers were called *Feuda* or *Fees*; and he gueſſes the Word *Baron* to be of Northern Original.

BASIL is the ſloping Edge of a *Chiſſel*, or of the Iron of a Plane uſed in Joinery.

BATCHELOURS, *i. e. Baſſe Chevaliers*, were Anciently a lower or inferior Sort of Knights, as diſtinguiſhed from *Barons* and *Bannerets*, which then were reckoned the Chief or Superior Knights. And now our lower Order of Knights which are inferior to Baronets, are called *Knights Batchelours*. And ſo in our Univerſities, there is an Academical Degree of *Batchelours*, (who have the Title of *Sir*) and which is inferior to that of Maſters and Doctors.

BATTEN is the Workmens Name for a ſcantling of wooden Stuff from two or four Inches broad, and about an Inch thick; the Length is pretty conſiderable, but undetermined as to Numbers.

BEAD, in Architecture, is a Moulding which in the *Corinthian* and *Roman* Orders is cut and carved into ſhort Emboſſements, which look like Beads born in Necklaces: And ſometimes an *Aſtragal* is thus carved.

A *Bead plain* is ſometimes ſet alſo on the Edge of each *Faſcia* of an *Architrave*. Its Convexity is uſually about a Quarter of a Circle, and differs from a *Boultine* only in not being ſo large. A Bead is often placed on the lining Board of a Door-Caſe, and on the upper Edges of skirting Boards.

BEAM, in any Building, is a Piece of Timber lying acroſs it, and into which the Feet of the principal Rafters are framed. No Building hath leſs than two of theſe Beams, *viz.* one at each Head; and into theſe Beams the Girders of the Garret Floor are framed; and if it be a Timber Building, into them the *Teazle Tenons* of the Poſts are alſo framed. Theſe *Teazle Tennons* ſtand at right-Angles to thoſe which are made on the Poſts to go into the *Raiſons*, and the *Reliſh* or Cheats of theſe Teazle Tennons ſtand up within an $1\frac{1}{2}$ Inch of the Top of the Raiſon; and then the Beam is *cauked* down (which is all one as Dove-tailing acroſs) till the Cheeks of the Mortices in the Beam conjoin with thoſe of the Teazle Tennon on the Poſts.

BEARER, in Architecture, is a Poſt or Brick Wall, which is trimmed up between the two Ends of a Piece of Timber to *ſhorten its bearing*, or to prevent its bearing with the whole Weight at the Ends only.

BEAUPLEADER is, in common Law, a Writ upon the Statute of *Malridge* for not fair Pleading; and this lies where the Sheriff, or other Bayliff in his Court, will take a Fine of the Party, Plaintiff or Defendant, for that he pleaded not fairly.

BEDMOULDING, in Architecture, is a Term uſed by the Workmen for thoſe Members in a Corniſh, which are placed below the Coronet or Crown; and now-a-days a Bedmoulding uſually conſiſts of theſe 4 Members, 1. an O----G. 2. a Liſt, 3. a large Boultine, and 4thly, under the Coronet another Liſt.

BEDRIP, *Bedrepe*, was the Cuſtomary Service which inferior Tenants formerly paid to their Lords, in cutting down their Corn, or doing any Work or Labour in the Field.

BENDS, in a Ship, are the ſame with the *Wailes* or *Wales*, which are the outmoſt Timbers of a Ship on which the Men ſet their Feet in climbing up: They are reckoned from the Water the firſt, ſecond, and third *Bend* or *Wail*. They help much to ſtrengthen the Ship, and have the Beams Knees and Foot hooks bolted into them.

BENEPED: They ſay at Sea a Ship is *benepped*, when it being a Nepe-Tide, the Water doth not flow high enough to bring her off from the Ground, out of the Dock, over the Bar, &c.

BENEFICES. All Church Preferments, except Biſhopricks, are by ſome called Benefices: *Vid. Godolph. c.* 18. And all Benefices are by the Canoniſts ſometimes called *Dignities*. But we now apply the Word Dignity to Biſhopricks, Deaneries and Archdeaconries, and as ſome will have it to Prebends.

BENEFICES are either *Parſonages*, *Vicarages*, or *Donatives*.

*Parſonages*, are Churches endowed with Glebe, Manſe, Tythes, and all other Duties payable by the Pariſhioners.

*Vicarages*, are Benefices which were created for the Maintenance of ſuch Clergymen as ſerved in Churches, where ſome or all the Tythes were impropriated. At firſt the Vicar was a meer Curate, but by Degrees ſome of them got a ſettled Maintenance diſtinct from the Impropriator, which conſiſted of a Manſe and Glebe, and ſome Portions of Tythes uſually; but in ſome Places only a Penſion from the Impropriator. And theſe are what the Law calls *perpetual Vicars*, or *Vicars endowed*.

*Donatives*, are ſuch as being exempt from the Juriſdiction of the Ordinary are viſitable only of the King or other Secular Patron, who puts his Clerk into Poſſeſſion of the Benefice, by Virtue of an Inſtrument under Hand and Seal, without any *Inſtitution* or *Induction*, and without any Examination by the Ordinary. But the Clerk is obliged to ſubſcribe the *Declarations*, and to take the Oaths enjoined by 14. *c.* 2. and 1. *W.* and *M.* the former before the Biſhop in whoſe Dioceſs the Donative lies, and the latter before the Patron, ſaith *Watſon*. And if it be a Benefice with Cure, he is alſo bound to ſubſcribe the 39 Articles before the Biſhop, to read the Common-Prayer, and to make the ſame Declaration as other Incumbents do.

BENEFICIO *primo Eccleſiaſtico habendo*, is a Writ directed from the Queen to the Chancellor or Lord Keeper, to beſtow the Benefit that firſt ſhall fall in the Queen's Gift, above or under ſuch a Value, on this or that particular Man.

BENEVOLENCE is uſed both in our Statutes and Chronicles, for a voluntary Gratuity given by the Subjects to the Sovereign.

BESANTINE was a Piece of Money coined by the Weſtern Emperors at *Byzantium* or *Conſtantinople*, and was of two Sorts, Gold and Silver, formerly both Current in *England:* The Silver *Beſantine* was the Value of two Shillings, and the Gold

was

was of the Weight of a Ducket, as *Chaucer* ſeems to repreſent. *Kennet's Gloſſary.*

BENEFICIUM *Cedendarum Actionum*, is the Right which one Surety hath who is ſued for the whole Debt, to force the Creditor by Exception to aſſign over his Action againſt the reſt of the Sureties, or elſe he ſhall not force that one to pay the Debt.

BENEFICIUM *Diviſionis*, in the Civil Law, is a Right by which the Creditor ſhall be forced, by way of Exception, to ſue each Surety for their Share and Proportion, eſpecially when the reſt of the Sureties are under the Juriſdiction of the ſame Judge, and able to pay.

BENEFICIUM *Ordinis ſive Excuſſionis*, in the Civil Law, is a Right by which the *Surety* can by way of Exception force the Creditor to ſue the principal Debtor, before he ſhall recover againſt him as the Surety, except the Surety was given judicially in a Cauſe depending.

BIRDS, are either *Land-fowl* or *Water-fowl*: Of *Land fowl*, ſome have crooked Beaks and Talons; and of theſe ſome are *Carniverous* and *Rapacious*, being call'd *Birds of Prey*; ſome *Frugiverous*, and theſe are called by the general Name of *Parrots*. Of Birds of Prey ſome are *Diurnal*, preying in the Day Time; and of theſe they reckon a *greater* and *leſſer* Sort: The greater are either of a more bold and generous Nature, as the *Eagle* Kind; or of a more cowardly and ſluggiſh, as the *Vulture:* The leſſer Diurnal Birds of Prey, in *Latin* are called *Accipitres*, the *Hawk* Kind; and theſe are either of a more bold and generous Nature, and are wont to be reclaimed and *manned* for fowling, and are called *Hawks*; which our Falconers diſtinguiſh into *Long-winged*, as the *Falcon*, *Lanner*, *&c.* whoſe Wings reach almoſt as far as the End of their Train; and *ſhort-winged*, as the *Goſhawk* and *Sparrow Hawk*, whoſe Wings, when cloſed, fall much ſhort of the End of their Trains. Thoſe of the Hawk Kind which are of a Nature more cowardly and ſluggiſh, or elſe *indocile*, are neglected by our Falconers, and ſo live at large; and of theſe alſo there is a *greater* Sort, as the *Buzzard* Kind, and a *leſſer*, as the *Butcher-Bird* or *Shrike* (about as big as a Black-bird, and found in *England*). The *Bird of Paradiſe*, which is exotick.

Of Birds of Prey with crooked Beak and Talons, ſome are *Nocturnal*, as the *Owl* kind, which fly and prey by Night; and theſe are either horned or eared, as the *Eagle-Owl* and *Horn-Owl*, &c. or without Horns, as the *Brown-Owl*, *Grey-Owl*, &c.

There is a ſort of Land-Birds with crooked Beak and Talons which is called *Frugiverous*, becauſe though they do ſometime eat Fleſh, and ſo are of the Carnivorous and Rapacious Kind, yet they eat *Fruits* too; and theſe are known by the general Name of *Parrots*, and are diſtinguiſhed into three Sorts according to their bigneſs, the greateſt Size being called *Maccaws*; the middle ſized, and moſt common, *Parrots* and *Popinjays*; and the leaſt ſort *Parrakeets*; and all this Kind make uſe of their Beak in climbing, and move the upper Jaw.

Land-Birds that have their Bill and Claws more ſtrait, are diſtinguiſhed into three Sizes. The *greateſt Kind* are ſuch as by reaſon of the Bulk of their Bodies, and ſmallneſs of their Wings cannot fly at all; theſe are Exotick Birds of a ſingular Nature, ſuch as the *Oſtrich*, the *Caſſowary*, and the *Dodo*. The *middle ſiz'd* Kind are divided by their Bills into ſuch as have *large*, *thick*, *ſtrong*, and *long* ones; ſome of which feed promiſcuouſly on Fleſh, Inſects, and Fruits, as the *Crow* Kind, which are wholly black; and the *Pie* Kind, which are party coloured: Some feed on Fiſh only, as the *King's-fiſher*; and ſome on Inſects only, as the *Wood-pecker*. And into ſuch as have a *ſmaller* and a *ſhorter* Bill, whoſe Fleſh is either *white*, as the *Poultry* Kind; or *blackiſh*, as the *Pigeon* and *Thruſh* Kind. The *leaſt ſiz'd* Kind of Land-Birds with ſtraight Bills and Claws, are called *ſmall Birds*; and theſe are of two kinds, *viz. ſoft beaked*, which have ſlender, ſtraight, and pretty longiſh Bills moſt of them, and feed chiefly upon Inſects; or *hard beaked*, which have thick and hard Bills, and feed moſtly on Seeds,

*Water-fowl*, are either ſuch as *frequent Waters and watry Places to ſeek their Food*; and theſe are all *cloven-footed*, and generally have long Legs, and thoſe naked or bare of Feathers for a good way above the Knees, that they may the more conveniently wade in Waters. Of theſe they reckon two Kinds; a *greater*, as the *Crane*, *Jabiru*, &c. and a *leſſer* which are either *Piſcivorous*, feeding on Fiſh, as the *Heron*, *Spoon-bill*, *Stork*, &c. or *Mudſuckers* and *Inſectivorous:* Of which ſome have very long Bills, which are ſometimes *crooked*, as in the *Curlew* and *Whimbrell*; and ſometimes *ſtraight*, as in the *Woodcock* and *Godwitt*. Others have *middle ſiz'd Bills*, as the *Sea-pie* and *Red-ſhank*, &c. and a third ſort have ſhort Bills, as the *Lapwing* and *Plover*. Thoſe are reckoned ſhort Bills which exceed not an Inch and $\frac{1}{2}$; middle ſiz'd are between two Inches $\frac{1}{2}$ and 1 $\frac{1}{2}$; and long Bills above two Inches $\frac{1}{2}$.

There is another Kind of *Water-fowl* which ſwim in the Water; ſome of which, as the *Moor-hen* and *Coot*, &c. are *cloven footed*, but moſt are *whole footed*: And of theſe ſome few have very *long Legs*, as the *Flammant*, the *Avoſetta*, and *Corrira*, (ſee *Willoughby*, *Part* 2. §. 2) but moſtly they are *ſhort leg'd:* Of which ſome few have but three Toes on each Foot, as the *Penguin*, *Razor-bill*, &c. but generally they have four Toes on each Foot; and theſe either all connected together by intervening Membranes, as in the *Pelican*, *Soland Gooſe*, &c. or more uſually with the *back Toe looſe:* And this Kind are either *narrow bill'd*, or *broad bill'd*; thoſe with *narrow Bills* have them either *blunt* and *hooked* at the Tip, of which ſort ſome are *ſerrate*, as in the *Diver-kind*, and ſome not *toothed*, as in the *Puffin*; or *ſharp pointed* or *ſtraighter*, of which ſort ſome have long Wings, as the *Gull* Kind; and ſome *ſhorter*, as thoſe Diving Birds called *Douckers*. Thoſe with *broad Bills* may be divided into the *Gooſe* Kind, which are larger, and the *Duck* Kind which are ſmaller; and theſe latter into *She Ducks*, or *River* or *Plaſh Ducks*. Moſt Water-Fowls have a ſhort Tail; and none of this Kind have their Feet diſpoſed like *Parrots* and *Woodpeckers*, that have two Toes forward and two backward, none having more than one back Toe, and ſome none at all.

BINDING *Joyſts*, in Architecture, are thoſe Joyſts in any Floor into which the *Trimmers* of the Stair-Caſes and Chimney-Ways are framed; and theſe ſhould be ſtronger than common Joyſts.

BISHOP. The whole Proceſs of the Creation of a Biſhop, according to the *Engliſh* Law, is thus. On the Vacancy of any See, the Dean and Chapter are to certify the King thereof in *Chancery*, and to requeſt his Leave to chuſe another Biſhop. The King, when he pleaſes, ſends his *Conge de*

*Eſtire*, or Leave to elect to the Dean and Chapter, nominating the Perſon whom he thinks fit to have choſen. The Dean and Chapter are obliged within twenty Days after the Receipt of this *Conge de Eſtire* to make the Election, which being accepted by the Perſon elected, is certified both to the King and the Archbiſhop of the Province. On this the King grants his Royal Aſſent under the Great Seal, directed to the Archbiſhop, together with a Mandate to Confirm and Conſecrate him. The Archbiſhop gives a Commiſſion to his Vicar General to proceed to Confirmation, which is a long formal Proceſs, of which the moſt obſervable Parts are two, *viz.* a Citation of all ſuch as have any Objections againſt the Biſhop Elect, to appear before them and offer them; and then a Deduction of all that has paſt in relation to the Election and the Royal Aſſent; the Particulars whereof are exhibited by the Proctor of the Dean and Chapter to the Vicar General. After this the Oaths of Supremacy, Simony, and Canonical Obedience are taken by the Biſhop Elect; on which Sentence is read, and ſubſcribed by the Vicar General, whereby the Election is ratified and decreed to be good. Next to this follows the Conſecration, which is performed by the Archbiſhop and two other Biſhops: Then the Archbiſhop ſends a Mandate to his own Archdeacon, to inſtall the Biſhop in that Cathedral Church which belongs to his See; and this is oftneſt done by Proxy. And the publick Notary there preſent, records the whole Proceſs in an Authentick Inſtrument to be kept to Poſterity; and after this the new Biſhop is introduced to the King to do Homage. On his Conſecration the Biſhop hath a Right to his Temporalties, but he cannot ſue for them till his Conſecration be certified by the Archbiſhop; but the King may grant the Biſhop his Temporalties immediately after his Confirmation. By his Confirmation he is inſtated in the Juriſdiction of his Dioceſe, ſo as to excommunicate and certify it; and therefore the Power of the Guardian of the Spiritualties ceaſes from that Time forward. *Clergyman*'s Vade Mecum.

BISSEXTILE. To prevent all Ambiguity which may ariſe on the Account of the Intercalation of a Day every fourth Year, 'tis appointed by the Statute *de Anno Biſſextili*, 21. *H.* 3. that the Day increaſing in the Leap-Year, and that next before, ſhall be accounted but as one Day.

BLACKNESS. The Incomparable Sir *Iſaac Newton* in his Opticks, ſhews, That for the Production of *Black* Colours, the Corpuſcles muſt be *leſs* than any of thoſe which exhibit other Colours, becauſe at greater Sizes of the component Particles, there is too much Light reflected to conſtitute this Colour; but if they be a little *leſs* than is requiſite to reflect the White and very faint Blue of the firſt Order: (*Vid. Book* 2. *Obj.* 4, 17, and 18.) they will reflect ſo little Light as to appear intenſely *Black*, and yet may perhaps reflect it variouſly to and fro within them ſo long, till it happen to be ſtifled and loſt: by which means they will appear *Black* in all Poſitions of the Eye without any Tranſparency.

And from hence it appears why *Fire*, and that yet more ſubtle Diſſolver *Putrefaction*, by dividing the Particles of Subſtances, turn them *Black*: Why ſmall Quantities of black Subſtances impart their Colour very freely and intenſely to other Subſtances to which they are applied; the minute Particles of theſe, by reaſon of their very great Number, eaſily over ſpreading the groſs Particles of others. Hence alſo it appears, why Glaſs ground very elaborately with Sand on a Copper Plate, till it be well poliſhed, makes the Sand, together with what by rubbing is worn off from the Glaſs and Copper, become very black: And why black Subſtances do ſooneſt of all others become hot in the Sun's Light, and burn; (which Effect may proceed partly from the Multitude of Refractions in a little Room, and partly from the eaſy Commotions of ſo very ſmall Particles:) And alſo why *Blacks* are uſually a little inclined to a bluiſh Colour; for that they are ſo, may be ſeen by illuminating white Paper by Light reflected from black Subſtances, where the Paper will uſually appear of a bluiſh White; and the Reaſon is, that Black borders on the obſcure Blue of the firſt Order of Colours deſcrib'd in the above-mention'd 18th Obſervation, and therefore reflects more Rays of that Colour than of any other.

'Tis neceſſary alſo to the Production of *Blackneſs* in any Bodies, that the Rays be ſtopt, retain'd, and loſt in them; and theſe conceive Heat (by means of a burning Glaſs, *&c.*) more eaſily than other Bodies, becauſe the Light which falls upon them is not reflected outwards, but enters the Bodies, and is often reflected and refracted in them till it be ſtifled and loſt.

BLOOD-RED *Heat*, is the laſt Degree of Heat given by Smiths to their Iron in the Forge, and is uſed only when Iron hath already its Form and Size, but wants a little Hammering to ſmooth it; and that is done with the Face of the *Hand-Hammer* with light flat Blows.

BLOOM, in the Iron Works, is a four-ſquare Maſs of Iron about two Foot long, brought from a *Loop* into that Form at the *Fintry*, and under the Hammer: See *Iron*.

BLOWING *Houſes*, in the Tin Miner's Language are the Furnaces where the Tin Ore (after it hath paſſed the *Stamping* Mill, and is throughly waſhed and ſeparated from the Parts not Metalline, which they call the *Cauſalty*; and after it hath been again dry, and hath paſſed the Cruzing Mill) is melted and then caſt.

BOMBARDEERS are Men employ'd to fire Bombs or Shells out of Mortars. They drive the Fuſee, fix the Shell, load and fire. They work alſo with the Fire-workers on all ſorts of Fire-works.

BOMB-KETCH is a ſmall Veſſel built and ſtrengthned with large Beams for the uſe of Mortars at Sea.

BONNY, the Miner's Term for a diſtinct Bed of Ore that communicates with no Vein. See *Squat* and *Tin*.

BORDAGE and *Board-half-penny* is a Fee or Duty paid in Markets and Fairs for Boards and Tables, Booths and Standings.

BORDARII are often mention'd in the Doomſday Book, and were diſtinct from the *Servi* and *Villany*, and ſeems to have been of a leſs Servile Condition: For theſe had a *Bord*, i. e. a *Cottage* with a ſmall Parcel of Land allowed them, on Condition they ſhould ſupply the Lord with Poultry and Eggs, *&c.* Hence,

BORDLODE was the Farm or Quantity of Food which they paid by this Tenure: And the ſmall Eſtates ſo held, called

BORDLANDS, which therefore are ſuch Demeaſnes as Lords kept in their Hands, for the Maintenance of the Board or Table. *Kennet*'s *Gloſſary*.

BOTANY,

BOTANY or *Botanicks*. Books on this Subject; Mr. *Ray's Historia Plantar.* 3 Vol. Fol. His *Synopsis Stirpium Anglican.* in 8vo. *Basis Botanica. Auth. D. Christ. Ludovico Welschio*, Lipsi. 1697. 12°. *Morison's Præludia Botanica*, Lond. 1669. His *Universal Herbal.* Dr. *Plukenet's Phytographia*, *Tournefort's Method of Plants*, 2 Vol. 4to. both in *French* and *Latin*.

*Plantar. Umbellif. Distributio Nova, per Tabulas Cognationis & Affinitatis, ex libr. Naturæ Observata Detecta, Auth.* R. Morison, Oxonii, Fol. 1672.

Grew's *Anatomy of Plants, and other Pieces. Marcelli Malpighii Anatome Plantarum*, &c. Lond. 1679.

*Cowlei Angli sex libri Plantar. Poemate Latino conscripti.* Lond. 8vo.

*Quadripartitum Botanicum Simonis Pauli, Med. Reg. in Dania. Argentorat.* in 4to. *Almagestrum Botanicum*, by Dr. *Plukenet.* Lond. 1696. Fol. *Dr.* Sloan's *Catalogus Plantar. quæ in Insula Jamaica Sponte proveniunt.* Lond, 1696. 8vo. *Icones & Descriptiones Rarior. Plantar. Siciliæ*, &c. *per* Paulum Boccone. 1674.

*Leon Thurneisseri Historia Plantar.* Berlini. 1578. Fol.

Johnson's *Herbal.* Fol.

Parkinson's *Herbal* Fol.

*Rivinus de Re Herbacca.* 2 Vol. Fol.

*Theophrasti Historia Plantar.*

*Jac. Breyneii Exotic. & minus Cognitar. Plantar. Centuria.*

*Fabius Columma de Stirp. Rarior. Cognitione.* 2 Vol. 4to.

*Hortus Indicus Malabaricus.*

1. *Boccone Icones & Descriptiones Plantar. Italiæ Galliæ*, &c.

BOTTOMRY is borrowing or lending Money on the Credit of a Ship or Vessel's safe Voyage.

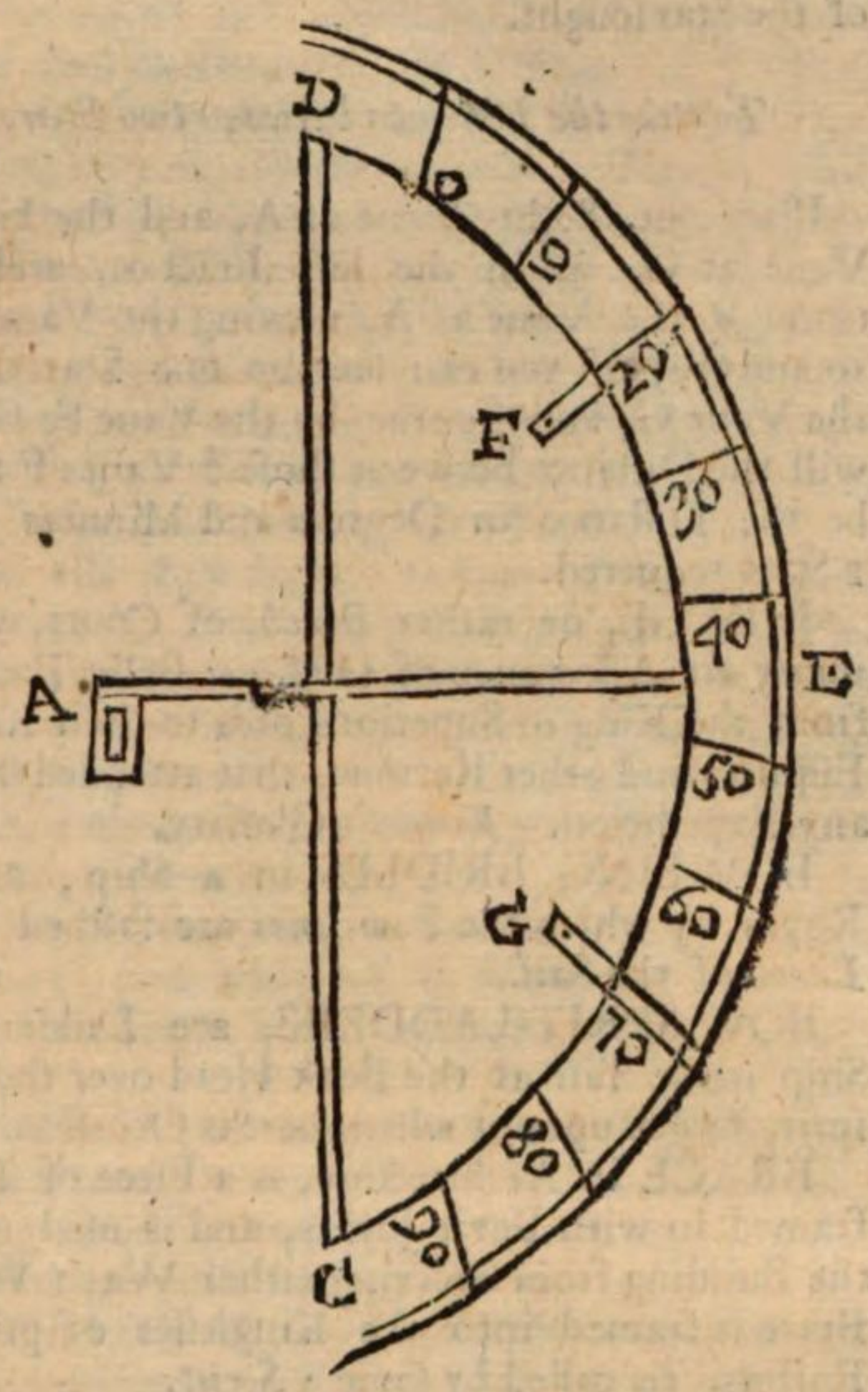
BOULTINE in Architecture is the Workmens Term for a Convex Moulding, whose Convexity is just $\frac{1}{4}$ of a Circle: 'Tis plac'd next below the *Plinth*, in the *Tuscan* and *Doric* Capital.

BOW is an Instrumeut which hath been sometimes used at Sea, consisting of only one large Arch of 90 Degrees, well and truly graduated, Three Vanes, and a Shank or Staff, as you see in the Figure annexed:

Where D E C is the Arch, A E the Staff or Shank passing the Arch at 45 Degrees inmost, but in some in 50° or 55°. F is the Shade Vane, G the Sight Vane, and A B the Horizon Vane.

*To take the Sun's* Altitude *by it.*

By the Handle C hold the Bow upright, and move the Sight Vane G up and down, still looking through the Sight till you see the Shade of the




upper Part of the Shade Vane upon the Slit of the Horizon Vane; and that at the same Time you see also the Horizon through the Slit of the Horizon Vane: In doing of which, if you see the Sky and not the Horizon, then draw the Sight Vane a little lower down towards C, but if you see the Sea and not the Horizon, then slide it a little upwards.

If it be the Meridian Altitude that is to be observed, you must wait and make Observation as oft as you think fit, till at last you begin to see the Sea instead of the Horizon. Then desist; and the Differences between the Degrees and Minutes cut by the Sight Vane, and those cut by the upper Edge of the Shade Vane, is the Distance of the Sun's upper Limb from the Horizon, from which if you substract 16 Minutes, which is the Sun's Semi-diameter, the Remainder will be the Distance of the Sun's Centre from the Horizon, allowing for the Refraction: And you need not substract above 8 or 10 instead of 16 Minutes for the Sun's Semi-diameter, when a Ship-board, since you must allow for the Height of your Eye above the Level of the Water.

*To observe the Height of a Star.*

Place the Sight Vane at A, and the Horizon Vane at G, and looking through the Sight Vane at A, move the Vane F higher or lower, till you can see the Star at the Horizon, through the Horizon Vane at G: So shall the Degrees and Minutes between the two Vanes F and G be the Altitude of the Star sought.

*To take the Distance between two Stars.*

Place the Sight Vane at A, and the Horizon Vane at G, as in the last Practice, and look through the Vane at A, moving the Vane F still to and fro, till you can see the one Star through the Vane G, and the other by the Vane F, for then will the Distance between those 2 Vanes F and G, be the Distance in Degrees and Minutes of the 2 Stars requered.

BOWGE, or rather *Bouch*, of Court, was formerly an Allowance of Diet or Belly. Provision, from the King or Superior Lords to their Knights, Esquires and other Retinue, that attended them in any Expedition. *Kennet*'s Glossary.

BOWLING BRIDLES in a Ship, are the Ropes by which the *Bow-lines* are fastned to the *Leech* of the Sail.

BOW-SPRIT-LADDERS, are Ladders in a Ship made fast at the Beak Head over the Bowsprit, to get upon it when there is Occasion.

BRACE in Architecture, is a Piece of Timber framed in with Bevil Joynts, and is used to keep the Building from swerving either Way: When a Brace is framed into the Kingless or principal Rafters, 'tis called by some a *Strut*.

BRACKETS in Gunnery are the Cheeks of the Carriage of a Mortar: They are made of strong Planks of Wood, of near a Semi-circular Form, and bound round with thick Iron Plates; they are fix'd to the *Bed* by four *Bolts*, which are called *Bed-bolts*; they rise up on each Side of the Mortar, and serve to keep her at an Elevation, by the Means of some strong Iron Bolts (called *Bracket-bolts*) which go through these Cheeks or Brackets.

BRADS, are Nails used in Building, having no spreading Heads as other Nails have: Of these some are called *Joyner's Brads*, and are for hard Wainscot; others *Batten Brads*, and are for soft Wainscot; and some *Bill Brads* or *Quarter Heads*, which are us'd when a Floor is laid in hast, or for shallow Joysts which are Subject to warp.

BRAKE in a Ship, is the Term for the Handle of a Pump.

BRASS is a Metal made out of a Mixture of Copper and *Lapis Calaminaris* (which is usually called *Calamine*). This Stone is dug out of several Mines in the *West* of *England* (as about *Mendipp*, &c.) about 20 Foot deep. It is burnt or calcined in an Oven or Kiln made red hot, then ground to Powder, and sifted as fine as Flour; then mix'd with ground Charcoal, because the Calamine is apt to be clammy, to clod, and so is not easily incorporable. Then they put about 7 lb of Calamine into a melting Pot, holding about a Gallon, and uppermost about 5 lb of Copper. The Calamine must be mix'd with as many Coals as will fill the Pot. This is let down with Tongs into a wind Furnace 8 Foot deep, and remains there 11 Hours; for they cast not off above twice in 24 Hours. One Furnace holds 8 Pots. After melting it is cast into Plates or Lumps. 45 lb of Crude Calamine produces 30 lb burnt or calcined. They use *Brass Shruff* sometimes instead of so much Copper; but that cannot always be procur'd in Quantities, being only a Collection of Pieces of old Brass.

The best Brass Guns are made of malleable Metal, and cannot be made of pure Copper or Brass; but it is necessary to put in courser Metals to make it run close and sounder, such as Lead and Pot-metal. *Bell-metal* being Copper and Tin, and *Pot-metal* Copper and Lead. About 20 lb of Lead is usually put into 100 lb of *Pot-Metal*, but about 6 lb is sufficient to put into a 100 lb of *Gun Metal*.

The Calamine Stones were heretofore fetch'd from *Poland*, but are now exported from us by the *Dutch*.

The Manufacture of Brass was privately kept in *Germany* for many hundreds of Years, wherein many thousands are employ'd, and all were maintain'd, some having thereby rais'd themselves to great Estates. *Phil. Transf. N.* 200 and 260.

BRAZING is a Kind of soldering of Iron, when the Work is so thin that it will not bear *Welding*; they lay small Pieces of Brass on the Places that are to be brazed, and strew a little Powder of Glass upon it to make the Brass run, and give it an Heat in the Forge till they find that the Brass is run, and then they take it out and let it cool.

BREASTS, in Women and other Females, are of a Substance consisting of a great Number of oval Glands, lying in a great Quantity of Fat: Their excretory Ducts approach the Nipple, join and unite together, till at last they form seven, eight, or more small Pipes call'd *Tubuli Lactiferi*, which have seven cross Canals, by which they communicate with one another, that if any of them be stopp'd, the Milk which was brought to it might not stagnate, but pass through by the other Pipes, which all terminate in the Extremity of the Nipple.

The Nipple is a spongeous Substance, made of two Orders of Fibres: the smallest make a fine Net-work within the largest Spaces of the Net-work of the bigger Fibres. Through it pass the *Tubuli Lactiferi*, which grow smaller and smaller to their Extremities, that the Milk might not run out, but when the Breasts are full, or upon Suction; It has an exquisite Sense, and a small Erection when it is handled.

The Arteries and Veins of the Breasts are Branches of the Subclavian and Intercostal. They have Nerves from the Vertebral Pairs, and from the sixth Pair of the Brain.

The Use of the Breasts is to separate the Milk for the Nourishment of the *Fœtus*. The Arteries which terminate in the Glands, which compose the Substance of the Breasts, bring the Blood pregnate with a Child which has received its last Perfection by its Circulation through the Lungs; this Chyle being separated by the Glands of the Breasts, runs through the *Tabuli Lactiferi* upon the Suction of the Child.

The Breasts in Men are very small; they are chiefly for Ornament. I have seen some Men who have had milk in them. *Keil.*

BREDEWITE was anciently a Fine, Penalty or Amercement in Default in the due Assize of Bread: And K. *Henry* II. granted, among other Things, to the Tenants of the Honour of *Walling-*



*ford*,

*ford, Oxon*, That they ſhould be *Quieti de Bredewite.*

BREST is a Term in Architecture, uſed by ſome for that Member or Column which is called the *Thorus* or *Tore.*

BREST *Summers*, in a Timber Building, are the Pieces in the outward Parts of any Building, and in the middle Floors, ( not in the Garret, nor in the Ground Floor ) into which the *Girders* are framed.

BRICKS. The ſeveral Kinds of Bricks uſed in Architecture are theſe: 1. *Compaſs Bricks*, which are of a Circular Form, and are uſed in ſteyning of Wells. 2. *Concave* or hollow *Bricks*, being on one Side flat like a common Brick, but on the other hallowed: They are uſed to convey Water. 3. *Cogging Bricks* are uſed to make the indented Work under the Coping of Walls built of great Bricks. 4. *Coping Bricks*, which are formed on Purpoſe for coping of Walls. 5. *Dutch* or *Flemiſh Bricks*, uſed to pave Yards and Stables, and for Soap-Boylers Fatts, and for Ciſterns. 6. *Clinkers* are ſuch Bricks which are *glazed* by the Heat of the Fire in the making. 7. *Feather-edg'd Bricks* are like the common Statute Bricks, only they are thinner on one Edge than on the other, and are uſed to pen up the Brick Pannels in Timber Buildings. 8. *Didoron*, was a Brick uſed by the Ancients of 1 ½ Foot, or two Spans long, ( whence the Name ) and one Foot broad. This was the ſmalleſt Sort of Bricks uſed by the *Greeks* in their private Houſes, for there was a large Sort in Uſe in their publick Edifices, which they called, 9. *Pentadoron*, which was 3 Foot 9 Inches long, and 1 Foot broad. 10. *Samel* or *Sandal Bricks*, are ſuch as lie outmoſt in a Kiln or Clamp, and conſequently are ſoft and uſeleſs, as not being thoroughly burnt. 11. *Great Bricks* are 12 Inches long, 6 broad, and 3 thick. The Weight of one about 15 Pound; ſo that 100 will weigh 1500, and 1000 of them 15000 Pound. Their Uſe is to build Fence Walls, together with, 12. *Pilaſter* or *Buttreſs Bricks*, which are of the ſame Dimenſions with them, only they have a Notch at one End of half the Breadth of the Brick. Their Uſe is to bind the Work at the Pilaſters of Fence Walls, which are built of great Bricks. 13. *Paving Bricks* or *Tiles*, theſe are of ſeveral Sizes in ſeveral Counties or Places. 14. *Place Bricks* are ſuch as are made in a Place made on Purpoſe for them near the Building they are to be uſed in. 15. *Statute* or *ſmall common Bricks:* Theſe ought to be 9 Inches long, 4 ½ broad, and 2 ½ thick; 100 of theſe uſually weighs about 550 Pound, and conſequently 1000, 5500 Pound, and about 407 in Number are a Tun Weight. Theſe are commonly uſed in paving of Cellars, Hearths, Sinks, *&c.* 30 or 32, if true Meaſure, will pave a Yard Square, and 330 will pave a Square of 100 Foot, laid flat; but if laid edge-wiſe, they muſt be double in Number.

*Bricks* are burnt either in a *Kiln* or a *Clamp*: Thoſe that are burnt in a *Kiln*, are firſt ſet or placed in it, and then the Kiln being covered with Pieces of Bricks, they firſt put in ſome great or cord Wood to dry the Ware with a gentle Fire, which is continued till the Ware is pretty dry: which they know by the Colour of the Smoaks turning from a whitiſh dark to a black tranſparent Smoak: then they put in no more Wood, but proceed to *burn the Bricks* with Buſh, Furze Straw, Heath, Brake or Fern Faggots, having firſt damm'd up the Mouth of the Kiln with their *Shinlog* as they call it ( which is Pieces of Bricks piled up one on another, and then cloſed up with wet Brick Earth inſtead of Mortar ) only leaving juſt Room to put in a Faggot. They then continue to put in more and more Faggots, till they make the Kiln and its Arches look white with Heat, and that the Fire begins to appear at the Top of the Kiln. Then they begin to ſlacken the Fire for about half an Hour or an Hour, and ſo let all cool by Degrees. The Ware will be burnt uſually in about 48 Hours. But now-a-days about *London*, they uſually burn Bricks in *Clamps*, which are built of the Bricks to be burnt, ſomething after the Manner of the Arches in Kilns, *viz.* with a Vacancy between each Brick's Breadth, *&c.* for the Fire to play through; but with this Difference that inſtead of arching, they *truſs* or *ſpan* it over, by making the Bricks project one over another on both Sides the Place for the Wood and Coals to lie in, till they meet, and are bonded by the Bricks at the Top which cloſes all up. The Place for the Fuel is carried up ſtrait on both Sides, till about 3 Foot high, then they fill it almoſt with Wood, and over that lay a Covering of Sea-coal; and then they over-ſpan the Arch: But they ſtrew Sea-coal alſo over at the Clamp, betwixt all the Rows of Bricks, then they fire the Wood, and then the Coal, and when all is burnt out, they conclude the Bricks burnt enough. *Builder's Dictionary.*

BRIDGE *of Communication*, is a Bridge made over a River, by which two Armies or Forts which are ſeparated by that River, have a free Communication one with another.

BRIGADE *Major*, is an Officer appointed by the Brigadeer to aſſiſt him in the Management and Ordering of his Brigade, and he there acts as a Major General does in an Army.

BRINGERS *up*, in a Battalion, are the whole laſt Rank of Men in it, or the laſt Man in every File.

BUDDLE, is the Word in the Works for dreſſing *Tin Ore*, for a Tye of Boards or Slate about 4 Foot deep, 6 long, and 3 over, wherein ſtands a Man with a Shovel in his Hand (called a *Trambling Shovel*, as this is alſo called the *Trambling Buddle*) bare-footed, to caſt up the Ore about an Inch thick, on a long ſquare Board placed juſt before him, and as high as his Middle, which is called the *Buddle Board:* There are ſeveral of theſe *Buddles* in which the Ore is ſtill trambled over again and again, till it be at laſt ſo well waſh'd, as to become what they call *black Tin*, which is compleatly ready for the *blowing Houſe.*

BUILDING. There are ſome good Rules and Directions about Building which are given in *Moxon's Mechanick Exerciſes*, and other Books of that kind, which 'tis very proper every Gentleman ſhou'd be acquained with, that he may not be cheated or impoſed upon by his Workmen: And thoſe are ſuch as theſe; Firſt with Reſpect to the Foundation, Care ought to be taken, that after the Cellars are dug, if there be any, or if none, after the Trenches are dug, in which the Walls are to ſtand, to try all the Foundations either by a Crow, a Rammer, or which is beſt, with a *Borer*, ſuch as Well Diggers, Miners, *&c.* uſe, whether they are throughly ſound, and are fit to bear the Weight that is to be laid upon them. If the Foundation be not very looſe, it may be cured by ramming in great

great Stones with an heavy Rammer, the Stones being placed close together, about a Foot wider on each Side of the Trench than the Breadth of the Wall is to be; but if it be so loose that this will not do, you must get good Pieces of Oak, whose Length must be the Breadth of the Trench, or about 2 Foot longer than the Breadth of the Wall, and these should be laid a-cross the Foundation, about a Foot asunder, and being well ramm'd down, lay long Planks upon them, which must be pinn'd down to them: and if this be not sufficient, Piles of a much greater Length must be driven down so deep, till they touch good Ground, and then strong Planks pinn'd down to their Tops, *&c.* If the Foundation be faulty only in Patches, there may Arches be turned over the insufficient Places, which will take off the Weight from bearing upon them. And sometimes it may be proper to use *inverted Arches.*

The Foundation being well secured, the next Care is to see that the Walls be all made of the same Thickness as they are in the Design; for which Purpose there should be Numbers to express their Thickness in the Draught.

The Walls also must be well wrought aud *bounded* as they call it: In order to which the Mortar must be well made of good well burnt Lime and sharp Sand; the usual Proportion is a Load of Sand of 36 Bushels to a Hundred of Lime of 25 Bushels, or a Bushel of Lime to one and an half of Sand; but when the Sand is not very sharp, there must be a greater Proportion of it to the Lime.

In slacking of Lime, Care should be taken, that though it be wetted every where a little, yet it be not over-wetted; and every Layer or Bed of Lime should be covered with Sand to keep in the Steam, that it may not fly away, but be forced to mix it self with the Sand; and this will make the Mortar much stronger. The Mortar also must be well *beaten* with a Beater three or four times over before it is used, that the Knots of the Lime may be all broken, and the Lime and Sand mingled very well together: And it will be still better, if after the first beating, it be let lie three or four Days, aud then let it be beat well over again when 'tis used.

If the Bricks are laid in very hot dry Weather, and it be some small Piece of Work which you would have very strong, it will be worth while to dip every Brick as 'tis laid in a Pan of Water; and it will be of good Use in great Work to throw Water on the Walls, after the Bricks are laid, by a *Wirtenburgh* Syphon, or some such Way. And the Walls also should be covered in Summer Time, to keep them from drying too hastily, as well as in Winter Time from Rain, Snow, or Frost, which last is a great Enemy to all Kinds of Mortar, especially to that which hath been newly wetted.

Let the Workmen also in doing up the Walls, not carry any one above three Foot high, before the next adjoining Wall is brought up equal with it, that so they may join together, and make *good Bond* in the Work.

In the middle of Walls, Care should be taken that Joint is not laid on Joint, at least as seldom as may be, that *good Bond* may be made there as well as on the Outsides.

When Timber is laid on Brick-Work, as Torsels for Mantle Trees, or Lintels for Windows, Templets for Girders, *&c.* let it be always laid in *Loam*, for that is a great Preserver of Timber, which Mortar will eat and corrode: The same thing should be done with the Ends of Joists and Girders, some Workmen dawb their End with Pitch, to preserve them from the Mortar.

BULL, perhaps from Βαλλὴ *Consilium*, is an Instrument so called, granted by the Bishop of *Rome*, and sealed with a Seal of Lead, containing in it his Arbitrary Decrees, Command, or other Actions. By the Statute of 28. *H.* 8. *c.* 16. it was enacted, that all Bulls, Briefs, Faculties, and Dispensations, of whatever Name or Nature, had or obtained from *Rome*, should be void. *Matt. Paris*, *A. D.* 1237. describes the Seal of the Bull to be a Cross in the middle, with St. *Paul* on the Right, and St. *Peter* on the left Hand.

BURNING *Glasses*. In *Philos. Transact. N.* 40. there is an Accounr of one *S. Setalla* at *Millan* who was causing a burning Glass to be made of 7 Foot in Diameter, and he pretends to make it burn at the Distance of 50 Palm or 33 Foot.

And in *N.* 188. there is mention of a burning Concave which was made at *Lusace* in *Germany* of near 3 *Leipsick* Ells in Diameter, which exceeds the great one at *Paris* by $\frac{5}{8}$ of an Ell. This was made of a Copper Plate, scarce twice so thick as the Back of a common Knife, and so may easily be moved from Place to Place, and ordered for Use; and the Workmanship of it may, by the Contrivances I have invented (saith the *German*) be easily, and in a little Time, performed by one Man. The Polish hereof is very good, and represents by distinct Reflexions, all those Appearances which arise from the Concave Figure thereof.

The Force of this Speculum is incredible: For, 1. a Piece of Wood put in the *Focus* (which is 2 Ells off) Flames in a Moment, so as a fresh Wind can hardly put it out. Water applied in an Earthen Vessel presently boils. 3. A Piece of Lead or Tin 3 Inches thick melts away in Drops, and in 2 or 3 Minutes time will be melted quite through. 4. A Plate of Iron or Steel is presently red hot, and soon after hath a Hole burnt through it. I have made 3 such Holes in a Plate in 6 Minutes time. 5. Copper and Silver, and the like, applied to the *Focus* melt; I tried with a Rix-Dollar: And the Iron aforesaid will run in 5 or 6 Minutes. 6. Slate at first is red hot, but in a few Minutes turns into a fine sort of black Glass, of which, if any Part be taken in the Tongs, and drawn out, it runs into Glass Threads. 7. Tiles and Earthen Pot-shreads, in a little time melt into Glass, as also doth Pumice Stone into a very white one: A Piece of a very strong Crucible runs into Glass in 8 Minutes. I have seen Bones turn into Glass of an Opaque Kind, and a Clod of Earth into Greenish Glass. These Experiments were made in *August* and *September*.

Dr. *Hook* proposed to the Society, that one might be made after this Manner, of many Feet in Diameter for a small Price; being hammered out of a Copper Plate, and tinn'd over with a Mixture of Tin, Lead, and Tin-glass, which is found to bear a very good Polish.

The Uses of such a Speculum would be very many, and perhaps its Effects wonderful, there being no other Heat in the World any thing like that of the Sun's Rays, whose Weight and Fineness are not possible to be equalled by any common Fire; yet the Moon's Rays, though the Light was augmented by the Glass, gave no Manner of Heat.

Mr. *Tschirnhaus* is said to have made Convex Burning Glasses of 3 or 4 Foot Diameter, and whose *Focus* is 12 Feet distant, and of 1 $\frac{1}{2}$ Inch in Diameter; and to make this *Focus* yet stronger, he

he contracts it by a ſecond *Lens*, placed parallel to, and at a due Diſtance from the firſt, and then the *Focus* is but of 8 Lines in Diameter. This Glaſs in a Moment vitrifies Tiles, Slates, Pumice Stones, *Dutch* Ware, and *Talk*. It melts Sulphur, Pitch, and all Roſins under Water; any Metal expoſed to it in little Lumps upon a Coal, melts in a Moment, and Iron ſparkles as in a Smith's Forge. All Metals vitrify on a Piece of *China* Plate, if it be not ſo thin as to melt it ſelf; and Gold in vitrifying *receives a Purple Colour: Hiſtoire de l' Academie des Sciences, Anne* 1699.

The *Linum Vivum* or *Asbeſtos* would be vitrified by this Glaſs, even in *January*, in about 10 Minutes Time: *Vid. Act. Erud. Leipſ. April.* 1688.

The Incomparable Sir *Iſaac Newton* preſented a Burning Glaſs to the Royal Society of *London*, whereof he is the moſt worthy Preſident, conſiſting of ſeven Concave Glaſſes, and ſo placed, as that all their Foci join in one Phyſical Point. Each Glaſs is about 11 ½ Inches in Diameter; ſix of them are placed round the ſeventh, to which they are all contiguous, and they compoſe a kind of Segment of a Sphere, whoſe Subtenſe is about 34 ½ Inches. The Central Glaſs lies about an Inch lower or farther in than the reſt. The common Focus is about 22 ½ Inches diſtant, and of about ½ an Inch in Diameter. It vitrifies Brick or Tile in a Moment, and in about half a Minute melts Gold.

If another round of Concaves were added about theſe ſeven, perhaps it would outdo any thing we have an Account of.

BUTMENTS, in Architecture, are the Maſon and Bricklayer's Term for thoſe Supports or Props, on or againſt which the Feet of Arches reſt. Alſo little Places taken out of the Yard of the *Ground-Plot* of a Houſe, for a Buttery, Scullery, *&c.* are ſometimes called *Butments*.

CADE, in the Book of Rates is us'd for a certain determinate Number of ſome kinds of Fiſh; as a *Cade* of *Herrings* is 500, of *Sprats* is 1000.

CALCAGE, *Calcagium*, was a Tax or Contribution formerly paid by the neighbouring Inhabitants, towards the making and repairing of common High-ways, Cauſe-ways and Roads; as

CALCEARUM *Operationes*, were the Work and Labour of this Kind done by the inferior ſervile Tenants; and from this it was a Privilege to be free.

CALCULUS *differentialis*; *J. Barnoulli* in the *Leipſick* Acts for *Jan.* 1691. owns that our famous Dr. *Barrow* had given ſome Specimens of this Method above 10 Years before that Date in his *Geometrical Lectures*, and of which, all his Apparatus of Propoſitions there contain'd are ſo many Examples. He acknowledges alſo, that Mr. *Leibnitz*'s Method of this *Calculus differentialis* is founded on Dr. *Barrow*'s, and differs from it only in Notation and ſome compendious Abridgments. And in this Diſcourſe Mr. *Bernoulli* gives ſome *Specimens* of the Uſe of this *Calculus*, in the Dimenſion of the Parabolick Spiral, and of the Flexures and Evolutions of Curves in general.

See on this Subject Mr. *L' Hoſpital*, Mr. *Neiwintis*'s *Analyſis Infinitor*.

CAMBER *Beam*, in Architecture, is a Beam or Piece of Timber cut hollow or arching in the Middle: They are us'd in Plat-forms, Church Leads, *&c.* and are very proper where-ever is occaſion for long Beams, being much ſtronger than flat Beams of the ſame ſize; for being laid with the hollow Side downwards, and having good Butments at the Ends, they ſerve for a kind of Arch.

CANON, in the Eccleſiaſtical Law, was originally a Book wherein the Religious of every Convent had a fair Tranſcript of the Rules of their Order: Theſe were often read over to them as their *Local Statutes*, and therefrom were called *Regula*, and *Canon* their Rule.

CANON in Muſick; *Ptolemy* rejecting the Ariſtoxenian Way of meaſuring the *Intervals* in Muſick by the Magnitude of a *Tone* (which they ſuppoſe to be formed by the Difference between a *Diapente* and *Diateſſaron*) thought that Muſical Intervals ſhould be diſtinguiſh'd according to the Ratio's or Proportions which the *Sounds terminating thoſe Intervals* bare one to another, when conſider'd according to their Degree of being *Acute* or *Grave*, which was alſo before *Ariſtoxenus*, the old *Pythagorick* Way. *Ptolemy* therefore made the *Diapaſon* to conſiſt in a double Ratio, the *Diapente* in a *Seſquialteral*, the *Diateſſaron* in a *Sequitertion*, and the *Tone* it ſelf (by which the *Diapente* and *Diateſſaron* differ) in a *Seſquioctave*; and all the other Intervals according to the Proportion of the Sounds that terminate them. Wherefore taking as *Canon* (as 'tis call'd) a determinate Line of any Length, he ſhews how this *Canon* is to be cut accordingly, ſo that it may repreſent the reſpective Intervals; and this Method anſwers exactly to Experiment in the different Lengths of Muſical Chords. And from this *Canon*, *Ptolemy* and his Followers have been called *Canonici*, as thoſe of *Ariſtoxenus* were called *Muſici*.

There is a Tract call'd *Sectio Canonis* attributed, but falſly, to *Euclid*; and which you will find at the End of his Works, in the *Oxford* Edition. *G. L.*

CANTALIVERS, in Architecture, are a Kind of *Modilions*, only thoſe are plain, but theſe are carved. They are much the ſame with *Cartouzes*, and are ſet as *Modilions* are, under the *Corona* of the Corniſh of a Building.

CAPIAS *Conductos ad Proficiſendum*, is a Writ that lies for taking up ſuch Men as having receiv'd *Preſs-money* to ſerve the King, ſlink away, and come not in time. 'Tis an original Writ directed to the *Serjeant at Arms*, having included a Clauſe of Aſſiſtance.

CARACT is not any certain Weight or Quantity, but the $\frac{1}{24}$ Part of any Quantity of Weight. And the *Minters* and *Goldſmiths* divide it into 4 Parts, which they call *Grains of a Caract*; and one of theſe they ſubdivide in Halves and Quarters.

CARKE ſeems formerly to have been the Word for a certain Quantity of Wool, whereof Thirty made a *Sarpler*, 27. *H.* 8. *c.* 2.

CAPSULATE *Plants* are ſuch as have a *Tetrapetalous regular Flower* conſiſting of four diſtinct *Petala* in each Flower, and which bear their Seeds in ſhort *Capſulæ*; by which they are diſtinguiſh'd from the *Siliquoſæ*, which bear their Seed in *long Caſes* or *Capſulæ Seminales*, and are the other Branch of this Genus of Plants.

CAPSQUARES, in Gunnery, are thoſe ſtrong Plates of Iron which come over the Trunnions of a Gun, and keep her in the Carriage. They are faſtned by Hinges to the Prize Plate, that it may lift up and down; it forms a Part of an Arch in the Middle, to receive a third Part of the Thickneſs of the Trunnions, for $\frac{1}{3}$ of them are let into the Carriage, and the other End is faſtened by two Iron Wedges, which are called the *Fore-locks* and *Keys*.

CAPTION, when a Commiſſion is executed, the Commiſſioners Names ſubſcribed and return'd, that is called a *Caption*.

CARCASE of a Houſe, in Architecture, are the Partitions, Floors, Rafters, *&c.* made by the Carpenter.

CARTESIAN *Syſtem* of the World.

Mr. *Des Cartes*, in order to account for the Celeſtial Appearances, ſuppoſes the Matter of the World to have been at firſt divided by Almighty God, into *innumerable little equal Parts*, each endow'd with an equal Degree of Motion, both about its own Centre and ſeparately, ſo as that this Matter conſtituted a *Fluid*. He ſuppos'd alſo that ſeveral Collections of this Matter, were endow'd with a Motion about different Points, as common Centres, which Points were placed at equal Diſtances; ſo as that the Matter round them compos'd different *Vortices*, as he calls them. He ſuppoſes alſo, that the firſt Particles of Matter by thoſe inteſtine Motions were rendred or ground of a ſpherical Figure, and ſo did compoſe *Globules* of ſeveral Magnitudes: And theſe he calls the *Matter* of his *ſecond Element*.

But the very ſmall Particles which, by the aforeſaid Motions, were ground and rubb'd off from the firſt Particles of Matter, and driven violently many different Ways, made up a new Matter, which he calls his *firſt Element*. And ſeeing that there would be more of this firſt Element, than was ſufficient to fill the Vacuities between the *Globules* of the *ſecond Element*, he ſuppoſes that the remaining Part would be driven towards the Centre by the circular Motion of theſe Globules, which did for that Reaſon recede from it; and this Matter being there amaſſed into a Sphere, would in the Centre of every Vortex produce a Body like the Sun: which Sun being thus form'd, and moving about its own Axis with the common Matter of the *Vortex*, would neceſſarily throw out ſome Parts of its Matter, through the Vacuities of the Globules of the ſecond Element conſtituting the *Vortex*, and this eſpecially at ſuch Places as are fartheſt from its Poles, receiving at the ſame Time in by theſe Poles as much as it loſes in its Equatorial Parts, or about the Equator: And by this Means it would be able to carry round with it thoſe Globules that are neareſt, with the greater Velocity, and the remoter with leſs. And by this Means thoſe Globules which are neareſt the Centre of the Sun muſt be leaſt; becauſe were they greater or equal, they would by Reaſon of their Velocity have a greater centrifugal Force and recede from the Centre. And if it ſhould happen that any of theſe *Sun-like* Bodies in the Centres of the ſeveral *Vortices*, ſhould be ſo incruſtated and weakened, as to be carried about in the Vortex of the *true Sun*; if it were of leſs Solidity, or leſs Motion than the Globules towards the Extremity of the Solar *Vortex*, then it would deſcend towards the Sun, till it met with Globules of the ſame Solidity, and capable of the ſame Degree of Motion with it ſelf; and then being fix'd there, it would be for ever after carried about by the Motion of the *Vortex*, without either approaching any nearer to, or receding from the Sun, and ſo become a Planet.

Suppoſing then all this, we are next to imagine that our *Syſtem* was at firſt divided into ſeveral *Vortices*, in the Centre of each of which was a lucid Spherical Body; and that ſome of theſe being gradually incruſtated, were ſwallowed up by others which were larger and more powerful, till at laſt they were all deſtroyed and ſwallowed up by the biggeſt *Solar Vortex*, except ſome few which were thrown off in right Lines from one *Vortex* to another, and ſo became *Comets*. And from hence it appears, that thoſe *Planets* which are neareſt the Sun are leſs ſolid: That is alſo *Des Cartes*'s Reaſon why we ſee always the ſame Face of the Moon; becauſe the Hemiſphere which is oppoſite to the Sun and the Earth is ſomewhat more ſolid than the other: Becauſe alſo the Matter of the *firſt Element* which makes up the Body of the Sun, moves with greater Velocity the Parts of the *Vortex*, and the Bodies ſwimming in it, than thoſe that are remoter: Therefore thoſe Planets which are nearer to the Sun, muſt finiſh their Periods ſooner than thoſe which are more remote from him. And the Reaſon why the Planets revolve round their Axis, is, becauſe according to this Hypotheſis, they were lucid, Sun-like, and revolving Bodies before.

But notwithſtanding all this fine Romance, it is (*Firſt*,) certain that a *Vortex* produced by the Revolution of a Sphere about its Axis, muſt be propagated *in infinitum*, if nothing hinder it: And therefore, ſince there muſt be as many *Vortices* as there are *fix'd Stars*, one Vortex would certainly run into another, and every Particle would be acted by a Motion compounded of the Motion of all the central Spheres; which is abſurd and contrary to that Conſtancy, Limitation and Uniformity which is obſerved in the *Phænomena* of the Heavenly Bodies.

2. Since the Motion and Parts of the *Vortices* neareſt the Centre, is ſwifter than that of the more remote, they muſt preſs upon the exterior Parts, and thereby perpetually impart ſome Part of their Motion to them; and therefore thoſe interior Parts of the *Vortex* will be continually leſſening ſome Part of their Motion, which never being reſtored, theſe Parts muſt ſtill move ſlower and ſlower by Degrees, till at laſt all the Motion will be quite deſtroyed.

3. According to this Hypotheſis, each Planet is of the ſame Denſity with the Parts of the *Vortex* in which it ſwims, being govern'd by the ſame Laws of Motions, and is, as it were, only ſome concreted Parts of the *Vortex*. But the Times of the Periodical Motion of Bodies carried about by a Vortex, are in a duplicate Ratio of their Diſtances from their Centre; as the incomparable Sir *Iſaac Newton* hath demonſtrated in *Sect.* IX. of his *Princip.* Whereas the Squares of the Times of the Periodical Revolutions of the Planets are as the Cubes of their mean Diſtance from the Centre, or from the Sun: Wherefore the Planets cannot be carried about by a *Vortex*.

4. If a *Vortex* run out *in Infinitum*, then would a Body carried round by it certainly deſcribe a perfect Circle, unleſs ſomething ſolid did hinder it; and therefore the greater Diſtance there were between thoſe ſolid Bounds, or the larger the Baſon be which contains the *Vortex*, in reſpect of the Orbit of the Body carried about in it, the nearer would this Orbit be to a Circle; that is, the Excentricity of the Planets neareſt the Sun, would be leſs than *that* of thoſe which are more remote: But the direct contrary to this is true in Fact, the Eccentricity of *Mercury* being greater than that of *Saturn*.

5. A Body carried about in a *Vortex* of the ſame Denſity with it, would neceſſarily deſcribe a Circle, to whoſe Plane the Axis of the central Body producing the Circulation of the Fluid, would be perpendicular: And yet there is not one Planet to the Plane of whoſe Orbit the Sun's Axis is perpendicular.

6. The Comets have their Orbits, not only oblique to, but ſometimes at right Angles, with the Plane of the Ecliptick; ſometimes the Courſe of theſe Comets is diametrically oppoſite to that of the Sun: They perſevere in their Motion without any Change: By Lines drawn from them to the Sun, they deſcribe equal Areas in equal Times; and ſometimes they enter into the Vortex of the Sun. All which is impoſſible, if the *Solar Vortex* moved round forcibly enough to carry theſe vaſt Bodies of the Planets along with it.

Mr. *Leibnitz* hath indeed a little altered and mended this Hypotheſis of *Des Cartes*; he hath accommodated it better to the Celeſtial Phænomena, and made it more agreeable to the Rules of Geometry.

And *Firſt* he ſhews, That all Bodies, which in a Fluid deſcribe a *Curve-line*, are moved by that Fluid, for of themſelves they would de-

ſcribe right Lines, and nothing (he ſaith) but the Fluid concurs to turn them out of the Way.

*Secondly*, He endeavours to ſhew, that every Planet is carried about by a Motion compounded of two other Motions; *viz.* the Harmonical Circulation of the deferent Fluid, and the Paracentrical Motion of Acceſs to, or Receſs from the Sun.

The Planets by a Radius from the Sun deſcribe Areas proportional to their Times; now the Fluid that carries the Planets, muſt of Neceſſity circulate ſo as to produce this Effect; which cannot be done otherwiſe than by ſuppoſing innumerable concentrical Orbits of exceeding Thinneſs to make up the Vortex; every one of which, hath its own proper Way of Circulation, *viz.* Thoſe Orbs which are neareſt the Sun move faſteſt, and the Velocities of the Circulations are every where reciprocally proportional to the Diſtances of the reſpective Orbs from the Sun, which will neceſſarily make the Planet to deſcribe equal Areas in equal Times, let it be in any Part of the *Vortex*: For theſe Areas are in a compounded Ratio of their Radii or Diſtances from the Sun, and in a reciprocal one of the Arches or Lengths of the Circulation, which in this Caſe will make a Proportion of Equality: And this Law of Circulation of the Vortex, he calls *Harmonical*.

The *Paracentrick* Motion is compounded of two others; that is, the *Excuſſory* Impreſſion of the Harmonick Circulation, whereby all Bodies moving in a Curve, endeavour to recede from the Centre by the Tangent; and the Attraction of the Sun, or the Planets Gravitation towards him. And this, Mr. *Leibnitz* is of Opinion, ariſes from an Impulſe communicated by the circulating Fluid. Now ſince the Planets move in *Ellipſes*, in one of whoſe *Foci* the Sun is placed, and by Lines drawn from him do deſcribe equal Areas in equal Times, which no other Law of a circulating Fluid, but the *Harmonick* Circulation can account for, we muſt find out a Law for the *Paracentrick* Motion that may make the Orbits elliptical. The excuſſory Impreſſion of the circulating Fluid, would throw off the Planet from the Centre by the Tangent, wherefore the Attraction of the Sun or the Gravitation of the Planets towards it, muſt be ſufficient to deſtroy that Effect; and beſides, to make them move in elliptick Orbits, which cannot be brought about, unleſs this Attraction or Gravitation be reciprocally as the Squares of the Diſtances from the *Focus*: And this is the Sum of Mr. *Leibnitz*'s Improvement of this Hypotheſis.

But this Account muſt be falſe for theſe Reaſons; *Firſt*, Becauſe the *Comets*, as hath been ſaid before, have their Orbits, ſome of them very oblique too; nay, ſometimes at right Angles with the Plane or the Ecliptick, and their Courſes are ſometimes quite contrary to thoſe of the Planets. Now theſe Comets deſcribing about the Sun Areas proportionable to the Times, muſt alſo according to their Motion be carried about by an harmonically circulating Fluid: But then we ſhall have *Vortices* moving contrary to *Vortices*, which is very abſurd.

2. In equable Motions, the Times are always *directly* as the Spaces, and *reciprocally* as the Velocities, but in a circular Motion, the Spaces in one Revolution are as the Radii; and in an harmonical Circulation, the Velocities are reciprocally as the *Radii*, and therefore the Periodical Times of a Fluid circulating harmonically are in a duplicate Proportion of the *Radii*: whereas the Periodical Times of the Planets are in ſeſquiplate Proportion of their Diſtances from the Centre, or of their *Radii*, and conſequently the Planets cannot be carried by an *harmonically circulating Fluid*.

It may, perhaps, be alledged here, that this harmonical Circulation is not continued from *Mercury* to *Saturn*, but is interrupted, and reaches only from the *Perihelion* of *Mercury* to his *Aphelion*, and is there again interrupted, and ſo on through the whole Syſtem of the Planets; but this would produce a Deformity, which is very unlike the ſimple uniform Meaſures of Nature every where elſe. And beſides, the Comets moving forward in the Zodiack, paſs through all theſe imaginary Chaſms and Interſtices, and yet move in the ſame Manner as if they were carried by a Fluid circulating harmonically, according to ſome uniform Law; neither do their Appearances give any Ground to ſuſpect ſuch Interruptions as theſe. *Vid Dr.* Cheyne *Phil. Prin. of Natural Religion.*

CARTILAGO *Scutiformis*, is one of the 5 Cartilages of the *Larynx*; 'tis called in *Greek* θυροειδὴς becauſe of its Figure. It makes that Protuberance in the fore-part of the *Larynx* called *Pomum Adami*. It is about one Inch broad, but not ſo long, being Concave within, and Convex without. Its four Angles have each a ſmall Production; the two upper, which are longer, are tied to the Horns of the *Os Hyoides*; and the two lower to the ſecond Cartilage, which is called *Cricoides* or *Annularis*, from its being like a Ring.

CARTONS, in Painting, are the moſt perfect Sort of Drawings on Paper, which are ſubſervient to great Works, that muſt be throughly finiſhed; all Sketches, Drawings, Models, and all other Works being Preparatory only, and to be reduced to *Cartons*. This Way was practiſed by *Michael Angelo* and *Raphael Urbin*, &c. the *Cartons* at *Hampton Court* being the Work of *Raphael*.

They are ſometimes made by meaſuring the Heighth and Breadth of the Place where the Painting is deſign'd to ſtand; and then by dividing that *Space* into Squares, and *one* afterwards of the ſame Dimenſions on Paper; they draw on the *latter* the Subject of their Story or Deſign, transferring it afterward from the *Carton* to the Wall, by painting it there in Oil, &c.

But ſome great and experienc'd Maſters will be able to do all this without the Help of the *Grate*, as they call it; that is, the Diviſion of the Space or Table into Squares, tho', after all, 'tis a good ſecure Way.

CARTOUCH, is a Caſe of Wood about 3 Inches thick at the Bottom, girt round about with Marlin, and holding about 48 Musket Balls, beſides 6 or 8 Iron Balls of a Pound Weight. 'Tis fired out of a *Hobit*, as they call it, that is, a ſmall Mortar; and is very proper for defending a Paſs.

CARTOUZES, in Architecture, are much the ſame with *Modilions*, only theſe are ſet under the Corniſh in Wainſcotting, and thoſe under the Corniſh at the Eves of a Houſe. Some Workmen call them *Dentils* or Teeth.

CARUCATE, from *Caruca*, and the *French Carui*, a Plough, was the Ancient *Plough Land*; and ſignified as much Arable Land as could be tilled with one Plough in a Year. This in *Rich.* 1. Reign, was computed at 60 Acres, but 'twas afterwards varied; and the Meaſure of a *Carucate* was different according to Time and Place.

CASE-

CASE-HARDENING, is a Way of making the Outside of Iron hard. And 'tis used sometimes by File-Cutters, when they make Course Files for Cheapness; and formerly most *Rasps* were *Case-hardened.* Gunsmiths also use it to harden the Barrels of Guns; and for Tobacco Boxes, Cane Heads, Buttons, &c. 'Tis done thus: They take Hoofs or Horns of Kine, dry them in an Oven, and powder them, then put an equal Quantity of Bay Salt to it, and mingle both together with stale Urine or Whitewine Vinegar. Some of this Mixture they lay upon Loam, and wrap it about the Iron, putting also more Loam over all. Then lay it upon the Hearth of the Forge to dry and harden; and when 'tis dry and hard they put it into the Fire, and blow till they give the whole Lump a *blood-red Heat*, but no greater. Then 'tis taken out and quenched, and at last the *Case-hardened* Iron is taken out of the Case.

CASEMENT, the same with *Cavetto*, in Architecture, is a hollow Moulding; some say $\frac{1}{4}$, some $\frac{1}{8}$ of a Circle in Compass.

CASSINE, in the Military Language, is a Farm House, where a Number of Soldiers have posted themselves, in order to make a Stand against the Approaches of an Enemy.

CASTELLORUM *Operatio*, was formerly Service of Work and Labour to be done by inferior Tenants for the Repair or Building of Castles. To this some came in Person, and others contributed, and it was one of the three necessary Taxes from which few Persons were exempted. Dr. *Kennet.*

CASTING *of Drapery*, is a Term in Painting, signifying a free, easy, genteel, negligent way of cloathing any Figure: and when the Drapery is so managed, they say 'tis *well Cast.*

CAVAZON, in Architecture, is the digging or hallowing away of the Earth from the Foundation of a Building. *Palladio* saith it ought to be $\frac{1}{4}$ of the whole Height of the whole Building.

CAVETTO, in Architecture, is a hollow Moulding of about $\frac{1}{7}$ or $\frac{1}{4}$ of a Circle in Compass.

CAUKING, in Architecture, signifies Dove-tailing across.

CAULICOLI are, in Architecture, the little carved Scrolls which are under the *Abacus* in the Corinthian Capital.

CASUALTY, is the Tin-miner's Words for the Earth, a Stony Matter which is by washing in the Stomping Mills, &c. separated from the Tin Ore, before 'tis dried and goes to the Crazing Mill.

CAZERN: See *Casern.*

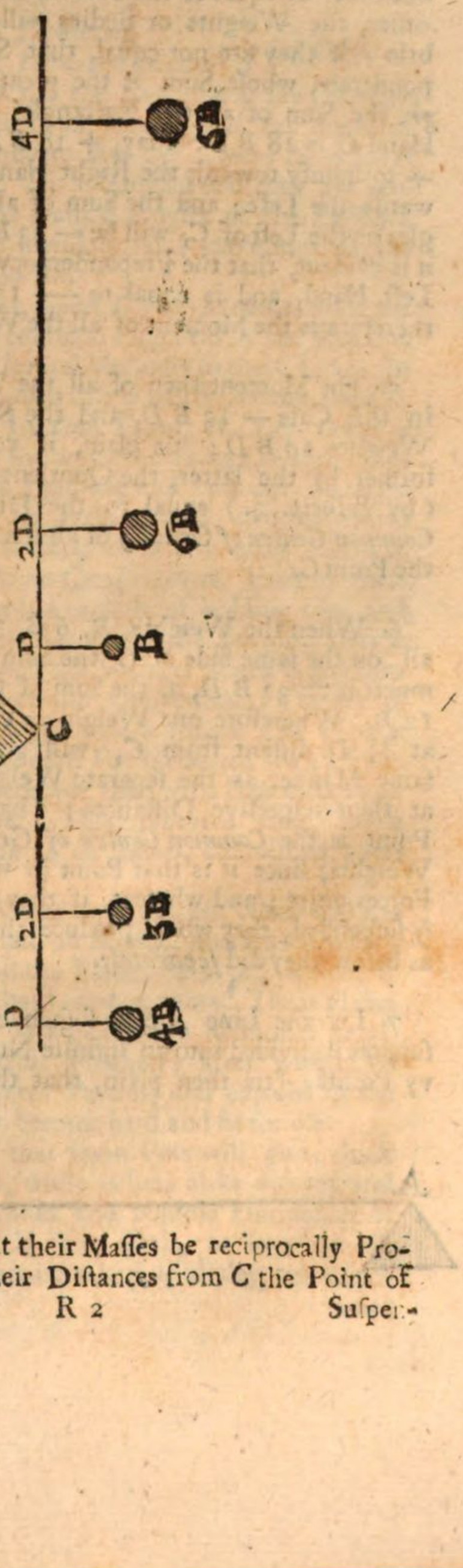
CEMENT, in Architecture, is a strong binding Mortar. 'Tis used to cement Bricks together for some Kinds of Moulding; to make a *Block of Bricks* for the carving of *Scrolls, Capitals,* &c. 'Tis of two Sorts: The *hot Cement*, which is common, is made by putting to a Pound of Rozin and a Quarter of a Pound of Bees Wax, half an Ounce of fine Brick-Dust, and as much Powder of Chalk; and boiling all together in a Pipkin, &c. for about $\frac{1}{4}$ of an Hour, stirring it all the while; then let it stand 4 or 5 Minutes, and 'tis fit for Use.

The Brick to be *cemented* must be heated in or by the Fire, and rubb'd one upon another like Boards in glewing. The *cold Cement* is less common, and is thus made.

Grate half a Pound of old Cheshire Cheese, well pared, very small, and to it in a Pot put half a Pint of Milk, and so let it stand all Night; the next Morning put it into a *Tray*, &c. With the Cheese and Milk, put half a Pound of very fine powdered and sifted quick Lime, and stir all well together with a Trowel, breaking the Knots of the Cheese if any remain; and then add the Whites of 12 or 14 Eggs, which incorporate well with the Mixture, and then it will be fit for Use: If you would have it reddish, colour it with a little very fine Powder of Bricks.

CENTRE *of Attraction*, in the New Astronomy, is that Point to which the revolving Planet or Comet is impelled or attracted by the Force or Impetus of Gravity. Thus the Sun is such a Centre of Attraction with regard to all the Primary Planets, and as they themselves are toward their Secondary ones, or Satellites, if they have any.

CENTRE *of Gravity.* The Consideration of the *Centre of Gravity* is one of the Noblest Speculations in Geometry; and since the *New Methods* have been in Use, such Advancements in it have been made, that hardly much more is to be expected: For the whole Business of the *Investigation of Centres of Gravity* is now reduced to one *General Proposition*, which depends on a few simple *Mechanical Principles*, such as these:




Balance, as that their Masses be reciprocally Proportional to their Distances from *C* the Point of

Suſpenſion, then they will be in Æquilibrio, as is the known Caſe of the *Libra*, (ſee *Libra:*) That is, if *D* repreſent the Diſtance of the Weight *B*, and 3 *D* that of 4 *B*, and 2 *D* that of 6 B, all from the Point of Suſpenſion *C*; then will the Weights 4 *B* and 6 *B* be in *Æquilibrio*, becauſe 3 *B*: 6 *B*:: 2 *D*: 3 *D*.

2. The *Moment* of any Weight is = to the Rectangle under its Velocity, and the Quantity of Matter in the ſame. *V. gr.* The Moment of 6 *B* is = 6 *B* × 2 *D* (2 *D* I ſay, for the Velocities are as the Diſtances from *C*) = 12 *B D*.

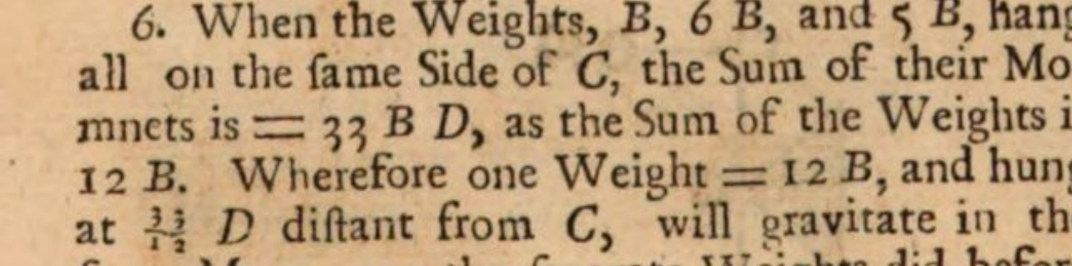
3. And if the Moment and Weight (or Quantity of Matter) be given, the Diſtance of the Point of Application from *C* the Point of Suſpenſion will be found, by dividing the Moment by the Weight. Thus, if the Moment of the Weight 6 *B* be 12 *B D*, (as in *Principle* 2.) then the Diſtance of the Point of Application from *C* will be $\frac{12\ B\ D}{6\ B} = 2\ D$.

4. If ſeveral Bodies be ſuſpended on each Side the Point *C*, then multiply every Weight by its reſpective Diſtance from the Center of Suſpenſion *C:* And then if the Sum of all the Rectangles on one Side, be equal to the Sum of all thoſe on the other, the Weights or Bodies will be in Æquilibrio; if they are not equal, that Side will preponderate, whoſe Sum is the greater. Thus, *v. gr.* the Sum of all the Rectangles on the Right Hand *C* is 18 *B D:* I ſay, + 18 *B D* (ſuppoſing + to ſignify towards the Right Hand, and — towards the Left; and the Sum of all the Rectangles on the Left of *C*, will be — 33 *B D*: Whence it is evident, that the Preponderancy is toward the Left Hand, and is equal to — 15 *B D*, which therefore is the Moment of all the Weights.

5. The Moment then of all the Weights being in this Caſe — 15 *B D*, and the Sum of all the Weights 19 *B D*; 'tis plain, if you divide the former by the latter, the Quotient $\frac{15}{19}\ D$ will be (by *Princip.* 3.) equal to the Diſtance of the *Common Centre of Gravity* of all the Weights from the Point *C*.

6. When the Weights, *B*, 6 *B*, and 5 *B*, hang all on the ſame Side of *C*, the Sum of their Momnets is = 33 *B D*, as the Sum of the Weights is 12 *B*. Wherefore one Weight = 12 *B*, and hung at $\frac{33}{12}\ D$ diſtant from *C*, will gravitate in the ſame Manner as the ſeparate Weights did before at their reſpective Diſtances: That is, the ſaid Point is the *Common Centre of Gravity* of thoſe Weights, ſince it is that Point in which all their Forces unite; and whereat, if they were all *jointly* ſuſpended, they would produce the ſame Effect as before they did *ſeparately*.

7. Let the Line *A B* be ſuſpended at *A*, and ſuppoſe it divided into an infinite Number of heavy Points; 'tis then plain, that the farther any Point is from *A*, the more it will gravitate; and the *Moment* of each Point will be a Rectangle under its Diſtance from *A*, multiplied by its ſelf or Unity: Wherefore the Moment of all the Points muſt be equal to the Sum of all the ſaid Rectangles; and therefore if the *whole Moment* be divided by the *whole Gravity* of all the Points, or by the Gravity of the whole Line *A B*, the Quotient (by *Princip.* 3. and 6.) will be equal to the Diſtance of a certain Point from *A*, at which, if all the Points be ſuſpended, their *Moment* will be the ſame as it is now; that is, that Point ſhall be the *Common Centre of Gravity* of the Line *A B*.




8. If a *Line*, *Plane*, or *Solid*, be biſſected ſo by a *Line* or *Plane*, as that all the Parts in one Segment be equal to the reſpective Parts in the other, and alſo equi-diſtant from the ſaid Line or Plane; 'tis then clear, that the Center of Gravity of all ſuch Figures, muſt be in that Line or Plane. And from hence it naturally follows,

*Prop. General*, That to find the *Centre of Gravity* of any *Line*, *Plane* or *Solid*, you muſt imagine Lines to conſiſt of an infinite Number of Points, Planes of an infinite Number of Lines, and Solids of an infinite Number of Planes or Surfaces; and then that all theſe are ſuſpended to the ſame Arm of a Balance common to them all: And let the Point of Suſpenſion be as in *A*, at the End or Extreme of the ſaid Line in the Edge of the Surface, or in the Surface of the Solid; and then find the Sum of the Moments of all thoſe Points; which Sum divide by the Sum of the Weights, or the Weight of all the Parts, and the Quotient will be the Diſtance of the *Center of Gravity*, or the Line, Plane or Solid, from the Point or Axis of Suſpenſion. *The Practice of all which in particular Inſtances, ſee in* Hayes's Fluxions, *p.* 261, &c.

CENTRES *of Gravity*. 'Tis plain that the Centre of Gravity of a Circle, and of a Sphere or Globe (ſuppoſing the Matter truly Homogeneous all over them) will be their Centre of Magnitude; the Centre of Gravity of all Parallelograms will be in the Point of Interſection of the two Diagonals; and the Centre of Gravity of all ſolid Parallelograms or Parallelopipeds will be in the ſame Point of the *Plane of Gravity*, *i. e.* in the Point found to be the common Interſection of the two Diagonals of that Plane which cuts the Solid into two Triangular Priſms, and conſequently is eaſily found. The Centre of Gravity of all Planes of Triangles, is in the Point of Interſection of two Right Lines biſſecting any two of their Angles; and of all ſolid Triangles or Triangular Priſms it will be in the middle Point of the *Diameter of Gravity:* And that *Diameter* is found by the common Interſection of two Planes, each of which biſſects one Angle of the Top and Baſe, and conſequently of all the Triangles of which the Priſm may be conceived to be compoſed.

If the Priſm be of a Quadrilateral, or any other more compounded Form, the thing will be more difficult, becauſe the Centre of Gravity will lie at a proportionable Diſtance from the Centre of Gravity of all the Triangular Priſms, that the Multiangular Solid can be divided into. But tho' this be a little more troubleſome, 'tis by no Means impoſſible, any more than to find the Centres of Gravi-

Gravity of *Cones*, *Pyramids*, &c. for which you have Rules enough in *Stephinus*, *Lib.* 2. *Elem. Stat.* and in many other Authors.

CENTRE *of an Hyperbola*, or an *Ellipsis*. In theſe Curves, and in the oppoſite Sections of Hyperbola's, all the Diameters terminated in the Section (or in the oppoſite Sections) do naturally biſſect one another in one and the ſame Point, which Point is called the *Centre*. And this Point in the Ellipſes is within the Figure, but in the *Hyperbola* without, being there the Middle of the *Latus Tranſverſum*.

CENTRE *of Oſcillation*. That Point of any Figure where all the Forces are united, is but one, (ſuppoſing the Figure to revolve round a Point or Axis) and conſequently only one ſingle Pendulum can be made, whoſe Vibrations (the Forces in both being equal) ſhall be *Iſochronical* to thoſe of the whole Solid; and becauſe that Point in the Figure wherein all the Forces are ſo united, determines the Length of the ſimple Iſochronical Pendulum, and is that wherein all the Figure is ſuppoſed to be contracted with all the Forces, while it vibrates, therefore 'tis called the *Centre of Oſcillation*; and ſince the *Centres of Percuſſion and Oſcillation* in every Figure are the ſame, the way of Inveſtigation of both muſt be the ſame: See *Centre of Percuſſion*.

CENTRE *of Percuſſion* of a Body in Motion, is that Point wherein all the Forces of that Body are conſidered as united in one; ſo that the *Force of Percuſſion* in that Point, is greater than any where elſe; ſo that the *Centre of Percuſſion* is the ſame with reſpect to the *Forces*, as that of Gravity is in reſpect of the *Weights*.

In calculating the *Centres of Gravity*, we ſuppoſe the Figures to be *ſimply ſuſpended* to a Point or Axis: But in order to calculate the *Centres of Percuſſion*, the Figures are ſuppoſed to be actually *revolving* about a Point or Axis; and as *there* the *ſimple Momenta* are conſidered, *here* they are conſidered alſo with the Velocity ſuper-added. And as the Sum of all the *ſimple Momenta* on each ſide the *Centre of Gravity* are equal, ſo here the Sum of all the *Forces* on every ſide the *Centre of Percuſſion* muſt be equal; and therefore, as the *Centre of Gravity* is found by dividing the Sum of all the *Moments*, by the Sum of all the *Weights*; ſo to find the *Centre of Percuſſion*, you muſt divide the Sum of all the Rectangles under all the *Momenta*, and their reſpective Velocities, by the Sum of all the Moments: *See more of this in* Hayes's Fluxions, *P.* 281.

CENTRIFUGAL *Force*. All moving Bodies endeavour after a rectilinear Motion, becauſe that is the eaſieſt, ſhorteſt, and moſt ſimple. Whenever therefore they move in any Curve, there muſt be ſomething that draws them from their rectilinear Motion, and detains them in the *Orbit*. Whenever this Force, which is called *Centripetal*, ceaſes, which attracts them towards a Centre, the moving Body wou'd ſtrait go off in a Tangent to the Curve in that very Point, and ſo wou'd get ſtill farther and farther from the Centre or Focus of its former curvilinear Motion: And that Endeavour to fly off in the Tangent, is the *Centrifugal Force*. The Effect of this Force is ſuch, that if a moving Body were to deſcribe a Circle, it wou'd cauſe it to deſcribe the largeſt poſſible, becauſe a great Circle is leſs curved, and differs leſs from a right Line than a ſmall one: A moving Body therefore will ſuffer more Violence of Attraction, and conſequently will exert more of its *Centrifugal Force* when it deſcribes a leſs Circle, than in a greater. It is much the ſame in other Curves as in the Circle; for every Curve may be conſidered as compoſed of an Infinity of Arks of infinitely ſmall Circles, all deſcribed by different Radii; and ſo, that where the Curve hath the greateſt Curvature, there it is compoſed of ſuch Arks as are Portions of the leaſt Circles, or which are deſcribed by the ſhorteſt Radii. A Body therefore moving in a Curve, doth every Moment endeavour by the *Centrifugal Force* to get off from a Point which is the Centre of the Ark of an infinitely ſmall Circle then deſcribed. And this Endeavour is ſo much the greater, by how much the Ark of the infinitely ſmall Circle is the Portion of a leſſer Circle; ſo that in one and the ſame Curve, the *Centrifugal Force* of the revolving Body may vary according to the different Points of the Curve in which it may at any time be. It may be therefore, that in a Curve where the Force of Gravity in the deſcribing Body is continually variable, the *Centrifugal Force* may alſo continually vary in the ſame manner, and ſo, that one may alſo ſupply the Defect, or abate for the Exceſs of the other, and conſequently the Effect be every where equal to the abſolute Gravity of the revolving Body. And this as a Problem, *viz. To find ſuch a Curve in a vertical Plane*, hath been propoſed by Mr. *Bernoulli* of *Groningen*. *Vid. Hiſt. de l' Academ. Royal*, *P.* 80. for the Year 1700.

CENTRUM *Phonicum*, } See *Echo*.
CENTRUM *Phonacampticum* }

CENTRY-BOX, the ſame with the *Gueritte*; only the former is of Wood, and the latter of Stone. It is made to ſave the *Centry* from Injuries of Weather. In a Fortification they are uſually placed on the Flank'd Angles of the Baſtions, on thoſe of the Shoulder, and ſometimes in the Middle of the Curtin.

CERT *Money*, *quaſi Certa Moneta*, was the *Head-Money* or common Fine paid by the Reſiants and Tenants of ſeveral Mannors to their Lords. In ſome ancient Records this is call'd *Certum Letæ*.

CERUSSE. In *Phil. Tranſ. N.* 137. there is this Account of the way of making *Ceruſſe*. Pigs of clean and ſoft Lead are caſt into thin Plates, a Yard long and ſix Inches broad; theſe are rolled round ſo as the Surfaces no where meet to touch, for where they do no *Ceruſſe* grows. Each of theſe is put into a Pot juſt capable of holding one, and upheld by a little Bar from the Bottom, that it come not to touch the Vinegar which is put into each Pot to effect the Converſion. Twenty of theſe abreaſt are put into a ſquare Bed of new Horſe-Dung; and each Pot is covered with a Plate of Lead, and then over that with Boards as cloſe as can well be. This repeated four times makes one *Heap* as 'tis called, containing 1600 Pots.

After three Weeks the Pots are taken up, the Plates unrolled, laid on Boards, and beaten with a Battledore, till all the Flakes come off, which, if good, are thick, hard, and weighty. Theſe Flakes are ground with Water betwen Milſtones to almoſt an impalpable Fineneſs; after which 'tis moulded into ſeveral Parcels, and expoſed to the Sun to dry, till it become hard and fit for uſe.

'Tis obſerved that ſome Pots will yield thick and good Flakes, while others alike ordered and ſet by them, without any poſſible Diſtinction of Diſadvantage, yield few, ſmall, or none at all. Sometimes the Pots are taken up all dry, and ſome-

times they prove beſt; ſometimes they are taken up wet. The Plates that cover the Pots yield better and thicker Flakes than do the Rolls within; and the Outſides next to the Planks bigger and better than the Inſides next to the Rolls, and to the Spirits which firſt riſe from the Vinegar.

CESSION, is one manner of an Eccleſiaſtical Benefices becoming void. By the Canon Law, if a Clerk have one Living, though under 8 Pound *per Annum* Value, and takes a Second of what Value ſoever, the former is void without a Diſpenſation; that is, 'tis void *de Jure, ſed non de Facto.* But by Statute, if a Clerk have one Benefice of 8 Pound *per Annum*, or upwards, and takes another of any Value whatſoever with Cure of Souls, and without Diſpenſation, the former Living is *ipſo facto*, void: And this kind of Voidance of a Living is called *Ceſſion.* And what is called *Ceſſion* in other Benefices, is called *Creation* in relation to a Biſhoprick; for if an Incumbent be made a Biſhop, his Benefice is ſaid to be void by *Creation.*

CESSION, in the Civil Law, is putting another Perſon, who therefore is called the

CESSIONARY, into the Place and Right of the true and proper Creditor, in any Caſe. This is called alſo *Subrogation.*

CESSOR, in Law, is one that ceaſeth or neglecteth ſo long to perform ſome Duty belonging to him, as that by this his *Ceſſe* or *Ceaſing*, he incurs the Danger of the Law, and hath, or may have, the Writ *Ceſſavit* (ſee *Vol.* I.) brought againſt him. And where it is ſaid in their Terms, the Tenant *Ceſſeth* without any more Words, it is to be underſtood, the Tenant ceaſeth to do by his Lands or Tenement.

CHAFERY, is the Term for one of the *Forges* in an Iron-work, (ſee *Iron.*) The other is called the Finery.

CHAFE-WAX, is an Officer belonging to the Lord High Chancellor, who fits the Wax for the Sealing of Writs, and ſuch other Inſtruments as are by his Order made to be ſent out.

CHALCOGRAPHY, is the Art of Engraving, Sculpture, &c.

CHAMBERLAIN, from the *French Chambellan*, i. e. *Cubicularius vel Præfectus Cubiculi*, is uſed in divers Senſes in our Chronicles, and old Books of Laws and Statutes: As the Lord Great Chamberlain of *England*, Lord Chamberlain of the King's Houſe, the King's Chamberlain, 13 *E.* 1. *c.* 41. 17 *R.* 2. *c.* 16. To whoſe Office it appertaineth to look to the King's Chambers and Wardrobe, and to govern the Under-Servants and Officers there. There is alſo a Chamberlain of any of the King's Courts; as *Chamberlain of the Exchequer*, 51 *H.* 3. *Stat.* 5. 13 *E.* 3. 11. 14 *E.* 3. 14. 26 *H.* 8. 2. There is a *Chamberlain of* North Wales, *of* Cheſter, *of the City of* London: This Officer is commonly the Receiver of all Rents and Revenues belonging to the City whereof he is Chamberlain. When there is no Prince of *Wales* and Earl of *Cheſter*, the Chamberlain of *Cheſter* hath the Receipt and Return of all Writs coming thither out of any of the King's Courts.

In the *Exchequer* there be two Officers of this Name, who were wont to keep a Controulment of the *Pells of Receipt* and *Exitus*; and kept certain Keys of the Treaſury and Records. They kept alſo the Keys of that Treaſury where the Leagues of the King's Predeceſſors, and divers ancient Books, as Dooms-day Book, and the black Book of the *Exchequer*, remain.

CHAMPION, in the Common Law, is uſed no leſs for him that trieth a Combat in his own Cauſe, than for him that fighteth in the Quarrel or Place of another: And according to *Bracton* and ſome others, it is uſed for one that holdeth by *Serjeantry*, or ſome ſuch Service, of another. There is alſo an Officer now called,

CHAMPION *of the King*, who is at a Coronation, while the King is at Dinner, to ride armed, *Cap-a-pee*, into *Weſtminſter-Hall*, and by a Herald make a Challenge, That if any Perſon ſhall deny the King's Title to the Crown, he is thereby ready to defend it: Which done, the Kings drinks to him, and ſends him a gilt Cup with a Cover, full of Wine, which he hath for his Fee.

CHANCELLOR, is a Title given in our Kingdom, to him that is the chief Man for matter of Juſtice (in private Cauſes eſpecially) next to the Prince: For whereas all other Juſtices are tied by the Law, and may not ſwerve from it in Judgment; the Chancellor hath in this the King's abſolute Power to moderate and temper the written Law, ſubjecting himſelf only to the Law of Nature and Conſcience, and ordering all things *juxta Æquum & Bonum.* And therefore *Stamford*, in his *Prerogative*, *c.* 20. *p.* 65. ſaith, that the Chancellor hath two Powers, one Abſolute and the other Ordinary; meaning, that though by his ordinary Power, in ſome Caſes he muſt obſerve the Form of Proceeding, as the other ordinary Judges do; yet that in his abſolute Power he is not limited by the written Law, but by Conſcience and Equity, according to the Circumſtances of the Matter in queſtion. This high Officer now bears the Title of *Lord High Chancellor of* Great-Britain. But there are others that bear this Name of Chancellor, as the

CHANCELLOR *of the Exchequer*; who ſits in the Court and *Exchequer* Chamber, and with the reſt of the Court ordereth things to the King's beſt Benefit. He is always in Commiſſion with the Lord Treaſurer for the letting of Crown Lands, &c. and hath by the Privy Seal from the King. Power with others, to compound for Forfeitures of Bonds upon penal Statutes; and his Power extends to the Firſt-Fruits Office, &c.

CHANCELLOR *of the Dutchy of* Lancaſter, is an Officer in that Court principally to judge and determine all Controverſies between the King and his Tenants about the *Dutchy Land*, and otherwiſe to direct all the King's Affairs belonging to that Court.

CHANCERY, is a Court of Equity and Conſcience, moderating the Rigors of other Courts, and is not tied ſtrictly to the Letter of the Law. The Officers in it are, The Lord Chancellor, or Keeper of the Great Seal: Twelve Maſters of Chancery, whereof ſome are always Sitting in their turn on the Bench, as Aſſiſtants. The ſix Clerks, who have under them about 90 Clerks, in the Nature of Attorneys in the Court; two chief Examiners, who have each of them ſeveral Clerks. One chief Regiſter, who uſually hath four or five Deputies. The Clerk of the Crown. The Warden of the Fleet, the Uſher, Serjeant at Arms, and Cryer of the Court. The Curſitors and their Clerks of the Petty Bag. The Clerk of the Appeals, of the Faculties, Patents, Preſentations, Diſmiſſion, Licenſes to alienate, Injunctions,

ctions, Enrollments, Protections, *Subpœnas*, and of the Affidavits, &c. The Sealer, Chafe-wax, &c.

CHAPEL, is of two ſorts; either *adjoining* to a Church, as a Parcel of the ſame, which Men of Worth hold; *ut ibidem Familiaria Sepulchra ſibi conſtituant*; or elſe *ſeparate* from the Mother Church, where the Pariſh is wide; and is uſually called a *Chapel of Eaſe*, becauſe built for the Eaſe of ſuch Pariſhioners as dwell too far from the Church. Sometimes this is ſerved by a Curate, provided at the Charge of the Rector, and ſometimes at *Theirs* that have Benefit by it, according to Cuſtom or Compoſition. And ſome of theſe latter Chapels which have a Maintenance perpetnal by ſome Lands charitably beſtowed on them, or otherwiſe, without the Charge of the Rector of the Church, are called *Free-Chapels*.

CHAPTER, *Capitulum*; in the Canon and Common Law, is either *Congregatio Clericorum in Eccleſia Cathedrali, regulari vel Collegiata*; or *Locus in quo fiunt communes tractatus Collegiatorum. Cowel.* Theſe Chapters aroſe thus; in ancient Times the Biſhops had their Clergy reſiding with them in their Cathedrals, to aſſiſt them in the Performance of ſacred Offices, and in the Government and Diſcipline of the Church. And even after Parochial Settlements were made, there were ſtill a Body of Clergymen, which continued with the Biſhop at his Church; and were indeed his Family, and maintained out of his Income. After the Monaſtic Life grew into Requeſt and Reputation, many Biſhops choſe to have *Monks* rather than Seculars to reſide with them and attend them in their Cathedrals. And theſe Bodies of either *Monaſticks* or *Seculars*, had the ſame Privilege of chuſing the Biſhop and being his Council, which the whole Clergy of the Dioceſe had before. But by degrees, their Dependance upon the Biſhop and Relation to him grew leſs and leſs; and when they had diſtinct Parcels of the Biſhop's Eſtate aſſigned for their Maintenance, at laſt the Biſhop had little more left than the Power of viſiting them. And on the other hand, theſe *capitular* Bodies did by degrees alſo loſe their Priviledges; particularly that of chuſing the Biſhop, for which the Kings of *England* had a long Struggle with the Pope, but at laſt *Henry* 8. got this Power veſted in the Crown, and now the Dean and Chapter have only the Shadow of it.

The ſame Prince did alſo eject the Monks out of theſe Cathedrals, and placed Secular Canons in their Room. And thoſe whom he thus regulated are called *Deans and Chapters of the new Foundation:* As are *Canterbury, Wincheſter, Worceſter, Ely, Carliſle, Durham, Rocheſter* and *Norwich*; and of ſuch ſort are the Chapters of the five new Sees of *Peterburgh, Oxford, Glouceſter* and *Briſtol*, to which may be added *Weſtminſter*; tho' this laſt Biſhoprick is now ſunk, and the Monaſtery turned into a Collegiate Church by Queen *Elizabeth*.

CHAPTRELS, in Architecture, are the ſame with *Impoſts*, and ſignify thoſe Parts on which the Feet of Arches ſtand. Their height or thickneſs ought to be equal to the breadth of the lower Part of the Key Stone.

CHARGED CYLINDER is that Part of the *Chace* of a great Gun where the Powder and Ball are placed.

CHARGE of Lead is 36 Pigs, and each Pig contains ſix Stone, wanting two Pound; *i. e.* every Stone (here) is twelve Pound.

CHARTER, in Law, is a written Evidence of any Thing done between Man and Man: And ſometimes Charters are called *Charters of the King*, and when the King paſſeth any Grant to any Perſon, Body Politick, &c. to excuſe a Man from being impanelled on a Jury: *Charters of Pardon*, whereby Men are forgiven Felonies, &c.

CHARTER-LAND is ſuch Land as a Man holds by *Charter, i. e.* by Deed or Evidence in Writing; and this is otherwiſe called *Free-hold*.

CHARTS uſed at Sea, are either the *Plain* or *Mercator's Charts*, as 'tis uſually called, though it ſhould indeed be rather called *Wright's Chart*. See the Word *Plain Chart* and *Mercator*, in *Vol.* I.

CHATTELS, *Catalla*, is a Word which came to us from the *Normans*, who called all moveable Goods by this Name, the contrary was called *Fief*, or as we now call it *Fee*: But now in our Law, *Chattels* are all Sorts of Goods moveable and immoveable, except ſuch as are in the Nature of Free-hold or Parcel thereof. They reckon *Chattels* alſo to be either *perſonal* or *real*. The Former are ſuch as either do belong immediately to the Perſon of a Man, as his Horſe, Sword, &c. or ſuch Things as being injuriouſly withheld from him, a Man hath no way to recover but by perſonal Action. But *Chattels real* do not appertain to the Perſon, but to ſome other thing by way of Depandance, as a Box with Charters of Land, Apples upon a Tree, &c. Such things alſo as neceſſarily iſſue out of ſome immoveable Thing to a Perſon, as a Leaſe or Rent for Years, they call a *Chattel real*. Alſo to hold at Will, is a *Chattel real*.

CHAUNTRY is a Church or Chapel endowed with Lands or other yearly Revenue, for the Maintenance (formerly) of one or more Prieſts daily ſaying or ſinging Maſs for the Souls of the Donors, and ſuch others as they ſhall appoint.

CHEMICE, the Art of caſting Figures in Metals.

CHEST-ROPE in a Ship, is the ſame with the *Gueſt* or *Gift-Rope*, and is added to the Boat-Rope, when the Boat is towed at the Stern of the Ship, to keep her from *Shearing*; *i. e.* from ſwinging to and fro.

CHILIADS are the *Tables of Logarithms*, and ſo called becauſe they were at firſt divided into Thouſands. Thus in the Year 1624. Mr. *Briggs* publiſh'd a Table of *Logarithms* for 20 *Chiliads* of abſolute Numbers, and again for 10 *Chiliads* more, and then for one more, that is, for 31 *Chiliads*. The Book is called *Arithmetica Logarithmica*.

*A. D.* 1628. *Adrian Viacq* publiſh'd this again with a Supplement (according to Mr. *Briggs*'s Direction) of the *Chiliads* before admitted; in all making up 101 *Chiliads*.

CHINALRY, in our Law, ſignifies a Tenure of Land by Knight's Service, or by Obligation to perform ſome Martial or Military Office to the Lord.

CHISSELS uſed in Joynery and Carpentry are of ſeveral Kinds; as 1. The *Former*, which is uſed firſt of all before the *Paring Chiſſel*, and juſt after the Work is ſcrib'd, and a little without the ſcribed Strokes, and with its Baſil outwards.

2. The *Paring Chiſſel* hath a very fine and ſmooth Edge, and 'tis uſed to pare off, or ſmooth the Irregularities which the *Former* makes. This is not ſtruck with the Mallet as the *Former* is, but preſſed with the Shoulder of the Workman, who holds

holds the *Chiſſel* between the Fore and Little Finger of his right Hand, and with the two middle Fingers clutched upon it.

3. The *Skew Former*, which is a *Chiſſel* uſed for cleanſing acute Angles by the Point or Corner of its narrow Edge, and where the Angles of other *Chiſſels* cannot come.

4. The *Morteſs Chiſſel* is narrow, but very thick and ſtrong to endure hard Blows with the Mallet, and 'tis ground to a very broad Baſil; its Uſe is to cut deep ſquare Holes in the Wood, which are called *Morteſſes:* Theſe are of ſeveral Sizes, according as the Breadth of the *Morteſſes* require.

5. The *Gough* is a *Chiſſel* with a round Edge, one ſize of which ſerves to prepare the way for an Augre; and others to cut ſuch Wood as is to be rounded or hollowed, *&c.*

6. *Socket Chiſſels* are ſuch as are chiefly uſed by Carpenters, and have their Shank made with a hollow *Socket* at the top, to receive a ſtrong wooden Sprig made to fit into that *Socket*, with a ſquare Shoulder above it; which makes them very ſtrong to bear the heavy Blows of the Mallet. They diſtinguiſh theſe *Socket Chiſſels* according to the Breadth of the Blade, and call them half Inch, three quarter Inch *Chiſſels*, Inch and half, two Inch, and three Inch *Chiſſels*.

7. The *Ripping Chiſſel* is a *Socket Chiſſel* about an Inch broad, and having a blunt Edge with no Baſil to it; its Uſe is to rip and tear two Pieces of Wood faſtned together from one another, by forcing in the blunt Edge between the two Pieces.

CHORDS. On all plain Scales, and particularly on the Sector, there is a Line drawn called the *Line of Chords*, whoſe Uſes are very numerous; as,

1. *To meaſure the Quantity of an Angle plain given.*

With 60 of the Chords, and one Foot of the Compaſſes in the Vertex of the Angle, ſtrike an Arch between the Legs of the Angle, and then taking that Arch in the Compaſſes, and applying the Length of the Chord which ſubtends it to the ſame Lines of Chords, you will find the Quantity of the Angle by the Numbers there placed.

2. *By the Chords on the Sector to divide any Circle into its proper Degrees, and to meaſure the Quantity of an Arch of a given Circle.*

Apply over the Radius of the Circle between 60 and 60 in the Lines of Chords, and then if you take out the parallel Chords of one Degree, *&c.* and apply them to the Circumference of the Circle given, they ſhall divide it into its proper Degrees: And the Degrees of any Arch ſhall be known by entering the Diſtance between its Extremities in the Sector, parallel to the Radius between 60 and 60; or by ſo applying it into the Sector, that it fall on the ſame Numbers on each Leg.

3. *To divide the Circumference of a Circle into any Number of equal Parts, or to inſcribe any regular Figure in a Circle.*

Divide 360 by the Number of equal Parts requir'd, or by the Number of the Sides of the regular Polygon, and the Quotient will be a Number of Degrees, whoſe Chord apply'd round the Circumference will divide it as requir'd. As if you would divide any Circle into 32 equal Parts; ſet the Sector to the Radius, and then dividing 360 by 32, the Quotient is 11°, 15′: The Chord of which taken off parallelly, will divide the Circle into 32 equal Parts; or into the Points of the Mariner's Compaſs.

CHOREPISCOPI were anciently *Rural* Biſhops delegated by the prime Dioceſan; but their Authority became reſtrained by ſome Councils, and this very Office by Degrees aboliſh'd; after whom the *Rural* Deans were ſo commiſſioned to exerciſe Epiſcopal Juriſdiction, till inhibited by Pope *Alexander* III. and the Council of *Tours*.

CHRISM was anciently (in times of Popery) a Confection of Oil and ſweet Balſam, which was conſecrated by the Biſhop, and uſed in Baptiſm, Confirmation, Extreme Unction, *&c.*

CHRISOM, *Chriſmale*, was the Face-cloth or Piece of Linen laid over the Child's Head when it was baptized: Whence in our Weekly Bills of *Mortality*, ſuch Children as die in the Month are called *Chriſoms*.

CHOROIDES is the fourth Coat of the Eye, lying under the *Selerotick*; it hath many little Glands which ſeparate a black Liquor, which tinges the Inſide thereof; otherwiſe of a white Colour, in order to hinder the reflected Light from diſturbing or confounding the Pictures of Objects from being truly repreſented on the *Retina*. This Coat hath a hole before, which is called the *Pupilla*, which ſerves to admit Light and Colours into the Eye.

CHRONOLOGY, Authors on this Subject are
*J. Bap. Riccioli Chronologia Reformata.* 2 Tom. Bonon. 1669.
*Guil. Beveregii Inſtitutiones Chronologicæ.*
*Mar. Boxhornii Chronologia.*
*Sethi Calviſii Opus Chronologicum.*
*Alſtedii Theſaurus Chronoligicus.*
*Mæſtini Chronolog. Theſes & Tabulæ.*
*Helvici Chronologia.*
*Joſ. Scaliger de Emendatione Temporum.*
*Stranchii Chronolog.*

CHRYSALIS, a Term uſed by the modern Writers of the natural Hiſtory of Inſects, for the ſame with *Nympha*, which ſee. Indeed the Word, as well as *Aurelia* uſed in the ſame Senſe, ſeems to imply a peculiar Yellow or golden Colour in the *Nympha*; but this is purely accidental, and is by no means found in all *Nymphæ:* Though ſome confine this Word *Chryſalis* to the *Nymphæ* of *Butterflies* and *Moths* only. See *Swammerdam Hiſt. Inſect general.* Sect. 2.

CHURCH-SCOT, Payment or Contribution; by the *Latin* Writers was frequently called *Primitiæ Seminum*, becauſe it was at firſt a Quantity of Corn paid to the Prieſt on St. *Martin*'s Day as the firſt Fruirs of Harveſt: This was enjoyn'd by the Laws of King *Ina*, *c.* 4. and by *Canute*, *c.* 10. but after this, it came to ſignify a Reſerve of Corn Rent paid to the Secular Prieſts, or to the Religious; and ſometimes was taken in ſo general a Senſe, as to include Poultry or any other Proviſion that was paid in kind to the Religious.

CHYROGRAPHUM, in the *Saxon* Times, ſignified any publick Inſtrument of Conveyance atteſted by Witneſſes: This the *Normans* called *Charta*.

To prevent Frauds and Concealments, they made their Deeds of mutual Covenant in a *Script*

and *Reſcript*, or in a *Part* and *Counter-Part*, upon the ſame Sheet of Paper or Parchment; and in the middle, between the two Copies, they draw the Capital Letters of the Alphabet, or ſometimes the Word *Syngraphies* in the like great Letters; and then *talliated* or cut the ſaid Sheet aſunder in an indented Manner, which being deliver'd to the two Parties concerned, were proved Authentick by matching with or anſwering to one another, like our preſent Indentures, or like Tallies in Wood. And when this prudent Cuſtom had for ſome time prevail'd, the Word *Chirographum* was appropriated to ſuch *bipartite Writings*.

CIMA, in Architecture, is a moulding ſomewhat reſembling an *S*. *Vitruvius* makes it of two Quarter Circles join'd together. Our Workmen call it an *O---G---*.

CIMATIUM, CIMATUM, } in Architecture, is what our Workmen call an *O - G--* with the Hollow downwards, 'tis part of the Ornament of the Dorick Capital; it ſtands juſt above the Square, and hath a *Fillet* over it.

CIRCLE. Its Quadrature, or the ſquaring of the Circle. This according to Mr. *Leibnitz*'s 7. *Philoſ. Collect.* may be underſtood as twofold; *viz.* either by *Calculation*, or by *Linear Conſtruction*: And each of theſe may be either perfectly exact, or elſe almoſt ſo, or pretty near. Of theſe, that which is done by accurate or exact Calculation may be called the *Analytical Way*, as that which is done by exact Linear Conſtruction is the *Geometrical Way*; that which is done by pretty near but not exact Calculation, may be called the *Approach*; and that by a Conſtruction, only pretty near, may be called the *Mechanical Way*.

The Approaches have been further carried on by *Ceulen*, *Vieta* and *Hugenius*; and others have given ſeveral Mechanical Ways.

The accurate Geometrical Conſtruction may be had, by which not only an entire Circle may be meaſured or ſquared, but any Section or Arch of it alſo: Indeed this is by an exact and ordinate Motion, but it is in thoſe that they call tranſcendental Curves; which, ſaith *Leibnitz*, are erroneouſly accounted Mechanical, for they are as Geometrical as thoſe which are commonly ſo eſteem'd. Though indeed they are not all Algebraical, nor can they be reduc'd to Algebraick Equations of certain Degrees, becauſe they have Degrees proper to themſelves; and though not Algebraical, are yet Analytical.

The *Analytick Quadrature* may be again ſubdivided into three Kinds, the *Analytical Tranſcendent*, the *Algebraical*, and the *Arithmetical*.

The *Analytical Tranſcendent* is to be obtain'd, amongſt others, by Equations of Degrees Indefinite, hitherto conſider'd by; as if $Xx + X$ be $= 30$, and X be ſought, it will be found to be 3, becauſe $3 + 3 + 3 = 27 + 3 = 30$.

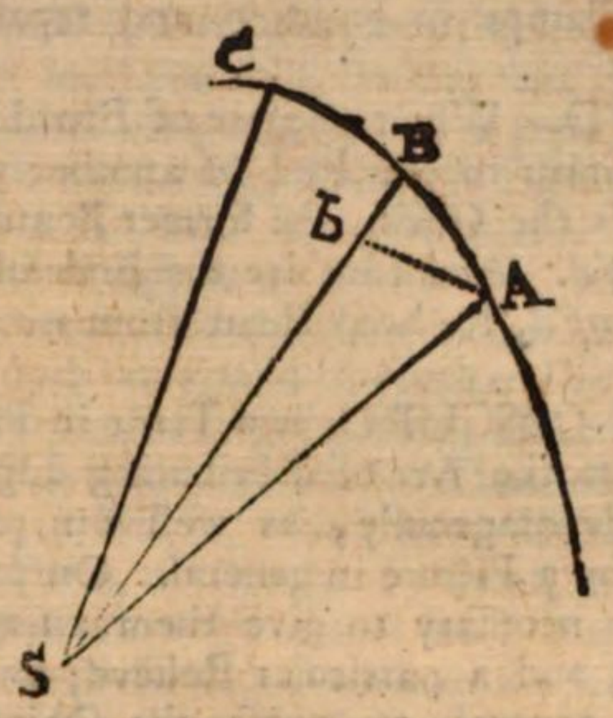
The Algebraical is done by Vulgar, though irrational Vulgar, or by the Roots of common Equations; which for the general Quadrature of the Circle, or its *Sectors*, is indeed impoſſible.

There remains therefore the Arithmetical Way, which is perform'd by certain Series exhibiting the Quantity of the Circle exact, by a Progreſſion of Terms (firſt) Rational; ſuch as I ſhall here propound.

I have found (ſaith he) that if the Square of the Diameter be put 1, *i. e.* one, the Area of the Circle will be $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13} - \frac{1}{15} + \frac{1}{17}$, &c. that is, diminiſhing the entire Square of the Diameter by a third Part (that it may not be too big); and then again, becauſe hereby too much is taken away, augment it one fifth, and then diminiſh it by one ſeventh; and ſo on continually in that alternate Order of the Signs, and the natural Order of the odd Numbers.

CIRCULAR-LINES, in Mathematicks, are ſuch ſtraight *Lines* as are divided from the Diviſions made in the Arch of a Circle; ſuch as *Sines*, *Tangents*, *Secants*, &c. an Account of the Conſtruction of which you have under the Word *Scale* in *Vol.* I.

CIRCULAR-VELOCITY is a Term in the new Aſtronomy, ſignifying that Velocity of any Planet or revolving Body which is meaſured by




the Arch of a Circle; as ſuppoſe by *Ab* deſcribed on the Centre of Attraction *S*: and the circular Velocity of a Body moving from *B* to *C*, is meaſur'd by the Ark *B C*.

CIRCUMSCRIBED *Hyperbola* is one that cuts its own *Aſymptotes*, and contains the Parts cut off within its own proper Space. See *Curves*.

CIRCUMSTANCES are ſuch Things, which tho' they are not eſſential to any Action, do yet ſome Way affect it. And they reckon that ſome Circumſtances are purely *Phyſical*, which don't connect any moral Good or Evil with an Action; ſuch as killing a Man with a *Right* or *Left Hand*, &c. And others, they account properly *Moral*, becauſe they do really influence our Actions, and render them more Good or Evil than they would be without ſuch Circumſtances. And the Writers of Ethicks ſum *them* all up in this one Verſe;

*Quis, quid, ubi, quibus auxilis, cur, quomodo, quando.* Vid. *Whitley*'s Ethicks, p. 13.

CIVIL *Law*. The Civil Law is not received at this Day in any one Nation without ſome Addition or Alteration, for ſometimes the *Feudal Law* is mixt with it, or *general* or *particular Cuſtoms*; and often Ordinances and Statutes cut off a great Part of it.

In *Turkey* the *Juſtinian Greek Code* is only uſed. In *Italy* the Canon Law and Cuſtoms have excluded a good Part of it. In *Venice*, Cuſtom hath almoſt an abſolute Government. In the *Milaneſe*, the *Feudal Law* and particular Cuſtoms bear ſway. In *Naples* and *Sicily* the Conſtitutions

and Laws of the *Lombards* are said to prevail. In *Germany* and *Holland* the Civil Law is esteemed to be the Municipal Law; but yet *many Parts* of it are there grown obsolete; and *others* are alter'd either by the Canon Law, or a different Usage. In *Friezeland* it is observ'd with more strictness. But in the *Northen* Parts of *Germany*, the *Jus Saxonicum*, *Lubecense* or *Culmense* is preferred before it. In *Denmark* and *Sweden* it hath scarce any Authority at all. In *France* only a Part of it is received, and that Part is in some Places as a customary Law; and in those Provinces neareſt to *Italy* the Municipal written Law. In criminal Causes the Civil Law is more regarded in *France*, but the manner of Trial is regulated by Ordinances and Edicts. The Civil Law in *Spain* and *Portugal* is corrected by the *Jus Regium* and Custom. In *Scotland* the Statutes of the *Sederunt*, Part of the *Regiæ Majestatis*, and their Customs, controul the Civil Law.

CLAMP-NAILS, are such Nails as are used to fasten on Clamps in building and repairing of Ships.

CLAMP'D. When a piece of Board is fitted with the Grain to the End of another piece of Board across the Grain, the former Board is said to be *clamp'd*. And thus are the Ends of Tables usually *clamp'd*, to keep them from *warping* or *casting*.

CLARO-OBSCURO, is a Term in Painting; and signifies the Art of distributing Lights and Shadows advantageously, as well on particular Objects as on a Picture in general. On particular Objects 'tis necessary to give them an agreeable Roundness, and a particular Relieve; and in the Picture in general, to expose the Objects with Pleasure to the View of the Spectators, by giving the Eye an Occasion to rest; which is best done by an happy Distribution of great Lights and Shadows, which by their Opposition set off one another.

CLASP-NAILS, are such whose Heads are brought into a little Compass, so that they will sink into the Wood, and when drove home, let a Smoothing Plane go over them.

CLENCH-NAILS, are such as will drive without splitting the Boards, and draw without breaking. They are used by Boat and Barge Builders; and are proper for any Building with Boards that must be taken down again: For fine Work they are made with Clasp-heads.

CLEPSYDRA. In the Memoirs of the *French Royal Academy* for *April* 1699. there is an Account by Mr. *Varignon*, of a General and Geometrick Method to make *Clepsydræ* or *Water-Clocks* with any kind of given Vessels, and with any given Orifices for the Water to issue out at, and according to any given Velocity of the Water's Descent.

CLERK. This Word did anciently signify a Secular Priest, in Contradistinction to a Religious or a Regular. But by Degrees it came to be in general attributed to every Scholar, and at last was common to every Scribe and Notary; and hence so many of our Law Officers have the Title of *Clerk*.

CLINCH-BOLTS in a Ship, are such as are clinched with a riveting Hammer at those Ends which come through.

CLOSE-FIGHTS, are, aboard a Ship, such Bulk-heads as are in a close Fight put up fore and aft in the Ship, for the Men to stand behind them secure, and fire upon the Enemy; and if the Ship is boarded, to scour or clear the Decks.

CLOVE, is a Weight of Cheese containing the 32d Part of the Weight; and so is 8 Pound by 9 *H.* 6. *c.* 8.

CLOUTS, are thin Plates of Iron nailed on that Part of the Axle-Tree of a Gun-Carriage which comes through the *Nave*, through which the *Lins-pin* goes.

CLOUT-NAILS, are such as are commonly used for nailing on of *Clouts* (or Plates of Iron) to the Axle-Trees of Carriages; and are proper to fasten any Iron to Wood.

COCCYGÆUS, is a Muscle of the *Os Coccygis*, arising *Tendino Carnous* from the acute Process of the *Os Ischium*, between the Ligament that reaches from thence to the *Os Sacrum*, and one of the Heads of the *Gemini*; from a narrow Beginning it gradually dilates its self into a thin fleshy Belly, interspersed with some tendinous Fibres. It is inserted into the whole Length of the *Os Coccygis*, laterally.

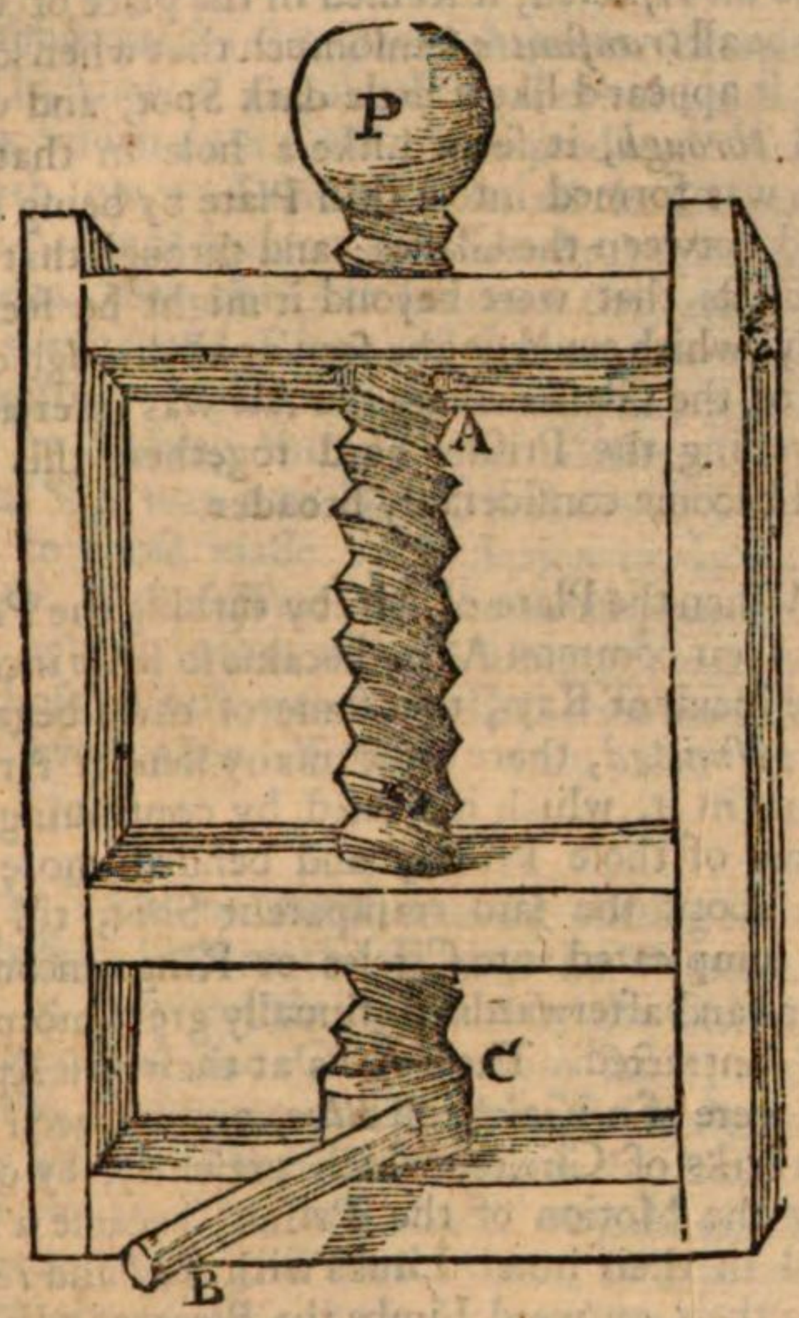
Its use is to draw that inwards or forwards after the Excretion of hardned *Faces*, &c. This Muscle was first discover'd by Dr. *Douglis*; See his *Myogr. Comp. Specim.*

COCKET, is a Seal appertaining to the King's Custom-House: And also a Scroll of Parchment sealed and delivered by the Officers of the Custom-House to Merchants, as a Warrant that their Merchandize be Customed. This Word is used also in the Statutes of Bread and Ale, made 15 *H.* 3. where there is mentioned *Cocket Bread*, among several other kinds: And it seems to have been hard Sea-Bisket, which perhaps had then some *Cocket Mark* or *Seal*; or else was so called from its being designed for the use of the *Cock-swains* or Seamen.

COCKS, aboard a Ship, are little square Pieces of Brass with Holes in them, and put into Wooden Shivers, to keep them from splitting and galling by the Pins of the Blocks in which they move.

COCK-WATER, is a Stream of Water brought in a Trough through a long Pole, in order to wash out the Sand of the Tin-Ore into the *Launder*, while it is bruising in the *Coffer* of a *Stamping-Mill*: See *Tin*.

COCHLEA, is one of the Mechanical Powers, consisting of a Cylinder sulcated or hollowed in a Spiral manner, and moving or turning in a Box or Nut, cut so as to answer to it exactly. Now the Power or Force of this Engine may be thus estimated: Suppose in the Figure annexed the Weight *P* to be raised by the Turn of the Male Screw *C A*, by means of the Handle or Lever *B C*. 'Tis plain that in one Revolution of the Cylinder *A C*, the Weight can be raised no more than is the Distance between any of the two adjoining Leaves of the Screw; and that the Power moves as far as is




the Compass of one Revolution: That is, the way of the Power to that of the Weight in the same time, is as the Ambit of the Power in one Revolution of the Cylinder, to the Distance between any two contiguous Leaves of the Screw. Wherefore the Celerity of the Power to that of the Weight will be in the same Ratio. And consequently, if you apply a Power, which shall be to the Weight to be raised, as the way of that Power in each Revolution, shall be to the aforesaid Distance between any two next adjoining Leaves of the Screw; the Power shall be in *æquilibrio* with the Weight, and therefore being increased never so little more shall raise it. This Power is plainly a Combination of the Lever and the *Axis in Peritrochio* together.

CODICIL, is a Schedule or Supplement to a Will or other Writing. 'Tis used as an Addition to a Testament, when any thing is omitted which the Testator would add, explain, alter, or retract; and is of the same Nature with a Testament, but that it is without an Executor: So that a *Codicil* is a less solemn Will of one that dies either Testate or Intestate, without the Appointment of an Heir. *Testate*, when he that made his *Codicil*, hath either before or afterwards made his Testament, on which that *Codicil* depends, as to which it refers. *Intestate*, when one leaves behind him only a *Codicil* without a Testament, wherein he gives Legacies only to be paid by the *Heir at Law*, and not by any Heir instituted by a Will or Testament. *Codicils* first came in use in the time of *Augustus*. A *Codicil* as well as a Will may be either *written* or *nuncupative*. *Institute of Imp. or Civil Law.*

COFFER is a long square Box of the firmest Timber, about 3 Foot long, and 1 ½ Foot broad, wherein Tin Ore is broken to Pieces in a stamping Mill. See *Tin.*

COFFERER of the King or Queen's Household, is a principal Officer in the Court, next under the *Comptroller*; that in the Counting-House and elsewhere at other Times, hath a special Charge and Oversight of other Officers of the House for their good Demeanor and Carriage in their Offices, to all which he pays their Wages. *Vid. 39. Eliz. c. 7.*

COHÆSION of the Parts of Matter. Sir *Isaac Newton* at the end of the *Latin* Edition of his admirable Opticks, concludes from the Coherence of the Parts of hard and solid Bodies, that their Particles do attract one another by a certain Force, which acts most intensely when the Particles touch one another. At some little Distance it produces those *Chymical Effects or Operations*, which you will find an account of under the Word *Attraction*, and which doth not extend to *remoter Distances*, as far at least as Sense can determine; and indeed 'tis hardly possible to account for the Firmness and Solidity of many Bodies, which have either a vast number of Pores, or *Meatus* in them, and consequently whose Particles cannot touch one another with their whole Surfaces, without supposing that those Particles be either strongly compress together, or do strongly attract one another. But it doth not seem reasonable to attribute this Cohæsion of the Parts of Matter to any *Pressure* of the *Æther*, as some have imagined; because there is no certain Experiment of the Existence of any such thing as their *Æther*, nor if there were, would it be effectual to solve this Phænomenon, any more than it is for many others, which they account for only by this means. But this mutual Attraction of the Particles of Matter within such very narrow Bounds and Limits, which seem to be as much the Law of Nature, as Gravity, *&c.* will fairly account for this hitherto Inexplicable *Phænomenon.* Dr. *Cheyne* takes into Consideration the plainness of the Surfaces of the cohering Parts of Matter, in order to account for this Property; which indeed seems a necessary requisite. He thinks we may suppose some of the primary Atoms of Matter of which Bodies are constituted, to be terminated with plain Surfaces on all Sides. And *such* produce Bodies of the strictest and firmest Cohesion; others may be terminated partly with Curve, as well as partly with plain Surfaces, and these combined may produce Bodies of a middle Degree of Cohesion; and such as have Surfaces *entirely Curve* may produce Fluids, *&c.* But this will not do alone, for though it will bring Bodies to immediate Contact, it will not keep them there, nor hinder them from being separated by any Force, how small soever: And the Fluids which surround our Globe, as the Particles of Light and Air, will get in between the Surfaces of Bodies when they are at any Distance greater than the Diameters of the constituent Particles of those Fluids, and so by their lateral Pressure will destroy the Efficacy of that attractive Force by which Bodies cohere. For since Light and Bodies act mutually one upon another; and that the Particles of Air endeavour

to recede one from another (*ſee Air and Light*) they will render that part of Attraction whereby Bodies cohere, altogether inſenſible at any Diſtance greater than the length of the Diameters of the Particles of theſe Fluids: So that the Force by which Bodies cohere, cannot act but at very ſmall Diſtances, and certainly is much greater in immediate Contact, than at any Diſtance how ſmall ſoever.

COLAPTICE, is the Art of Carving or Cutting the Reſemblances and Figures of Natural Things in Stone. The Term for the Artiſt here is *Lithoxos*.

COLD. It hath been obſerv'd by Mr. *Geoffroy* (in a Diſcourſe which he read before the *French* Royal Academy of Sciences, and which is mentioned in *Phil. Tranſ.* N. 274.) that a Mixture of the greateſt Part of all the ſeveral Kinds of Salts, in many Liquors is accompanied with a *ſenſible degree of Coldneſs*, notwithſtanding the violent Fermentations which ſuch Mixtures do ſometimes produce. As indeed the Learned and Ingenious Dr. *Slare* had before Experimented (ſee *Phil. Tranſ.* N. 150.) in a Mixture of an Acid Menſtruum, and the Volatile Spirit of human Blood. Mr. *Geoffroy* found that pouring but half an Ounce of *Sal Armoniac* into three Ounces of Spirit of Vitriol, though a very violent Fermentation enſued, yet the Spirit of Wine in the included Thermometer deſcended three Inches and a half.

COLDSHIRE *Iron*, is ſuch as is brittle when it is cold. See *Iron*.

COLLATION, is the beſtowing of a Living on a Clerk by an Archbiſhop or Biſhop, when that Living is the Biſhop's or Archbiſhop's own Gift: But when the Living is in the Gift of another, the Biſhop is ſaid to give the Clerk *Inſtitution* into it on the Patrons Preſentation, and the Arch-deacon gives him *Induction* into it on the Biſhops Mandate, as well from the Collation as Inſtitution.

COLLATIONE *Heremitagii*, is a Writ whereby the King confers the keeping of a Hermitage upon a Clerk.

COLLEGIATE Churches, are Churches built and endowed for a Body Corporate, of a Dean or other Preſident and Secular Prieſts; as Canons or Prebendaries in the ſaid Church. Such as are with us, *Weſtminſter*, *Windſor*, *Rippon*, *Wolverhampton*, *Southwel*, *Mancheſter*, &c. None of theſe Collegiate Churches are Epiſcopal Sees or Cathedrals.

COLLUM *Minus Uteri*, is the Cavity of the Womb next its internal Orifice, where it is more contracted than it is at the Bottom.

COLONNADE, in Architecture, is a Range of Pillars running quite round a Building, and ſtanding within the Walls of it.

COLOUR, in a Law Senſe, is a Plea that is probable, though in truth falſe; and hath this End, to draw the Trial of the Cauſe from the Jury to the Judge.

COLOUR of *Office*, is always uſed in the Law in an ill Senſe, ſignifying ſome ill Act done under Countenance of an Office; and ſo 'tis oppoſed to *Virtute Officii*, which is always taken in the beſt Senſe; and implies a Man's doing a right and juſt Thing under the Execution of his Office.

COLOUR. It hath been obſerv'd, that tranſparent Subſtances, as Glaſs, Water, Air, &c. when made very *thin* by being blown into Bubbles, or otherwiſe formed into Plates, do exhibit various Colours according to their various Thinneſs, although at a greater Thickneſs they appear very clear and colourleſs. About theſe Sir *Iſaac Newton*, in his *Opticks*, *Book* 2. made many excellent Obſervations ſerving to illuſtrate and demonſtrate the Theory of Colours.

As, 1. By compreſſing two Priſms hard together, ſo that their Sides, which by chance were a little Convex, might ſomewhere touch; he found the place where they touch'd to become *abſolutely tranſparent*, as if they had been there but one continued piece of Glaſs: For when the Light fell ſo obliquely on the Air, between them in other Places as to be *all reflected*, it ſeemed in the place of Contact to be all *tranſmitted*, inſomuch that when look'd *upon*, it appear'd like a little dark Spot, and when look'd *through*, it ſeem'd like a hole in that Air which was formed into a thin Plate by being compreſſed between the Glaſſes; and through that hole all Objects that were beyond it might be ſeen diſtinctly, which could not be ſeen at all through other Parts of the Glaſſes where the Air was interjacent. By preſſing the Priſms hard together, this Spot would become conſiderably broader.

2. When the Plate of Air, by turning the Priſms about their common Axis, became ſo little inclined to the incident Rays, that ſome of them began to be *tranſmitted*, there aroſe many ſlender Arks of Colours in it, which increaſed by continuing the Motion of thoſe Priſms, and bended more and more about the ſaid tranſparent Spot, till they were compleated into Circles or Rings encompaſſing it, and afterwards continually grew more and more contracted. Theſe Arks at their firſt Appearance were of a *Violet* and *Blue*, and between were *White* Arks of Circles, which preſently, by continuing the Motion of the Priſms, became a little tinged in their inner Limbs with *Red* and *Yellow*, and to their outward Limbs the *Blue* was adjacent. The Motion of the Priſms round their Axis being continued, theſe Colours contracted more and more, ſhrinking towards the *Whiteneſs* on either Side of it, till at laſt they totally vaniſhed into it, and then the Circles in thoſe Parts appeared black and white, without any other Colours intermixed; but by farther moving the Priſms, the Colours would emerge out of the *Whiteneſs* again.

In his 4th Obſervation he conſidered more nicely the *Order* of the Colours ariſing out of the white Circles, according as the Rays became leſs and leſs inclined to the Plate of Air; and by uſing two Object Glaſſes of pretty long Teleſcopes, he obſerved the Succeſſion and Quantity of the Colours to be thus: Next to the Pellucid Central Spot ſucceeded blue, white, yellow and red; the blue was ſo ſmall that he could not diſcern it in the Circles made by the Priſms, nor could he well diſtinguiſh any violet in it; but the yellow and red were pretty copious, and ſeem'd about as much in extent as the white, and four or five times more than the blue. The next Circuit or Order of Colours ſucceeding and compaſſing theſe, were violet, blue, green, yellow and red; and theſe were all copious and vivid, except the green, which was very little in Quantity, and very faint and dilate. Of the other four the Violet was the leaſt in extent, and the blue leſs than the yellow and red. The third Circuit or Order was purple, blue, green, yellow and red; in which the purple ſeemed more reddiſh than the violet

Violet in the former Circuit; and the Green much more conſpicuous, and as vivid and copious as any Colour there but the Yellow; but the Red began to look faded, and very much inclining to Purple. After this ſucceeded a fourth Circuit or Order of Green and Red: The Green was very copious and lively, inclining on one Side to Blue, on the other to Yellow. But here was neither Violet, Blue, nor Yellow, and the Red was imperfect and dirty. Alſo the ſucceeding Colours became more and more imperfect and dilute, till after three or four Revolutions they ended in perfect Whiteneſs.

In Obſervation the 5th and 6th he determines the Thickneſs of the Air lying between the Glaſſes, by which each Colour was produced: And in the 7th gives a Table of it in all the Obliquities of the Angle of Incidence: (See *Air*.) In the 9th he ſhews, that the Air between the two Object Glaſſes exhibited Rings of Colours, as well by *tranſmitting* Light, as by reflecting it; which he found by looking through the Glaſſes. But the Central Spot was now *White*, and the Colours oppoſite to thoſe made by Reflexion in the former Caſes; *i. e.* thoſe Parts of the Glaſs, were now Black, which before were White, *& vice verſa*; and thoſe which were then Red were now Blue; which were then Yellow, were now Violet, *&c.*

In the Tenth he found, that by wetting the Object Glaſſes a little at the Edges, the Water crept ſlowly in between them, whereby the Circles became leſs, and the Colours more faint; and he found the Diameters of the coloured Circles made now by Water to thoſe before made by Air, to be about ſeven to eight; and that if any other Medium, more or leſs denſe than Water, be compreſſed between the Glaſſes, their *Intervals* at the Rings cauſed thereby, will be to thoſe made by Air, as the Sines meaſuring the Refraction made out of that Medium into Air.

In the 12th he found, that by viewing theſe Rings in a darkened Room, they became more viſible and diſtinct, and appear'd in a greater Number.

In the 13th Obſervation he found, that when the Priſm was made to turn round its Axis, ſo that all the Colours might ſucceſſively fall on that Part of the Paper which he ſaw by Reflection from that Part of the Glaſſes where the Circles appeared, ſo that all the Colours might be ſucceſſively reflected from the Circles to the Eye, while it was held immoveable; he found, I ſay, that the Circles which the *Red* Light made, were manifeſtly bigger than thoſe made by the *Blue* and *Violet*; and it was pleaſant to ſee them gradually ſwell and contract, according as the Colour of the Light was changed: And in the 14th *Obſervation*, he found then the Contraction or Dilatation of the Colours was ſwifteſt in the Red, and ſloweſt in the Violet, and in the intermediate Colours had intermediate Degrees of Celerity: and he gives you the Proportions in Numbers; and he ſhews alſo, that the Thickneſs of the Air between the Glaſſes there where the Ring is ſucceſſively made by the Limits of the five principal Colours (Red, Yellow, Green, Blue, Violet) in order, are to one another very nearly, as the ſix Lengths of a Chord which ſound the Notes in a ſixth Major *ſol, la, mi, fa, ſol, la.* But that it agrees better with Obſervation to ſay, that the Thickneſs of the Air between the Glaſſes there where the Rings are ſucceſſively made by the Limits of the ſeven Colours, Red, Orange, Yellow, Green, Blue, Indico, and Violet in order, are to one another as the Cube Roots of the Squares of the eight Lengths of a Chord, which ſound the Notes in an Eighth, as *ſol, la, fa, ſol, la, mi, fa, ſol*; that is, as the Cube Roots of the Squares of the Numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{9}{16}$, $\frac{1}{2}$.

Then in *Obſervation* 15. he manifeſtly ſhews the *Origin of theſe Rings*; for he found that theſe Rings in the preceding Obſervation, were not of various Colours like thoſe made in the open Air, but appeared all over of that Priſmatick Colour only with which they were illuminated; and by projecting the Priſmatick Colours immediately upon the Glaſſes, he found that the Light which fell on the dark Spaces which were between the coloured Rings, was tranſmitted through the Glaſſes without any Variation of Colour; for on a white Paper placed behind, it would paint Rings of the ſame Colour with thoſe which were reflected, and of the Bigneſs of their immediate Spaces: ſo that 'tis plain, *That the Air between the Glaſſes, according to its various Thickneſs, is diſpoſed in ſome Places to reflect, and in others to tranſmit the Light of any one Colour; and in the ſame Place to reflect that of one Colour, where it tranſmits that of another.*

In *Obſervation* 16. he found, that the Squares of the Diameters of theſe Rings were in Arithmetical Progreſſion. In *Obſervation* 17 and 18, he conſiders the Phænomena ariſing from the Colours ſeen in Bubbles of Water, made tenacious by a little Soap; and in the 19th he collects the *Thickneſs* of the Water requiſite to exhibit one and the ſame Colour at ſeveral Obliquities, and expreſſes their Proportions in a Table: And in the 21ſt *Obſervation* he ſhews, by Help of *Obſervation* 10. and 16. the *Thickneſs* which Plates of *Muſcovy* Glaſs, Water, or any other Subſtances, *have*, at at any Colour exhibited by them.

Sir *Iſaac Newton*, in the 22d *Obſervation* of his Second Book of *Opticks*, found, that a thin tranſparent Body, which is *denſer* than its ambient Medium, exhibits more brisk and vivid Colours than that which is ſo much rarer: as he particularly obſerved in the Air and Glaſs: for blowing Glaſs very thin at a Lamp Furnace, thoſe Plates encompaſſed with Air, did exhibit much more vivid Colours than thoſe of Air made thin between two Glaſſes: *Vid. Obſerv.* 1. and 4.

And he ſhews farther, that ſince by his 10th Obſervation, *the Thickneſs of Air to the Thickneſs of Water*, which between the ſame Glaſſes exhibited the ſame Colour, *was as* 4 *to* 3; and ſince it appears (by the 21ſt *Obſervation*) that the Colours of thin Bodies are not varied by varying the Ambient Medium; therefore *the Thickneſs of a Bubble of Water exhibiting any Colour, will be* $\frac{3}{4}$ *of the Thickneſs of Air producing the ſame Colour.* And ſo according to Obſervation 21. the Thickneſs of a Plate of Glaſs, whoſe Refraction of the mean Refrangible Ray is meaſured by the Proportion of the Sines of 31 to 20, may be $\frac{20}{31}$ of the Thickneſs of Air producing the ſame Colours, and the like of

of other Mediums. And on these Grounds the excellent Author gives a Table, wherein the Thickness of Air, Water and Glass, at which each Colour is most intense and specifick, is expressed in Parts of an Inch, divided into 100,000 equal Parts. And by means of this Table, he shews how to conjecture at the Bigness of the Parts of Natural Bodies by their Colours.

In the 24th *Observation* he takes Notice of something very odd and surprizing; and that is, that Bubbles of Water, or of Glass, and Plates of *Muscovy* Glass, which are not quite thin enough to represent the various Colours above-mentioned, yet when look'd on through a Prism, should appear adorn'd with *Rings* or *Wavings*; whereas a Prism usually makes Objects appear coloured only where they are terminated with Shadows, or have Parts unequally luminous: And the Reason of this he explains largely at p. 42, 43, &c. of Book the 2d, Part the 2d. And from the whole he effectually proves those Properties of Light above discovered to be connate with the Rays and immutable; and consequently that all the Productions and Appearances of Colours in the World, are derived not from any Physical Change caused in the Light by Refraction or Reflexion, but only from the various Mixtures or Separations of Rays by virtue of their different Refrangibility or Reflexibility. And in this Respect the Science of Colours becomes a Speculation as truly Mathematical as any other Part of Opticks, so far as they depend upon the Nature of Light, and are not produced or altered by the Power of Imagination, or by striking or pressing the Edges.

Then in the following Part of the Second Book he considers the Phænomena of the permanent Colours of Natural Bodies; and the Analogy between them, and the Colours of thin transparent Plates: And having before shewn, *That Bodies appear of divers Colours, according as they are disposed to reflect most copiously the Rays originally endued with these Colours*; he proceeds to examine their Constitutions, and to shew the Reason of their thus reflecting some Rays more copiously than others; which he doth in the following Propositions.

## PROP. I.

*Those Superficies of transparent Bodies* reflect *the greatest Quantity of Light, which have the greatest* refracting *Power:* That is, which intercede Mediums which differ most in their refractive Densities. And in the Confines of equally refracting Mediums there is no Reflexion.

## PROP. II.

*The least Particles of almost all Natural Bodies are in some Measure transparent; and the Opacity of those Bodies ariseth from the Multitude of Reflexions caused in their internal Parts.*

## PROP. III.

*Between the Parts of opake and coloured Bodies are many Spaces, either empty, or repleniſh'd with Mediums of other Dnsities; as Water between the tinging Corpuscles with which any Liquor is impregnated; Air between the Aqueous Globules that constitute Clouds or Mists: And for the most part Spaces void of both Air and Water, but yet perhaps not void of all Substance, between the Parts of hard Bodies.*

## PROP. IV.

*The Parts of Bodies and their Interstices, must not be less than of some definite Bigness, to render them coloured and opake.*

## PROP. V.

*The transparent Parts of Bodies, according to their several sizes, must reflect Rays of one Colour, and transmit those of another, on the same Grounds that thin Plates or Bubbles do reflect or transmit those Rays.* And this I take to be the Ground of all Colours.

For if a thinn'd or plated Body, which being of an even thickness, appears all over of an uniform Colour, should be slit into Threads, or broken into Fragments of the same thickness with the Plate; I see no Reason why every Thread or Fragment should not keep its Colour, and consequently, why an heap of those Threads or Fragments should not constitute a Mass of Powder of the same Colour which the Plate exhibited before it was broken.

And the Parts of all natural Bodies being like so many Fragments of a Plate, must on the same Grounds exhibit the same Colours; and that they do so, will appear by the Affinity of their Properties. The finely coloured Feathers of some Birds, and particularly those of Peacocks Tails, do in the very same Part of the Feather appear of several Colours in several Positions of the Eye, after the very same manner that thin Plates were found to do in the 7th and 19th Observations; and therefore arise from the thinness of the transparent Parts of the Feathers; that is, from the Slenderness of the very fine Hairs, or *Capillamenta*, which grow out of the sides of the grosser lateral Branches or Fibres of those Feathers. And to the same Purpose it is, that the Webs of some Spiders, by being spun very fine, have appeared coloured, as some have observed; and that the coloured Fibres of some Silks, by varying the Position of the Eye, do vary their Colour: Also the Colours of Silks, Cloaths, and other Substances which Water or Oyl can intimately penetrate, become more faint and obscure by being immerged in these Liquors, and recover their Vigor again by drying, much after the manner of the thin Bodies mentioned in the 10th and 12th Observations. Leaf Gold, some sorts of painted Glass, the Infusion of *Lignum Nephriticum*, and some other Substances, reflect one Colour and transmit another, like thin Bodies in the 9th and 20th Observations: And some of those coloured Powders which Painters use, may have their Colours a little changed, by being very elaborately and finely ground. Where I see not what can be justly pretended for those Changes, besides the breaking of their Parts into less Parts by that contrition, after the same manner that the Colour of a thin Plate is changed by varying its thickness. For which Reason also it is, that the coloured Flowers of Plants and Vegetables, by being bruised, usually become more transparent than before, or at least in some Degree or other change their Colours. Nor is it much less to this Purpose, that by mixing divers Liquors, very odd and remarkable Productions of Colours may be effected;

effected; of which no Cauſe can be more obvious and rational, than that the ſaline Corpuſcles of one Liquor, do variouſly act upon or unite with the tinging Corpuſcles of another, ſo as to make them ſwell or ſhrink, (whereby not only their *Bulk*, but their *Denſity* alſo may be changed;) or to divide them into ſmaller Corpuſcles, (whereby a coloured Liquor may become tranſparent;) or to make many of them aſſociate into one Cluſter, whereby two tranſparent Liquors may compoſe a colour'd one. For we ſee how apt thoſe ſaline Menſtruums are to penetrate and diſſolve Subſtances to which they are applied, and ſome of them precipitate what others diſſolve.

In like manner if we conſider the various Phænomena of the Atmoſphere, we may obſerve, that when Vapours are raiſed, they hinder not the Tranſparency of the Air, being divided into Parts too ſmall to cauſe any Reflexion in their Superficies. But when, in order to compoſe Drops of Rain, they begin to coaleſce, and to conſtitute Globules of all intermediate Sizes, thoſe Globules, when they become of a convenient Size to reflect ſome Colours and tranſmit others, may conſtitute Clouds of various Colours according to their Sizes. And I ſee not what can be rationally conceived in ſo tranſparent a Subſtance as Water for the Production of theſe Colours, beſides the various Sizes of its Fluid and Globular Particles.

## PROP. VI.

*The Parts of Bodies on which their Colours depend, are denſer than the Medium which pervades their Interſtices.*

This appears by conſidering that the Colour of a Body depends not only on the Rays which are incident perpendicularly on its Parts, but on thoſe alſo which are incident at all other Angles: And that according to the 7th Obſervation, a very little Variation of Obliquity will change the reflected Colour, where the thin Body or ſmall Particle is rarer than the ambient Medium, inſomuch that ſuch a ſmall Particle will at diverſely oblique Incidences reflect all ſorts of Colours in ſo great a Variety, that the Colour reſulting from them all, confuſedly reflected from a heap of ſuch Particles, muſt rather be white or grey than any other Colour, or at beſt it muſt be but a very imperfect and dirty Colour: Whereas if the thin Body or ſmall Particle be much denſer than the ambient Medium, the Colours, according to the 19th Obſervation, are ſo little changed by the Variation of Obliquity, that Rays which are reflected leaſt obliquely, may predominate over the reſt ſo much, as to cauſe a heap of Particles to appear very intenſely of their Colour. It conduces alſo ſomething to confirm this *Prop.* that according to Obſervation 22. the Colours exhibited by the denſer thin Body within the rarer, are more brisk than thoſe exhibited by the rarer within the more denſer.

## PROP. VII.

*The Bigneſs of the component Parts of Natural Bodies may be conjectured by their Colours.*

For ſince the Parts of theſe Bodies, by *Prop.* 5. do moſt properly exhibit the ſame Colours with a Plate of equal thickneſs, provided they have the ſame refractive denſity; and ſince their Parts ſeem for the moſt part to have much the ſame denſity with Water or Glaſs, as by many Circumſtances is obvious to collect; to determine the Sizes of theſe Parts, you need only have recourſe to the preceding Table where the thickneſs of Water or Glaſs exhibiting any Colour is expreſs'd. Thus, if it were deſired to know the Diameter of a Corpuſcle, which being of equal denſity with Glaſs, ſhall reflect green of the third Order; (and what the meaning of theſe Orders are, I have explained above under Sir *Iſaac*'s 4th Obſervation:) The Number in the Table will be $16\frac{1}{4}$, which ſhews it to be $\frac{16\frac{1}{4}}{100000}$ Parts of an Inch. And from that 4th and his 18th Obſervation, he gathers theſe Particulars.

1. That *Scarlets*, and other *Reds*, *Oranges* and *Yellows*, if they be pure and intenſe, are moſt probably of the ſecond Order: Thoſe of the firſt and third alſo may be pretty good, only the yellow of the firſt Order is faint, and the orange and red of the third Order have a great Mixture of blue and violet.

2. There may be good *Greens* of the fourth Order, but the pureſt are of the third. And of this Order the green of all Vegetables ſeems to be, partly becauſe of the Intenſeneſs of their Colours; and alſo that when they wither, ſome of them turn to a greeniſh yellow, others to a more perfect yellow or orange, or perhaps to red, paſſing firſt through all the aforeſaid intermediate Colours. Which Changes ſeem to be effected by the exhaling of the Moiſture, which may leave the tinging Corpuſcles more *denſe*, and ſomething alſo augmented by the Accretion of the oily and earthy Part of that Moiſture. Now the green is without doubt of the ſame Order with thoſe Colours into which it changes, becauſe the Changes are gradual; and theſe Colours, though uſually not very full, yet are often too full and lively to be of the fourth Order.

3. *Blues* and *Purples* may be either of the ſecond or third Order, but the beſt are of the third. Thus the Colour of Violets ſeems to be of that Order, becauſe their Syrup by Acid Liquors turns red, and by Urinous and Alkalizate turns green. For ſince 'tis the Nature of Acids to diſſolve and attenuate, and of Alkalies to precipitate and incraſſate; if the purple Colour of the Syrup was of the ſecond Order; an Acid Liquor, by attenuating its tinging Corpuſcles, would change it to a red of the firſt Order, and an Alkali, by incraſſating them, would change it to a green of the ſecond Order: Which red and green, eſpecially the green, ſeem too imperfect to be the Colours produced by theſe Changes. But if the ſaid purple be ſuppoſed to be of the third Order, its change to red of the ſecond, and green of the third, may without any Inconvenicncy be allowed.

If there be any Body of a deeper and leſs reddiſh purple than that of Violets, 'tis probable its Colour is that of the ſecond Order.

The *Blue* of the firſt Order, though very faint and little, may poſſibly be the Colour of ſome Subſtances; and particularly the Azure Colour of the Sky ſeems to be of this Order. For all Vapours, when they begin to condenſe and coaleſce into ſmall Parcels, become firſt of that bigneſs whereby ſuch an Azure muſt be reflected, before they

they can constitute Clouds of others Colours. And so this being the first Colour which Vapours begin to reflect, it ought to be the Colour of the finest and most transparent Skies in which Vapours are not arrived to that Grossness requisite to reflect other Colours; as we find it by Experience.

4. *Whiteness*, if most intense and luminous, is that of the first Order; if less strong and luminous, 'tis a Mixture of the Colours of several Orders. Of this last kind he takes the Whiteness of Froth, Paper, Linen, and most white Substances to be; and of the former that of white Metals. For since the densest of Metals (Gold) if foliated, is transparent, and that all Metals become transparent by being dissolved in Menstruums, or by being vitrified, the Opacity of white Metals ariseth not from this Density alone: They being less dense than Gold, would be more transparent than it, did not some other Cause concur with their Density to make them Opake. And this Cause he takes to be such a Bigness of their Particles as fits them to reflect the white of the first Order: For if they be of other Thicknesses, they must reflect other Colours, as is manifest by the Colours which appear upon hot Steel in tempering it, and sometimes upon the Surface of melted Metals in the Skin or Scoria which arises upon them in their cooling. And as the white of the first Order is strongest which can be made by Plates of transparent Substances, so it ought to be stronger in the denser Substances of Metals than in the rarer of Air, Water and Glass. Nor doth he see but that Metallick Substances of *such a Thickness* as may fit them to reflect the white of the first Order, may by reason of their great Density (according to *Prop.* 1.) reflect all the Light incident upon them, and so be as opake and splendent as 'tis possible for any Body to be. Gold or Copper mix'd with less than half their Weight of Silver, Tin or Regulus of Antimony, either in Fusion or amalgamated with a very little Mercury, become *white*; which shews both that the Particles of white Metals have much more Superficies, and so are *smaller* than those of Gold and Copper; and also that they are so opake as not to suffer the Particles of Gold or Copper to shine through them: Nor is it to be doubted but that the Colours of Gold and Copper are of the second Order, or of the third, and therefore the Particles of white Metals cannot be much bigger than is requisite to make them reflect the white of the first Order. The Volatility of Mercury argues that they are not much *bigger*, nor may they be much *less*, lest they lose their Opacity, and become either *transparent* as they do when attenuated by Vitrification, or by Solution in Menstruums; or *black* as they do when ground smaller, by rubbing Silver, Tin, or Lead on other Substances to draw black Lines. The first and only Colour which white Metals take by grinding their Particles smaller is *black*; and therefore their *white* ought to be that which borders upon the black Spot in the Centre of the Rings of Colours mentioned in the preceding Observation; that is, the white of the first Order: But if you would hence gather the Bigness of Metallick Particles, you must allow for their *Density*. For were Mercury transparent, its Density is such, that the Sine of Incidence upon it (by Sir *Isaac Newton*'s Computation) would be to the Sine of its Refracting, as 71 to 30, or as 7 to 2. And therefore the Thickness of its Particles, that they may exhibit the same Colours with those of Bubbles of Water, ought to be less than the thickness of the Skin of those Bubbles in the Ratio of 2 to 7.

Whence 'tis possible, that the Particles may be as little as the Particles of some transparent and volatile Fluids, and yet reflect the white of the first Order.

5. For the Production of *Blackness* (he shews) that the Corpuscles must be less than any of those which exhibit any other Colours, because at all greater sizes of Particles there is too much Light reflected to constitute this Colour: But if they be supposed a little less than is requisite to reflect the white and very faint blue of the first Order, they will, according to Observation 4, 8, 17, and 18, reflect so very little as to appear intensely black; and yet may perhaps variously refract it to and fro within themselves so long, until it happen to be stifled and lost, by which means they will appear black in all Positions of the Eye without any Transparence. And from hence may be understood why *Fire*, and that more subtle Dissolver *Putrefaction*, by dividing the Particles of Substances, turn them to black: Why small Quantities of black Substances impart their Colour very freely and intensely to other Substances to which they are applied, the minute Particles of these, by reason of their very great Number, easily overspreading the gross Particles of others: Why Glass, ground very elaborately with Sand on a Copper Plate till it be well polished, makes the Sand, together with what is worn off from the Glass and Copper, become very black: Why black Substances do soonest of all others become hot in the Sun's Light, and burn; (which Effect may proceed partly from the Multitude of Refractions in a little Room, and partly from the easy Commotion of so very small Particles:) And why Blacks are usually inclined a little to a bluish Colour; for that they are so, may be seen by illuminating white Paper by Light reflected from black Substances, when the Paper will usually appear of a bluish white: And the reason is, because black borders on the obscure blue of the first Order in the 18th Observation, and therefore reflects more Rays of that Colour than any other.

The *Sensations* of *different Colours* seem to arise from hence, That several sorts of Rays do make Vibrations of several Bignesses, which, according to their Magnitudes, do excite Sensations of several Colours; much after the manner that the Vibrations of the Air, according to their several Bignesses, do excite Sensations of different Sounds. And in particular 'tis probable, that the *most refrangible Rays* excite the *shortest* Vibrations, and so produce the Sensation of a *deep violet Colour*; and that the *least refrangible Rays* excite the *largest* Vibrations, and so produce the Sensation of a *deep Red:* And that the several intermediate Sorts of Rays do excite Vibrations of several intermediate Bignesses, and thereby produce the Sensations of the several intermediate Colours.

And 'tis probable also, that the *Harmony* and *Discord* of Colours (for some Colours, as that of Gold, Yellow, and Indico, are agreeable to the Eyes, and some not) arise from the *Proportions* of these Vibrations propagated through the Fibres of the Optick Nerves into the Brain, just as the *Harmony* and *Discord* of Sounds arises from the Vibrations

brations of the Air: *See* Newton's Opticks, *at the End.*

He ſhews alſo there at the 21ſt Query, That to the Production of all the *Varieties of Colours*, and the *various Degrees of Refrangibility* of the Rays of Light, there is nothing more neceſſary than that the Rays of Light be ſmall Bodies or Particles of different Magnitudes. The *leaſt* Size of which conſtitute a deep *Violet Colour*; as being the moſt dark and languid of all others, and as being moſt turned out of their way by the Action of refracting Surfaces upon them. And the other Sizes of the Rays of Light, according as they *increaſe in Magnitude*, do exhibit ſtronger and brighter *Colours*, as *Blue*, *Green*, *Yellow* and *Red*; and are, in Proportion to their Bigneſs, leſs and leſs capable of being refracted, or turned out of their Way.

COLOURS. Dr. *Hook*, in his *Oper. Poſt.* p. 54. from the Apparition of Colours in the Triangular or Hexangular *Striæ* of Cryſtal, where a lovely Variety of Colours is produc'd, in a way different quite from that which Nature takes in the Generation of Colours in other Bodies, as in Flowers, Blood, Metals, &c. he concludes, that all other *Hypotheſes* of Colours are overthrown, and that nothing beſides a *Refraction*, which *is conſiderable enough to obliquate the Pulſe of* Light, is neceſſary for the Production of Colours.

COMBARONS are the *Fellow-Barons* or *Commonalty* of the Cinque-Ports, of the two ancient Towns, and their Members. The Members that repreſent them in the Houſe of Commons, are called Barons of the *Cinque-Ports*.

COMBINATION of Quantities is defined by Mr. *Strode*, in his Treatiſe on this Subject, printed, *London*, 1678. to be the many ſeveral Ways one may take any Number of Quantities, without having any reſpect to their Places.

*Col.* Thornycroft's *Treatiſe of* Combinations *from* Phil. Tranſ. N. 299. *in which the whole Affair of* Combinations *and* Alternations *is improved and compleated.*

And *Firſt*, He premiſes,

That as in the Notation of Powers, $a\,a\,a\,a\,b\,b\,b\,c\,c$ is deſign'd by $a^4\,b^3\,c^2$, and univerſally $p$ times the Poſition of $c$, by $a^p$, &c. ſo in things expos'd likewiſe, (unleſs where 'tis propos'd they ſhould be all different) which Indices, as they have here no relation to Powers, but expreſs only the Occurrences of thoſe Things to which they reſpectively belong, I therefore call Indices of Occurrences.

2*dly*, That as often as I ſhall hereafter mention the *Combination* and *Alternations* of the $p^s\,q^s\,r^s$ or $s^s$, (which conſider'd by themſelves are capable of no Variation) I mean, of thoſe things whoſe Indices they are.

3*dly*, That $m$ is generally put for the whole Number of things expos'd, whether all different or not, *i. e.* equal to the Sum of their Indices; and $n$ for ſuch a Number of them as each *Combination* and *Alternation* muſt conſiſt of, (unleſs preſuppos'd equal); which explains what is hereafter meant by the *Combinations* and *Alternations* of $m$ things taken $n$ and $n$, or of $m$ things taken $m$ and $m$; and the like Expreſſion, by whatever Symbols the Number of things out of which the *Combinations* and *Alternations* are to be made, or of which they are to conſiſt, may be deſign'd.

### *Lemma* I.

If in a right Line, at any Diſtances, be plac'd any number of Things, $a\,b\,c\,d$, &c. the Number of the Intervals, $a\,b$, $b\,c$, $c\,d$, &c. terminated each by two adjacent Things, is one leſs than the Number of Things.

For whereas every Interval is terminated by two adjacent Things, if to any Number of Things be added one Thing more, one Interval only is thereby added. Q. E. D.

### *Lemma* II.

The Number of the *Alternations* of $m$ Things $a\,b\,c\,d$, &c. different each from other, taken $m$ and $m$, is $m$ times the Number of the *Alternations* of $m-1$ Things $a\,b\,c$, taken $m-1$ and $m-1$.

For (by *Lemma* I.) the laſt Letter $d$, beſides the Poſition it hath, may have $m-2$ Poſitions, *viz.* in the Intervals which are between $m-1$ Things $a\,b\,c$; but it may alſo have one more, for it may be put firſt of all, it may therefore have $m$ Poſitions; and thoſe in all the different Orders, whereof $m-1$ Things are capable, which being all the poſſible Poſitions of $d$, in all the Varieties of $a\,b\,c$, is all the Variety whereof the whole Number of things expoſed $a\,b\,c\,d$, &c. is capable. *Q. E. D.*

### *Lemma* III.

The Number of the Alternations of $m$ things $a\,b\,c\,d$, &c. different each from other, taken $m$ and $m$, is equal to $m \times m-1 \times m\,m-2 \times m-3 \times m-4$, &c. continu'd to $m$ places.

For let $m\,O$ expreſs the Number of the Alternations of $m$ things different each from other; $\overline{m-1}\,O$, of $m-1$ things, and the like.

'Tis evident, that if $m = 1$, it will be $m\,O = m$; for there can be but one Order of one thing.

And if $m$ be greater than Unity, then it will be (by *Lem.* 2.) $m\,O = m \times \overline{m-1}\,O = m \times m-1 \times \overline{m-2}\,O = m \times m-1 \times m-2 \times \overline{m-3}\,O =$, &c. till we have an Equation conſiſting of $m$ places; *i. e.* $= m \times m-1 \times m-2 \times m-3 \times$, &c. continu'd to $m$ places. *Q. E. D.*

### *Lemma* IV.

If $m\,\omega$ expreſs the Number of the Alternations of $m$ things $a\,p$, $b\,p$, $c\,p$, $d\,p$, $e\,q$, $f\,r$, &c. taken $m$ and $m$; and $\alpha$ the Number of $p$'s, $\beta$ the Number of $q$'s, $\gamma$ the Number of $r$'s, it will be,

$m\omega = \frac{m - m-1 \times m-2 \times m-3 \times m-4 \times m \times 5 \times, \&c.}{p \times p-1 \times p-2 \times, \&c. \alpha \times q \times q-1 \times, \&c. \beta \times r \times r-1 \times, \&c. \gamma}$ each Series continued to $m$ places.

$\&c.$ places respectively.

For the Number of the Alternations of any Number of things, however divided into Parts, is produc'd by a continual Multiplication of the Alternations of those things amongst themselves respectively, which compose each Part, into the Number of their Alternations one amongst the other; *i. e.* in the present Case (the several Occurrences being supposed to compose the several Parts, and consequently the Number of the Alternations of the things composing each Part equal to Unity) $m\omega$ = to the Number of the Alternations of the things composing the Parts one amongst the other; but the Number of their Alternations one amongst the other, is the same in this Case, as if the things expos'd, being all different, were divided into the same Parts; for the things which compose each Part in both Cases, are different from the rest of the things expos'd; *i. e.* by *Lem.* 3.

$m\omega = \frac{m \times m-1 \times m-2 \times m-3 \times m-4 \times m-5 \times, \&c.}{p \times p-1 \times p-2 \times, \&c. \mid \alpha \times q \times q-1 \times, \&c. \mid \beta \times r \times r-1 \times, \&c. \mid \gamma}$ each Series continued to $p$, $q$, $r$ places respectively. *Q. E. D.*

### *Lemma* V.

The Number of the Combinations of $m$ things $a\ b\ c\ d$, $\&c.$ different each from other, taken $n$ and $n$, is equal to $\frac{m \times m-1 \times m-2 \times m-3 \times, \&c.}{n \times n-1 \times n-2 \times n-3 \times, \&c.}$ each Series continued to $n$ places.

For if the things expos'd be divided in two Parts, *viz.* in the *Ratio* of $n$ and $m-n$, 'tis evident that their different Combinations taken $n$ and $n$, are produc'd by the Alternations of the composing the Parts one amongst the other: And therefore the Number of those = to the Number of these = to the Number of the Alternations of $m$ things taken $m$ and $m$, the Indices of whose Occurrences are $n$ and $m-n = \frac{m \times m-1 \times m-2 \times m-3 \times, \&c.}{n \times n-1 \times, \&c. \times m-n \times m-n-1 \times, \&c.}$ each Series continued to $n$ and $m-n$ places respectively, (by *Lem.* 4th;) *i. e.* because $n + m - n = m = \frac{m \times m-1 \times m-2 \times m-3, \&c.}{n \times n-1 \times n-2 \times n-3, \&c.}$ each Series continued to $n$ places, by *Lem.* 3. Therefore,

continu'd to $m$ places.

rem for finding the Combinations and Alternations of $m$ things taken $n$ and $n$ universally; *i. e.* Whether $m$ consist of things all different or not; and whether $n$ be equal to, or less than $m$.

### *Lemma* VI.

The Number of the Alternations of $m$ things $a\ b\ c\ d$, $\&c.$ different each from other, taken $n$ and $n$, is $= m \times m-1 \times m-2 \times m-3 \times, \&c.$ continu'd to $n$ places. *Q. E. D.*

### *Theorem.*

If $n$ be expres's'd, according to all the different Forms of Combination which the things expos'd are capable of, and

| | | |
|---|---|---|
| $p$ = the highest Index | $\alpha$ = the number of $p$'s | in ev'ry form of Combination. |
| $q$ = the next highest | $\beta$ = the number of $q$'s | |
| $r$ = the next highest | $\gamma$ = the number of $r$'s | |
| $s$ = the next highest | $\delta$ = the number of $s$'s | |

$\&c.$

| | | | |
|---|---|---|---|
| $A$ $B$ $C$ $D$ $\&c.$ | = the Number of all Indices not less than | $p.$ $q.$ $r.$ $s.$ | Which are in the things expos'd. |

And $b = \alpha + \beta$, $c = b + \gamma$, $d = c + \delta$, $\&c.$

I say the Number of the Combinations of $m$ things taken $n$ and $n$, in any one Form of Combination, shall be $\frac{A \times A-1 \times A-2}{\alpha \times \alpha-1 \times \alpha-2} \times, \&c. \times \frac{B-\alpha \times B-\alpha-1}{B \times \beta-1} \times, \&c. \times \frac{C-b \times C-b-1}{\gamma \times \gamma-1} \times, \&c. \times \frac{D-c \times D-c-1}{\delta \times \delta-1}, \&c.$ continu'd to so many Terms as there are different Indices in the Form of Combination, and each Term to $\alpha$, $\beta$, $\gamma$, $\delta$, $\&c.$ places respectively, and this Number multiply'd into

$n \times n-1 \times n-2 \times n-3 \times n-4 \times n-4 \times n-5 \times n-6, \&c.$ continu'd to $n$ places.

$p \times p-1 \times p-2 \times, \&c. \mid x \times q \times q-1 \times, \&c. \mid \beta \times 1 \times 1-1 \times, \&c. \mid \gamma \times, \&c.$ each Series continued to $p$, $q$, $r$, $\&c.$ places respectively, shall be the Number of their Alternations.

But the Sum of all the Combinations and Alternations which are in every Form of $n$, shall be the whole Number of Combinations and Alternations of $m$ things taken $n$ and $n$.

Since in the things expos'd the same things may occur more than once, and also $n$ be less than $m$, the Indices of the Occurrences which are in some of the Combinations of $m$ things taken $n$ and $n$, may differ from those which are in others; but those Combinations, the Indices of whose Occurrences are the same, are said to be in the same Form: Therefore whereas $n$ is equal to the Sum of the Indices which are in each Combination taken $n$ and $n$, if $n$ be expres's'd by all the different Combinations of such Indices only (being integer Numbers) whereof no one may exceed the highest Index of the things expos'd, and being more than one in a Combination, are each of them, which are in the same Combination, comprehended in a distinct Index thereof; these Expressions of $n$ will necessarily be the several Forms of the Combinations taken $n$ and $n$, whereof $m$ things are capable: Whence is deriv'd a General Theo-

*Demon-*

*Demonstration.*

First then 'tis evident, that those Combinations, which are in different Forms, differ from each other.

Again, 'Tis evident that the Combinations of $m$ things, as $a^p, b^p, c^p, d^p, e^q, f^q, g^q, h^r, i^r$, &c. (the Indices simply consider'd) taken $n$ and $n$, in a Form wherein are $p^r$, $q^s$, $r^s$, shall be equal to the Number of the Combinations of the $p^r$, which are in the things expos'd, taken $\alpha$ and $\alpha$, multiplied into the Number of the Combinations of the $q^s$ taken $\beta$ and $\beta$, multiply'd into the Number of the Combinations of the $r^s$ taken $\gamma$ and $\gamma$.

But because $p$, and all lesser Indices, are comprehended in every Index which is greater than themselves, therefore is $A =$ to the Number of $p^r$ which are in the things expos'd; and for the same Reason would $B =$ the Number of the $q^s$, and $C$ the Number of $r^s$: But the Number of the $p^r$, which are in every Form of Combination, is $= a$; therefore is $B - \alpha =$ to the Number of $q^s$: Also because the Number of $p^r$ and $q^s$ together, which are in every Form of Combination, wherein there are $q^s$, is $= \alpha + \beta = b$; therefore is $C - b =$

$$= \frac{n \times n-1 \times n-2 \times n-3 \times n-4 \times n-5 \times n-6 \times, \&c.}{p \times p-1 \times p-2 \times, \&c. \mid \alpha \times q \times q-\times, \&c. \mid \epsilon \times t \times r-1 \times, \&c. \mid \gamma \times,}$$

$p, q, r$, &c. places respectively. *Q. E. D.*

Now to make an Application of this General Rule to those particular Cases which have already been consider'd by others, and which are contain'd in our 3d, 4th, 5th and 6th *Lemma's*, and by us more generally demonstrated; I say,

If $n=m$, there can be but one Form of Combination, and but one Combination in that Form; and therefore the Number of Alternations $= \frac{m \times m-1 \times m-2 \times m-3 \times m-4 \times, \&c. \text{ continu'd to } m \text{ places.}}{p \times p-1 \times, \&c. \mid \alpha \times q \times q-1 \times, \&c. \mid \epsilon \times r \times, \&c. \mid \gamma \times, \&c.}$ each Series to $p, q, r$, &c. places respectively; *i. e.* (if $p=1$) $= m \times m-1 \times m-2 \times m-3 \times m-4 \times$, &c. continu'd to $m$ places, which are the Cases of the 4th and 3d *Lemma's*.

But if the things expos'd are all different, and $n$ be less than $m$, which is the Case of the 5th and 6th *Lemma's*, then also can there be but one Form of Combination, and it will be $A = m$ and $a = n$, and the whole Number of Combinations

$$= \frac{A \times A-1 \times A-2 \times, \&c.}{a \times a-1 \times a-\times 2, \&c.} = \frac{m \times m-1 \times m-2 \times, \&c.}{n \times n-1 \times n-2 \times, \&c.}$$ each Series

*i. e.* $=$ continued to $n$ places, and therefore the Number of Alternations $= m + m-1 \times m-\times 2$, &c. continued to $n$ places.

But fully to illustrate this Theorem, which, as delivered in general, may seem somewhat too abstracted to be commonly understood, I shall subjoin one short Example.

*Example.*

Let the things expos'd be $a\ a\ a\ b\ b\ b\ c\ c$, or according to our way of Notation, $a^3$, $b^3$, $c^2$; 'tis requir'd to find the Number of their Combinations and Alternations taken 4 and 4.

to the Number of $r^s$, and so on, how many soever were the different Indices in any Form of Combination.

But (by *Lem.* 5.) the Number of the Combinations of the $p^r$, which are in the things expos'd, whose Number is $A$, taken $\alpha$ and $\alpha$, is $= \frac{A \times A-1 \times A-2}{\alpha \times \alpha-1 \times \alpha-2}$, &c. continu'd to $\alpha$ places; and the Number of the Combinations of the $q^s$, whose Number is $B-\alpha$, taken $\epsilon$ and $\epsilon$, is $= \frac{B-\alpha \times B-\alpha-1 \times B-\alpha-2}{\epsilon \times \epsilon-1 \times \epsilon-2}$, &c. continu'd to $\epsilon$ places; and the Number of the Combinations of the $r^s$, whose Number is $C-b$, taken $\gamma$ and $\gamma$, is $= \frac{C-b \times C-b-1}{\gamma \times \gamma-1}$, &c. continu'd to $\gamma$ places. *Q. E. D.*

But every Combination in one and the same Form, affords the same Number of Alternations: Therefore the Number of Alternations in any one Form, is so many times the Number of Combinations, as is the Number of Alternations in any one of these Combinations.

But (by *Lem.* 4.) the Number of Alternations in any of those Combinations shall be

$$= \frac{n \times n-1 \times n-2 \times n-3 \times n-4 \times n-5 \times n-6 \times, \&c.}{p \times p-1 \times p-2 \times, \&c. \mid \alpha \times q \times q-\times, \&c. \mid \epsilon \times t \times r-1 \times, \&c. \mid \gamma \times,}$$ each Series continued to

$p, q, r$, &c. places respectively. *Q. E. D.*

Then (because in the things expos'd there is no one thing occurs more than thrice, nor more than three things different from each other) will all the Forms of Combination, which the things expos'd are capable of, be these,

*Viz.* $\left\{\begin{matrix} 3 \cdot 1 \\ 2 \cdot 2 \\ 2 \cdot 1 \cdot 1 \end{matrix}\right\}$ Then

In the first Form will $p = 3$, $q = 1$, $\alpha = 1$, $\epsilon = 1$, $A = 2$, $B = 3$.

In the 2d Form will $p = 2$, ——, $\alpha = 2$, ——, $A = 3$, ——.

In the 3d Form will $p = 2$, $q = 1$, $\alpha = 1$, $\epsilon = 2$, $A = 3$, $B = 3$.

The Number of Combinations in the First Form $= \frac{A}{\alpha} \times \frac{B-\alpha}{\beta} = \frac{2}{1} \times \frac{2}{1} = 4$

The Number of Combinations in the Second Form $= \frac{A \times A-1}{\alpha \times \alpha-1} = \frac{2 \times 2}{2 \times 1} = 3$

The Number of Combinations in the Third Form $= \frac{A}{\alpha} \times \frac{B-\alpha \times B-\alpha-1}{\beta \times \epsilon-1} = \frac{2 \times 1}{2 \times 1} = 3$ ——

And the whole Number of Combinations $= 10$

Alſo the Number of Alternations:

$$\text{In the Firſt Form} = 4 \times \frac{n \times n-1 \times n-2 \times n-3}{p \times p-1 \times p-2 \,|^{\alpha} \times q^{\beta}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{3 \times 2 \times 1 \,|\, 1 \times} = 4 \times 4 = 16$$

$$\text{In the Second Form} = 3 \times \frac{n \times n-1 \times n-2 \times n-3}{p \times p-1^{\alpha}} = 4 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \,|\, 2} = 3 \times 6 = 18$$

$$\text{In the Third Form} = 3 \times \frac{n \times n-1 \times n-2 \times n-3}{p \times p-1 \,|^{\alpha} \times q^{\beta}} = 3 \times \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \,|\, 1 \times 12} = 3 \times 12 = 36$$

And the whole Number of Alternations = 70

Many are the Properties of this *Theorem*, in common with others; as, To find the *Unciæ* of a Multinominal rais'd to any integer Power: To raiſe an infinite Series to an integer Power, though of an interrupted Order, without introducing any thing immaterial, or which muſt afterwards be expung'd; and many others. But then ſo many Terms of the Series muſt be taken in at firſt, as ſhall ſerve to the Purpoſes of the intended Approximation, otherwiſe as often as it ſhall fall ſhort of that, the Operation muſt be began *de novo*.

Many likewiſe are the Properties peculiar to this *Theorem*, and great Variety of Problems might be fram'd; and I ſcruple not to ſay, many may occur in Practice, which are ſolvable by this, and no other Method whatever.

Hence may be found the Number of all Words whereof the 24 Letters are capable, from one Letter in each Word, to any Number of Letters given.

Hence may be found the Number of all Numbers, to any given Number of Places, which may be produced from any Number of Figures given.

Hence alſo the Compaſs of a Muſical Inſtrument being given, the Time and Number of the Bars, whereof each Tune ſhall conſiſt, the Numbers of Tunes may be found, which that Inſtrument is capable of.

To give an Inſtance of the prodigious Variety that there is in Muſick, I have calculated the Number of Tunes in common Time, conſiſting of eight Bars each, which may be play'd on an Inſtrument of one Note Compaſs only; and it is this, *viz.* 27584. 270157. 013570. 368586. 999728. 299176. whereas the Changes on 24 Bells is but 620448. 401733. 239439. 360000. which is but $\frac{1}{444588.604583}$ of the Number of Tunes: And yet Dr. *Wallis* in his *Algebra* demonſtrates, could not be diſpatch'd in 31557. 600000. 00000 Years.

If then the Inſtrument were of as many Notes Compaſs as any Inſtrument now in Uſe, how prodigiouſly muſt the Number of Tunes be increas'd; the Calculation of which (though much more intricate and operoſe) would be equally attainable by our Theorem.

COMETS. See *Caſſini*'s Diſſertation in the Memoirs of the *French Academy of Sciences*, 1699. In the *Act. Erud. Lipſ.* May 1682. there is a way of finding the Diſtance of a Comet from the Earth, by *P. M. Kavina*, Mathematick Profeſſor of *Faenza:* And another in *December*, 1685. by *G. S. D.* whereby the Comet's Diſtance from the Earth is found, without any Change of Place or Station of the Obſervator, or taking any Altitudes or Azimuths,

Writers on the Subject of Comets.

*Lubinietski Theatrum Cometicum. Cum* Fig. 2. Vol. Amſt. 1661.

*Johan. Hevelii Cometographia. Geduni*, 1668.

———*Ejuſdem Prodromus Cometicus*, 1660.

*Eraſmus Bartholinus de Cometis.*

*Staniſlai Theatrum Cometicum.*

*Gattus de Cometis.*

*Jac. Bernouilli Conamen Novi Syſtematis Cometarum.*

*Diſſertation ſur le Nature des Cometes, per* M. Petit.

*Mr.* Edmund Halley, *Savilian Profeſſor of* Geometry *in* Oxon, *and* F. R. S. *his* Synopſis of the Aſtronomy of Comets *is as follows:*

The ancient *Egyptians* and *Chaldeans*, (if we may credit *Diodorus Siculus*) by a long Courſe of Obſervations, were able to predict the *Apparitions* of Comets. But ſince they are alſo ſaid, by the Help of the ſame Arts, to have prognoſticated Earthquakes and Tempeſts; 'tis paſt all doubt, that their Knowledge in theſe Matters was the Reſult rather of mere *Aſtrological Calculation*, than of any *Aſtronomical Theories* of the Cœleſtial Motions. And the *Greeks*, who were the Conquerors of both thoſe People, ſcarce found any other Sort of Learning amongſt them than this; ſo that 'tis to the *Greeks* themſelves as the Inventors (and eſpecially to the great *Hipparchus*) that we owe this *Aſtronomy*, which is now improv'd to ſuch a heighth. But yet amongſt theſe, the Opinion of *Ariſtotle* (who wou'd have Comets to be nothing elſe but ſublunary Vapours, or airy Meteors) prevail'd ſo far, that this moſt difficult Part of the Aſtronomical Science lay altogether neglected; for no body thought it worth while to take notice of, or write about the wandring uncertain Motions of what they eſteemed Vapours floating in the *Æther*; whence it came to paſs, that nothing certain concerning the Motion of Comets can be found tranſmitted from them to us.

But *Seneca* the Philoſopher, having conſider'd the *Phænomena* of two remarkable Comets of his Time, made no Scruple to place them amongſt the Cœleſtial Bodies, believing them to be Stars of equal Duration with the World, though he owns their Motions to be govern'd by Laws, not as then known or found out. And at laſt (which was no untrue or vain Prediction) he foretels, That there ſhould be Ages ſome time hereafter, to whom Time and Diligence ſhou'd unfold all theſe Myſteries; and who ſhou'd wonder that the Ancients

Ancients could be ignorant of them, after some lucky Interpreter of Nature had shewn *in what Parts of the Heavens the Comets wander'd, what and how great they were.* Yet almost all the Astronomers differ'd from this Opinion of *Seneca*; neither did *Seneca* himself think fit to set down those *Phænomena* of the Motion, by which he was enabled to maintain his Opinion, nor the *Times* of those Appearances which might be of use to Posterity, in order to the Determining these Things. And indeed, upon the turning over very many Histories of Comets, I find nothing at all that can be of Service in this Affair, before *A. D.* 1337. at which Time *Nicephorus Gregoras*, a *Constantinopolitan* Historian and Astronomer, did pretty accurately describe the Path of a Comet amongst the fix'd Stars, but was too lax as to the Account of the Time; so that this most doubtful and uncertain Comet only deserves to be inserted in our Catalogue for the Sake of its appearing near 400 Years ago.

Then the next of our Comets was in the Year 1472. which being the swiftest of all, and nearest to the Earth, was observ'd by *Regiomontanus*, This Comet (so frightful upon the Account both of the Magnitude of its Body and the Tail) mov'd Forty Degrees of a great Circle in the Heavens in the Space of one Day; and was the first of which any proper Observations are come down to us. But all those that consider'd Comets until the Time of *Tycho Brahe* (that great Restorer of Astronomy) believ'd them to be below the Moon, and so took but little Notice of them, reckoning them not other than Vapours.

But in the Year 1577, (*Tycho* seriously pursuing the Study of Stars, and having gotten large Instruments for the performing Cælestial Mensurations, with far greater Care and Certainty than the Ancients could ever hope for) there appear'd a very remarkable Comet; to the Observation of which, *Tycho* vigorously apply'd himself, and found by many just and faithful Trials, that it had not a *Diurnal Parallax* that was at all perceptible; and consequently was not only no aereal Vapour, but also much higher than the Moon; nay, might be plac'd amongst the Planets for any Thing that appear'd to the contrary: The cavilling Opposition made by some of the *Schoolmen* in the mean Time being to no purpose.

Next to *Tycho* came the Sagacious *Kepler*. He having the Advantage of *Tycho's* Labours and Observations, found out the *true Physical* System of the World, and vastly improv'd the Astronomical Science.

For he demonstrated that the Planets perform their Revolutions in *Elliptick Orbits whose Planes pass through the Center of the Sun*, observing this Law, That the *Areas (of the Elliptick Sectors taken at the Centre of the Sun, which he proved to be in the common Focus of these Ellipses) are always proportional to the Times in which the correspondent Elliptical Arches are describ'd.* He discover'd also, That *the Distances of the Planets from the Sun are in the* Sesquialteral Ratio *of the Periodical Times*, or (which is all one) *That the Cubes of the Distances are as the Squares of the Times.* This great Astronomer had the Opportunity of observing two Comets, one of which was a very remarkable one. And from the Observations of these (which afforded sufficient Indications of an *Annual Parallax*) he concluded, *That the Comets mov'd freely through the Planetary Orbs with a Motion not much different from a Rectilinear one; but of what Kind he could not then precisely determine.*

Next, *Hevelius* (a noble Emulator of *Tycho Brahe*) following in *Kelper's* Steps, embraced the same Hypothesis of the *Rectilinear Motion of Comets*, himself accurately observing many of them; yet he complain'd, that his Calculations did not agree to the Matter of Fact in the Heavens: And was aware, *That the Path of a Comet was bent into a Curve Line towards the Sun.* At length came that prodigious Comet of the Year 1680. which descending, as it were, from an infinite Distance *perpendicularly* towards the Sun, arose from him again with as great a Velocity.

This Comet, which was seen for four Months continually) by the very remarkable and peculiar Curvity of its Orbit (above all others) gave the fittest Occasion for investigating the *Theory of their Motion.* And the *Royal Observatories* of *Paris* and *Greenwich* having been for some Time founded and commited to the Care of most *excellent Astronomers*, the *apparent* Motion of this Comet was most accurately (perhaps as far as human Skill could go) observ'd by Messieurs *Cassini* and *Flamsteed.*

Not long after, that *great Geometrician*, the *illustrious* Sir *Isaac Newton*, writing his *Mathematical Principles of Natural Philosophy*, demonstrated not only that what *Kepler* had found, did necessarily obtain in the *Planetary System*, but also that all the *Phenomena* of Comets would naturally follow from the same Principles; which he abundantly illustrated by the Example of the aforesaid Comet of the Year 1680. shewing, at the same Time, a Method of Delineating the Orbits of Comets Geometrically; wherein he (not without the highest Admiration of all Men) solv'd a Problem, whose Intricacy render'd it worthy of himself. This Comet he prov'd to move round the Sun in a Parabolical Orb, and to describe Area's (taken at the Center of the Sun) proportional to the Times.

Wherefore (following the Steps of so *great a Man*) I have attempted to bring the same Method to *Arithmetical Calculation*; and that with desired Success. For having Collected all the Observations of Comets I could, I fram'd this Table, the Result of a prodgious deal of Calculation; which, though but small in Bulk, will be no unacceptable Present to Astronomers. For these Numbers are capable of representing all that has been yet observ'd about the Motion of Comets by the Help of the following *general Table*; in the making of which I spar'd no Labour, that it might come forth perfect, as a Thing consecrated to Posterity, and to last as long as *Astronomy* itself.

*The Astronomical Elements of the Motions in a Parabolick Orb of all the Comets that have been hitherto duly observ'd*

| Comt An. | Nodus Ascend. | Inclin. Orbitæ. | Perihelion | Distan. Perihel. a Sole. | Log. Dist. Perihelii a Sol. | Temp. equat. Perihelii. | Perihelion a Node. | |
|---|---|---|---|---|---|---|---|---|
| | gr. ′ ″ | gr. ′ ″ | gr. ′ | | | d. h. ′ | gr. ′ ″ | |
| 1337 | ♊ 24.21. 0 | 32.11. 0 | ♉ 7.59. 0 | 40666 | 9.609230 | *June* 2. 6.25 | 46.22. 0 | Retrog. |
| 147 | ♍ 11.46.20 | 5.20. 0 | ♉ 15.33.30 | 54273 | 9.734584 | *Feb.* 28.22.23 | 123.47.10 | Retrog. |
| 1531 | ♉ 19.25. 0 | 17.56. 0 | ♒ 1.39. 0 | 56700 | 9.753583 | *Aug.* 24.21.18½ | 107.46. 0 | Retrog. |
| 1532 | ♊ 20.27. 0 | 32.36. 0 | ♋ 21. 7. 0 | 50910 | 9.706803 | *Oct.* 19.22.12 | 32.40. 0 | Direct. |
| 1556 | ♑ 25.42. 0 | 32. 6.30 | ♍ 8.50. 0 | 46390 | 9.666424 | *Apr.* 21.20. 3. | 103. 8. 9 | Direct. |
| 1577 | ♈ 25.52. 0 | 74.32.45 | ♎ 9.22. 0 | 18342 | 9.263447 | *Oct.* 26.18.45 | 103.30. 0 | Retrog. |
| 1580 | ♈ 18.57.20 | 64.40. 0 | ♋ 19. 5.50 | 59628 | 9.775450 | *Nov.* 28.15.00 | 90. 8.30 | Direct. |
| 1585 | ♉ 7.42.30 | 6. 4. 0 | ♈ 8.51. 0 | 109358 | 0.038850 | *Sept.* 27.19.20 | 28.51.30 | Direct. |
| 1590 | ♑ 15.30.40 | 29.40.40 | ♏ 6.54.30 | 57661 | 9.760882 | *Jan.* 29. 3.45 | 51.23.50 | Retrog. |
| 1596 | ♒ 12.12.30 | 55.12. 0 | ♏ 18.16. 0 | 51293 | 9.710058 | *July* 31.19.55 | 83.56.30 | Retrog. |
| 1607 | ♉ 20.21. 0 | 17. 2. 0 | ♒ 2.16. 0 | 58680 | 9.768490 | *Oct.* 16. 3.50 | 108.05. 0 | Retrog. |
| 1618 | ♊ 16. 1. 0 | 37.34. 0 | ♈ 2.14. 0 | 37975 | 9.579498 | *Oct.* 29.12.23 | 73.47. 0 | Direct. |
| 1650 | ♊ 28.10. 0 | 79.28. 0 | ♈ 28.18.40 | 84750 | 9.928140 | *Nov.* 2.15.40 | 59.51.20 | Direct. |
| 1661 | ♊ 22.30.30 | 32.35.50 | ♋ 25.58.40 | 44851 | 9.651772 | *Jan.* 16.23.41 | 33.28.10 | Direct. |
| 1664 | ♊ 21.14. 0 | 21.18.30 | ♎ 10.41.25 | 102575½ | 0.011044 | *Nov.* 24.11.52 | 59.27.25 | Retrog. |
| 1665 | ♐ 18.02. 0 | 76. 5. 0 | ♊ 11.54.30 | 10649 | 9.027309 | *Apr.* 14. 5.15½ | 156. 7.30 | Retrog. |
| 1672 | ♍ 27.30.30 | 83.22.10 | ♉ 16.59.30 | 69739 | 9.843476 | *Feb.* 20. 8.37 | 109.29. 0 | Direct. |
| 1677 | ♏ 26.49.10 | 79.03.15 | ♎ 17.37. 5 | 28059 | 9.448072 | *Apr.* 26.00.37½ | 99.12. 5 | Retrog. |
| 1680 | ♍ 2. 2. 0 | 60.56. 0 | ♐ 22.39.30 | 00612 | 7.787106 | *Dec.* 8.20. 6 | 9.22.30 | Direct. |
| 1682 | ♉ 21.16.30 | 17.56. 0 | ♏ 2.52.45 | 58328 | 9.765877 | *Sep.* 4.07.39 | 108.23.45 | Retrog. |
| 1683 | ♑ 23.23. 0 | 83.11. 0 | ♊ 25.29.30 | 56020 | 9.748343 | *July* 3. 2.50. | 87.53.30 | Retrog. |
| 1684 | ♐ 28.15. 0 | 65.48.40 | ♏ 28.58. 0 | 96015 | 9.982339 | *Mai.* 29.10.16 | 29.23.00 | Direct. |
| 1686 | ♓ 23.34.40 | 31.21.40 | ♊ 17.00.30 | 3 2500 | 9.511883 | *Sept.* 6.14.33 | 86.25.50 | Direct. |
| 1698 | ♐ 27.44.10 | 11.46. 0 | ♍ 00.51.15 | 0 9129 | 9.839660 | *Oct.* 8.16.57 | 3. 7. 0 | Retrog. |

This Table needs little Explication, since 'tis plain enough from the Titles what the Numbers mean. Only it may be observ'd, that the *Perihelium* Distances are estimated in such Parts, as the Middle Distance of the Earth from the Sun contains 100000.

*A General Table for Calculating the Motions of Comets in a Parabolick Orbit.*

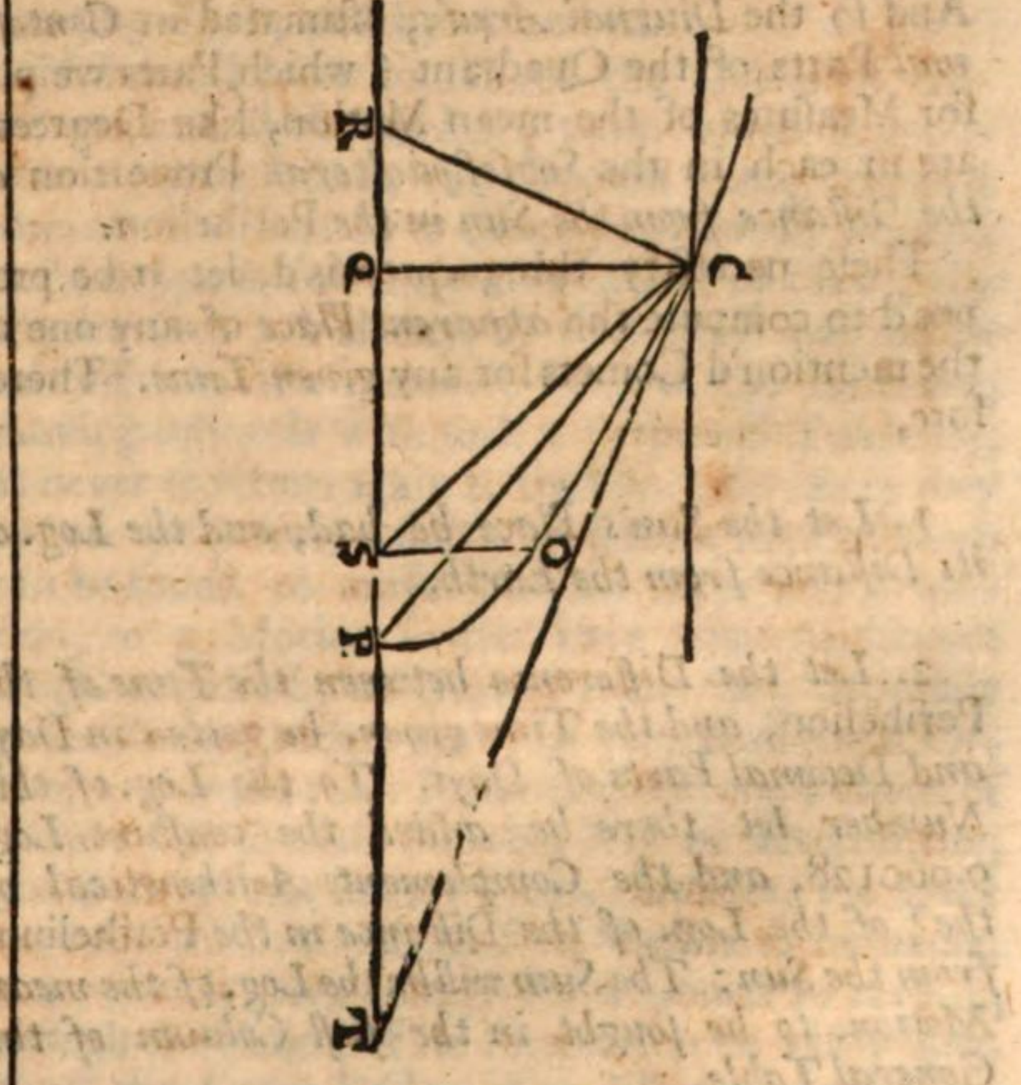
| Mea mot. | Ang. a Perihelio. | Logar. pro. dist. a Sole. | Mea mot. | Ang. a Perihelio. | Logar. pro dist. a Sole. | Mea mot. | Ang. a Perihelio. | Logar. pro dist. a Sole | Mea mot. | Ang. a Perihelio. | Logar. pro dist. a Sole. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | gr. ′ ″ | | 0 | gr. ′ ″ | | 0 | gr. ′ ″ | | 0 | gr. ′ ″ | |
| 1 | 1.31.40 | 0.000077 | 31 | 42.55.06 | 0.062400 | 61 | 69.55.58 | 0.172914 | 91 | 86.20.34 | 0.274 76 |
| 2 | 3. 3.15 | 0.000309 | 32 | 44. 3.20 | 0.065838 | 62 | 70.36.56 | 0.176557 | 92 | 86.46.20 | 0.277239 |
| 3 | 4.34.43 | 0.000694 | 33 | 45.10.29 | 0.069319 | 63 | 71.17.16 | 0.180188 | 93 | 87.11.43 | 0.280287 |
| 4 | 6. 6. 0 | 0.001231 | 34 | 46.16.35 | 0.072839 | 64 | 71.56.56 | 0.183803 | 94 | 87.36.45 | 0.283306 |
| 5 | 7.37. 1 | 0.001921 | 35 | 47.21.36 | 0.076396 | 65 | 72.35.57 | 0.187404 | 95 | 88.01.27 | 0.286308 |
| 6 | 9. 7.43 | 0.002759 | 36 | 48.25.33 | 0.079984 | 66 | 73.14.15 | 0.190978 | 96 | 88.25.49 | 0.289293 |
| 7 | 10.38. 2 | 0.003745 | 37 | 49.28.27 | 0.083600 | 67 | 73.51.59 | 0.194540 | 67 | 88.49.48 | 6.292252 |
| 8 | 12. 7.54 | 0.004876 | 38 | 50.30.19 | 0.087244 | 68 | 74.29. 6 | 0.198085 | 98 | 89.13.32 | 0.295201 |
| 9 | 13.37.17 | 0.006151 | 39 | 51.31. 8 | 0.090910 | 69 | 75. 5.38 | 0.201614 | 99 | 89.36.54 | 0.298122 |
| 10 | 15. 6. 7 | 0.007564 | 40 | 52.30.56 | 0.094596 | 70 | 75.41.35 | 0.205122 | 100 | 90.00.00 | 0.301030 |
| 11 | 16.34.20 | 0.009115 | 41 | 53.29.44 | 0.098300 | 71 | 76.16.56 | 0.208612 | 102 | 90.45.14 | 0.306782 |
| 12 | 18. 1.54 | 0.010798 | 42 | 54.27.32 | 0.102019 | 72 | 76.51.43 | 0.212080 | 104 | 91.29.18 | 0.307469 |
| 13 | 19.28.47 | 0.012609 | 43 | 55.24.21 | 0.105742 | 73 | 77.25.57 | 0.215529 | 106 | 92.12.14 | 0.318060 |
| 14 | 20.54.54 | 0.014550 | 44 | 56.20.12 | 0.109490 | 74 | 77.59.41 | 0.218963 | 108 | 92.54. 4 | 6.323587 |
| 15 | 22.20.14 | 0.016607 | 45 | 57.15. 6 | 0.113240 | 75 | 78.32.54 | 0.222378 | 110 | 93.34.52 | 0.329042 |
| 16 | 23.44.44 | 0.018783 | 46 | 58. 9. 0 | 0.116995 | 76 | 79. 5.35 | 0.225769 | 112 | 94.14.40 | 0.334424 |
| 17 | 25. 8.22 | 0.021072 | 47 | 59. 2. 4 | 0.120756 | 77 | 79.37.45 | 0.229142 | 114 | 94.53.30 | 0.339736 |
| 18 | 26.31. 8 | 0.023470 | 48 | 59.54.11 | 0.124518 | 78 | 80. 9.23 | 0.232488 | 116 | 95.31.22 | 0.344979 |
| 19 | 27.52.55 | 0.025969 | 49 | 60.45.25 | 0.128278 | 79 | 80.40.34 | 0.235809 | 118 | 96. 8.22 | 0.350153 |
| 20 | 29.13.47 | 0.028570 | 50 | 61.35.45 | 0.132035 | 80 | 81.11.16 | 0.239127 | 120 | 96.44.30 | 0.355262 |
| 21 | 30.33.40 | 0.031263 | 51 | 62.25.14 | 0.135792 | 81 | 81.41.34 | 0.242416 | 122 | 97.19.48 | 0.360306 |
| 22 | 31.52.32 | 0.034045 | 52 | 63.13.52 | 0.139544 | 82 | 82.11.19 | 0.245684 | 124 | 97.54.17 | 0.365284 |
| 23 | 33.10.23 | 0.036916 | 53 | 64. 1.40 | 0.143291 | 83 | 82.40.40 | 0.248933 | 126 | 98.28.00 | 0.370200 |
| 24 | 34.27.12 | 0.039864 | 54 | 64.48.38 | 0.147029 | 84 | 83. 9.34 | 0.252159 | 128 | 99.00.37 | 0.375052 |
| 25 | 35.42.59 | 0.042892 | 55 | 65.34.50 | 0.150762 | 85 | 83.38. 4 | 0.255366 | 130 | 99.33.11 | 0.379842 |
| 26 | 36.57.41 | 0.045982 | 56 | 66.20.13 | 0.154482 | 86 | 84. 6. 8 | 0.258552 | 132 | 100. 4.43 | 0.384576 |
| 27 | 38.11.20 | 0.049154 | 57 | 67.04.50 | 0.158192 | 87 | 84.33.49 | 0.261720 | 134 | 100.35.45 | 0.389252 |
| 28 | 39.23.54 | 0.052382 | 58 | 67.48.42 | 0.161890 | 88 | 85. 1. 5 | 0.264865 | 136 | 101. 5.48 | 0.393868 |
| 29 | 40.35.23 | 0.055668 | 59 | 68.31.50 | 0.165578 | 89 | 85.27.58 | 0.267989 | 138 | 101.35.22 | 0.398428 |
| 30 | 41.45.47 | 0.059009 | 60 | 69.14.16 | 0.169254 | 90 | 85.54.27 | 0.271092 | 140 | 102. 4.19 | 0.402930 |

| Med mot. | Ang. a Perihelio. | Logar. pro. dist. a Sole. | Mea mot. | Ang. a Perihelio. | Logar. pro dist. a Sole. | Mea mot. | Ang. a Perihelio. | Logar. pro dist. a Sole | Med. mot. | Ang. a Perihelio. | Logar. p. o dist. a Sole. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | gr. ′ ″ | | 0 | gr. ′ ″ | | 0 | gr. ′ ″ | | 0 | gr. ′ ″ | |
| 142 | 102.32.41 | 0.407380 | 204 | 113.37.25 | 0.523406 | 360 | 117.28. 6 | 0.708104 | 820 | 141.49.24 | 0.970837 |
| 144 | 103.00.31 | 0.411784 | 208 | 114. 9.52 | 0.529705 | 370 | 128. 2.33 | 0.716976 | 840 | 142.10.00 | 0.978397 |
| 146 | 103.27.47 | 0.416132 | 212 | 114 41.25 | 0.535886 | 380 | 128.35.38 | 0.725606 | 860 | 142.29.56 | 0.985771 |
| 148 | 103.54.31 | 0.420430 | 216 | 115.12.02 | 0.541958 | 390 | 129. 7.27 | 0.734006 | 880 | 142.49.10 | 0.992970 |
| 15 | 104.20.43 | 0. 24676 | 220 | 115.41.51 | 0.547922 | 400 | 129.38. 4 | 0.742186 | 900 | 143. 7.48 | 0.100000 |
| 152 | 104.46.22 | 0.428866 | 224 | 116.10.52 | 0.553782 | 410 | 130. 7.34 | 0.750160 | 920 | 143.25.51 | 1.006871 |
| 154 | 105.11.33 | 0.433012 | 228 | 116.39. 7 | 0.559538 | 420 | 130.36. 2 | 0.757930 | 940 | 143.43.21 | 1.013586 |
| 156 | 105.36.16 | 0.437110 | 232 | 117. 6.38 | 0.565199 | 430 | 131. 3.30 | 0.765516 | 960 | 144.00.18 | 1.020155 |
| 158 | 106.00.32 | 0.441164 | 336 | 117.33.27 | 0.570762 | 440 | 131.30. 2 | 0.772918 | 980 | 144.16.46 | 1.026583 |
| 160 | 106.24.23 | 0.445178 | 240 | 117.59.35 | 0.576233 | 450 | 131.55.41 | 0.780148 | 1000 | 144.32.46 | 1.032876 |
| 162 | 106.47.47 | 0.449144 | 244 | 118.25. 5 | 0.581616 | 460 | 132.20.30 | 0.787216 | 1500 | 149.26. 8 | 1.158188 |
| 164 | 107.10.44 | 0.453060 | 248 | 118.49.57 | 0.586912 | 470 | 132.44.32 | 0.794122 | 2000 | 152.26.15 | 1.246058 |
| 166 | 107.33.17 | 0.456936 | 252 | 119.14.14 | 0.592122 | 480 | 133.37.50 | 0.800882 | 2500 | 154.32.20 | 1.313703 |
| 168 | 107.55.27 | 0.460772 | 256 | 119.37.56 | 0.597252 | 490 | 133. 0.25 | 0.807494 | 3000 | 156. 7.27 | 1.368678 |
| 170 | 108.17.14 | 0.464208 | 260 | 120. 1. 6 | 0.602301 | 500 | 133.52.20 | 0.813969 | 3500 | 157.22.49 | 1.414974 |
| 172 | 108.38.37 | 0.468318 | 264 | 120.23.44 | 0.607274 | 520 | 134.34.18 | 0.826522 | 4000 | 158.24.36 | 1.454950 |
| 174 | 108.59.39 | 0.472030 | 268 | 120.45.52 | 0.612174 | 540 | 135.14. 0 | 0.838600 | 4500 | 159.16.36 | 1.490125 |
| 176 | 109.20.20 | 0.475705 | 272 | 121. 7.30 | 0.616998 | 560 | 135.51.28 | 0.850187 | 5000 | 160. 1.12 | 1.521521 |
| 178 | 109.40.40 | 0.479340 | 276 | 121.28.39 | 0.621750 | 580 | 136.27. 6 | 0.861369 | 5500 | 160.40. 5 | 1.549864 |
| 180 | 110.00.40 | 0.482937 | 280 | 121.49.22 | 0.626438 | 600 | 137. 0.57 | 0.872155 | 6000 | 161.14.24 | 1.575718 |
| 182 | 110.20.20 | 0.486498 | 284 | 122. 9.38 | 0.631056 | 620 | 137.33.13 | 0.882575 | 6500 | 161.45.00 | 1.599460 |
| 184 | 110.39.41 | 0.490022 | 288 | 122.29.28 | 0.635608 | 640 | 138. 3.58 | 0.892649 | 7000 | 162.12.34 | 1.621417 |
| 186 | 110.58.44 | 0.493512 | 292 | 122.48.54 | 0.640098 | 660 | 138.33.21 | 0.902401 | 7500 | 162.37.34 | 1.641838 |
| 188 | 111.17.28 | 0.496965 | 296 | 123. 7.57 | 0.644525 | 680 | 139. 1.29 | 0.911866 | 8000 | 163.00.23 | 1.660922 |
| 190 | 111.35.55 | 0.500484 | 300 | 123.26.36 | 0.648393 | 700 | 120.28.25 | 0.927012 | 8500 | 163.21.20 | 1.678834 |
| 192 | 111.54.05 | 0.503769 | 310 | 124.11.40 | 0.659559 | 720 | 139.54.16 | 0.929907 | 9000 | 163.40.42 | 1.695708 |
| 194 | 112.11.58 | 0.507121 | 320 | 124.54.36 | 0.669880 | 740 | 140.19. 5 | 0.938549 | 9500 | 163.58.38 | 1.711662 |
| 196 | 112.29.34 | 0.510441 | 330 | 125.35.34 | 0.679876 | 760 | 140.42.56 | 0.946951 | 10000 | 164.15.20 | 1.726784 |
| 198 | 112.46.55 | 0.513729 | 340 | 126.14.44 | 0.689578 | 780 | 141. 5.55 | 0.955124 | 50000 | 170.52. 0 | 2.197960 |
| 200 | 113. 4.00 | 0.516984 | 350 | 126.52.12 | 0.698970 | 800 | 141.28. 3 | 0.963082 | 100000 | 172.45.44 | 2.399655 |

*The Conſtruction and Uſe of the General Table.*

As the Planets move in *Elliptical* Orbs, ſo do the Comets in *Parabolick* ones, having the Sun in their common *Focus*, and deſcribe equal *Area's* in equal *Times*. But now becauſe all *Parabola's* are *ſimilar* to one another, therefore if any determinate Part of the *Area* of a given *Parabola* be divided into any Number of Parts at Liberty, there will be a *like* Diviſion made in all *Parabola's*, under the ſame Angles, and the Diſtances will be proportional: And conſequently this one Table of ours will ſerve for all Comets. Now, the manner of the Calculation of this Table is thus: In the *Fig.* let *S* be the *Sun*, *P O C* the Orbit of a Comet, *P* the *Perihelion*, *O* the Place where the Comet is 90 *gr.* diſtant from the Sun, *C* any other Place. Draw the Right Lines *C P*, *C S*, and make *S T*, *S R* equal to *C S*; and then having drawn the Right Lines *C R*, *C T*, (whereof the one is a Tangent, and the other a Perpendicular to the Curve) let fall *C Q* perpendicular to the *Axis P S R*.

Now, any *Area*, as *C O P S*, being given, 'tis requir'd to find the Angle *C S P*, and the Diſtance *C S*. From the Nature of the *Parabola R Q* is ever $= \frac{1}{2}$ the Parameter of the *Axis*, and conſequently if the Parameter be put $= 2$, then *R Q* $= 1$. Let *C Q* $= z$; then *P Q* ſhall $= \frac{1}{2} z z$, and the Parabolick Segment *C O P* $= \frac{1}{12} z z z$. But the Triangle *C S P* will $= \frac{1}{4} z$, and ſo the Mixtilineal *Area C O P S* $= \frac{1}{12} z^3 + \frac{1}{4} z = a$, whence $z^3 + 3 z = 12 a$. Wherefore reſolving this Cubical Equation, $z$ or the Ordinate *C Q* will be known. Now, let the *Area O P S* be propos'd to be divided into 100 Parts; this *Area* is $\frac{1}{12}$ of




the Square of the Parameter, and conſequently 12 *a* is $=$ that Square $= 4$. If therefore the Roots of theſe Equations $z^3 + 3 z = 0,04 : 0,08 : 0,12 : 0,16$, *&c.* be ſucceſſively extracted, there will be obtain'd ſo many $z$ or Ordinates *C Q* reſpectively, and the *Area S O P* will be divided into 100 Parts. And in like manner is the *Calculus*

to be continued beyond the Place *O*. Now the Root of this Equation (ſince *R Q* is equal 1) is the Tabular Tangent of the Angle *C R Q*, or ½ the Angle *C S P*, and ſo the Angle *C S P* is given. And *R C*, the Secant of the ſame Angle *C R Q*, is a mean Proportional between *R Q* or Unity; and *R T*, which is the double of *S C*, as is plain from the *Conicks*. But if *S P* be put = 1, and ſo the *Latus Rectum* = 4, (as in our Table) then *R T* will be the Diſtance ſought, *viz.* the double of *S C* in the former *Parabola*. After this manner therefore I compos'd the foregoing Table, which ſerves to repreſent the Motions of all Comets: For hitherto there has been none obſerv'd, but comes within the Laws of the *Parabola*.

It remains now, that we give the Rules for the Calculation, and ſhew the way of determining the Place of a Comet ſeen, by thoſe Numbers. *The Velocity of a Comet moving in a* Parabola, *is every where to the Velocity of a Planet deſcribing a Circle about the Sun, at the ſame Diſtance from the Sun*, as √ 2 to 1, as appears from *Cor.* 7. *Prop.* 16. *Lib.* 1. of the *Princip. Phil. Nat. Math.* If therefore a Comet in its *Perihelium* were ſuppos'd to be as far diſtant from the Sun as the Earth is, then the Diurnal *Area* which the Comet wou'd deſcribe, would be to the Diurnal *Area* of the Earth, as √ 2 to 1. And conſequently, the Time of the Annual Revolution, is to the Time in which ſuch a Comet wou'd deſcribe a Quadrant of its Orbit from the *Perihelium*, as 3 14159, &c. (that is, the *Area* of the Circle) to √$\frac{8}{3}$. Therefore the Comet would deſcribe that Quadrant in 109 Days, 14 Hours, 46 Minutes, and ſo that Parabolick *Area* (analogous to the *Area P O S*) being divided into 100 Parts, to each Day there would be allotted 0.912280 of thoſe Parts; the Log. of which, *viz.* 9.960128, is to be kept for continual Uſe. *But then the Times in which a Comet, at a greater or leſs Diſtance, would* deſcribe ſimilar Quadrants, *are as the Times of the Revolutions in Circles*, that is, in the *Sſquiplicate Ratio* of the Diſtances: And ſo the *Diurnal Area's*, eſtimated in *Centeſimal* Parts of the Quadrant (which Parts we put for Meaſures of the mean Motion, like Degrees) are in each in the *Subſeſquialteral* Proportion *of the Diſtance from the Sun in the* Perihelion.

Theſe neceſſary things premis'd, let it be propos'd to compute the *apparent Place* of any one of the mention'd Comets for any *given Time*. Therefore,

1. *Let the Sun's Place be had, and the Log. of its Diſtance from the Earth.*

2. *Let the Difference between the Time of the* Perihelion, *and the Time given, be gotten in Days and Decimal Parts of Days. To the Log. of this Number let there be added the conſtant Log.* 9.960128, *and the Complement Arithmetical of the* $\frac{3}{2}$ *of the Log. of the Diſtance in the* Perihelium *from the Sun: The Sum will be the Log. of the mean Motion, to be ſought in the firſt Column of the General Table.*

3. *With the mean Motion let there be taken the correſpondent Angle from the* Perihelium, *in the Table, and the Log. for the Diſtance from the Sun: Then in Comets that are direct, add, and in retrograde ones, ſubſtract, if the Time be after the* Perihelium, *the Angle thus found, to or from the Place of the* Perihelium; *or in direct Comets ſubſtract, and in retrograde ones add, if the Time be before the* Perihelium, *the foreſaid Angle to or from the Place of the* Perihelium; *and ſo we ſhall have the Place of the Comets in its Orbit. And to the Log. found for the Diſtance, let there be added the Log. of the Diſtance in the* Perihelium, *and the Sum will be the Log. of the true Diſtance of the Comet from the Sun.*

4. *The Place of the Node, together with the Place of the Comet in its Orbit, being given, let the Diſtance of the Comet from the Node be found; then the Inclination of the Plane being given, there will be given alſo (from the common Rules of Trigonometry) the Comet's Place reduced to the Ecliptick, the Inclination or Heliocentrick Latitude, and the Log. of the* curtate *Diſtance.*

5. *From theſe things given (by the very ſame Rules that we find the Planet's Place from the Sun's Place and Diſtance given) we may obtain the* Apparent *or* Geocentrick *Place of the Comet, together with the Apparent Latitude.* And this it may be worth while to illuſtrate by an Example or two.

*Example* I.

*Let it be required to find the Place of the Comet of the Year* 166$\frac{4}{5}$, March *the* 1d, 7h, 00′, *P. M.* London. *That is*, 96d, 19h, 8′, *after the* Perihelium, *which happened* Novemb. 2$\frac{0}{+}$, 11h, 52′.

| | |
|---|---|
| Log. Diſt. Perihel. | 0.011044 |
| Log. Seſquialt. | 0.016566 |
| Comp. Arith. | 9.983434 |
| | 9.960128 |
| Log. Temp. | 1.985862 |
| Log. Med. Mot. | 1.929424 |
| Medius Motus | 85.001 |
| Perihel. ☊ | 10.41.25 |
| Ang. Correſp. | 83.38.05— |
| Comet. in Orb. ♉ | 17. 3.20 |
| Aſcend. Nod. ♊ | 21.14.00 |
| Com. a Nodo | 34.10.40 |
| Red. ad Eclip. | 32.19.05 |
| Com. Helioc. ♉ | 18.54.55 |
| Incl. Bor. | 11.46.50 |
| Log. pro diſt. | 0.255369 |
| Log Perihel. | 0.011044 |
| Co-ſin. Incl. | 9.990754 |
| Log. diſt. Curt. | 0.257167 |
| Log. diſt. ☉ | 9.997918 |
| ☉ ♓ | 21.44.45 |
| Com. Viſus ♈ | 29.18.30 |
| Lat. Viſa | 8.36.15 |

*Example* II.

*Let it be required to find the Place of the Comet of the Year* 1683, July 23$^{o}$, 13h, 35′, *P. M.* London: *Or* 13h, 40′, *Equat. Time. That is*, 21d, 10h, 50′ *after the* Perihelium.



Log.

| | |
|---|---|
| Log. dist. Perihel. | 9.748343 |
| Log. Sesquialt. | 2.622514 |
| Comp. Arith. | 0.377486 |
| | 9.960128 |
| Log. Temp. | 1.310723 |
| Log. Med. Mot. | 1.648337 |
| Medius Motus | 44.498 |
| Perihel. ♊ | 25.29.30 |
| Ang. Corresp. | 23.23.20 |
| Comet. in Orb. ♈ | 28.42.10 |
| Nod. Descend. ♓ | 23.23.00 |
| Com. a Nodo | 35.19.10 |
| Red. ad Eclip. | 4.48.30 |
| Com. Helioc. ♓ | 28.11.30 |
| Incl. Bor. | 35. 2.00 |
| Log. pro dist. | 0.111336 |
| Log. Perihel. | 9.748343 |
| Co-sin. Incl. | 9.913187 |
| Log. dist. Curt. | 9.772866 |
| Log. dist. ☉ | 0.006104 |
| ☉ Locus ♌ | 10.41.25 |
| Com. Visus ♋ | 5.11.50 |
| Lat. Bor. | 28.52.00 |

At the Instant of Time specified in the first Example, 'twas observed (at *London*) that the Comet applied to the second Star of *Aries*; so that it was found to be 9′ more Northerly, and 3′ to the *East*, according to Mr. *Hook*'s Observation. But at that of the Second Example, I my self (near *London*, with the same Instruments whereby I formerly observed the *Southern* Constellations) found the Place of the Comet to be ♋, 5°. 11½′. and 28°. 52′. *North* Latitude, which agreed exactly with the Observation made at *Greenwich* almost the very same Moment.

As for the Comet of the Year 1680, which came almost to the very *Sun* it self (being in its *Perihelion*, not above ¼ of the Semidiameter of the Sun distant from the Surface of it) since the *Latus Rectum* is so very small, could hardly be contained within the Limits of the General Table, because of the excessive Velocity of the *Mean Motion*. Therefore in this Comet the best way is (after the *mean Motion* is found) to get from thence (by the Help of the foregoing Equation $z^3 + 3z = \frac{4}{1000}$ of the *mean Motion*) the Tangent of half the Angle from the Perihelion, together with the Log. for the Distance from the Sun. Which things being given, we are to proceed by the same Rules as in the rest.

After this manner therefore the Astronomical Reader may examine these Numbers, which I have calculated with all imaginable Care from the Observations I have met with. And I have not thought fit to make them publick before they have been duly examin'd, and made as accurate as 'twas possible, by the Study of many Years. I have published this Specimen of Cometical Astronomy, as a *Prodromus* of a designed future Work; lest happening to die, these Papers might be lost, which every Man is not capable to retrieve, by reason of the great Difficulty of the Calculation.

Now it may not be amiss to put the Reader in mind, That our Five first Comets (the Third and Fourth observed by *Peter Apian*, the Fifth by *Paulus Fabricius*) as also the Tenth seen by *Mæstl.us*, if I mistake not, in the Year 1586, are not so certain as the rest; for the Observations were made neither with fit Instruments, nor due Care, and upon that Account are disagreeing with themselves, and can by no means be reconcil'd with a regular Computation. The Comet which appear'd in the Year 1684, was only taken notice of by *Blanchinus*, who observed at *Rome*: And the last, which appear'd in the Year 1698, was seen only by those at *Paris*, who determined its Course in a very uncommon way. This Comet was very obscure; and although it moved swift, and came near enough our Earth, yet we, who were wont to be curious enough in these Matters, saw nothing of it. For want of Observations, I have left out of the foregoing Catalogue, those two remarkable Comets which have appear'd in this our Age, one in *November*, in the Year 1689. the other in *February*, in the Year 1702. For they directing their Courses towards the *Southern* Parts of the World, and being scarce conspicuous here in *Europe*, met with no Observers capable of the Business. But if any one shall bring from *India*, or the *Southern* Parts, an accurate Series of requisite Observations, I will willingly fall to work again, and undergo the Fatigue of representing their Orbits in Numbers, as I have done the rest.

By comparing together the Accounts of the Motions of these Comets, 'tis apparent their Orbits are disposed in no manner of Order; nor can they, as the Planets are, be moved indifferently every way, as well retrograde as direct: From whence it is clear, they are not carried about or moved in *Vortices*. Moreover, the Distances in their *Perihelium* are sometimes greater, sometimes less; which makes me suspect there may be a far greater Number of them, which moving in Regions more remote from the Sun, become very obscure; and wanting Tails, pass by us unseen.

Hitherto I have considered the Orbits of Comets as exactly *Parabolick*; upon which Supposition it would follow, that Comets being impell'd towards the Sun by a Centripetal Force, descend as from Spaces infinitely distant, and by their Falls acquire such a Velocity, as that they may again run off into the remotest Parts of the Universe, moving upwards with such a perpetual Tendency, as never to return again to the Sun. But since they appear frequently enough, and since none of them can be found to move with an Hyperbolick Motion, or a Motion swifter than what the Comet might acquire by its Gravity to the Sun, 'tis highly probable they rather move in very Excentrick Orbits, and make their Returns after long Periods of Time: For so their Number will be determinate, and perhaps not so very great. Besides, the Space between the Sun and the fix'd Stars is so immense, that there is room enough for a Comet to revolve, though the Period of its Revolution be vastly long. Now the *Latus Rectum* of an *Ellipsis*, is to the *Latus Rectum* of a *Parabola*, which has the same Distance in its *Perihelium*, as the Distance in the *Aphelium* in the *Ellipsis*, is to the whole *Axis* of the *Ellipsis*; and the Velocities are in a subduplicate *Ratio* of the same: Wherefore in every Excentrick Orbit, this *Ratio* comes very near to a *Ratio* of Equality; and the very small Difference which happens on account of the greater Velocity in the *Parabola*

*rabola*, is eaſily compenſated in determining the Situation of the Orbit. The principal Uſe therefore of this Table of the Elements of their Motions, and that which induced me to conſtruct it, is, That whenever a new Comet ſhall appear, we may be able to know, by comparing together the Elements, whether it be any of thoſe which has appeared before, and conſequently to determine its Period and the *Axis* of its Orbit, and to foretell its Return. And indeed there are many Things which *Apian* obſerved in the Year 1531. was the ſame with that which *Kepler* and *Longomontanus* took Notice of and deſcribed in the Year 1607. and which I my ſelf have ſeen return, and obſerved in the Year 1682. All the Elements agree, and nothing ſeems to contradict this my Opinion, beſides the Inequality of the Periodick Revolutions: Which Inequality is not ſo great neither, as that it may not be owing to Phyſical Cauſes: For the Motion of *Saturn* is ſo diſturbed by the reſt of the Planets, eſpecially *Jupiter*, that the Periodick Time of that Planet is uncertain for ſome whole Days together. How much more therefore will a Comet be ſubject to ſuch like Errors, which riſes almoſt four times higher than *Saturn*, and whoſe Velocity, though increaſed but a very little, would be ſufficient to change its Orbit from an Elliptical to a Parabolical one. This, moreover, confirms me in my Opinion of its being the ſame; that in the Year 1456. in the Summer Time, a Comet was ſeen paſſing retrograde between the Earth and the Sun, much after the ſame manner: Which, though no Body made Obſervations upon it, yet from its Period, and the Manner of its Tranſit, I cannot think different from thoſe I have juſt now mention'd. Hence I dare venture to foretel, That it will return again in the Year 1758. And, if it ſhould then return, we ſhall have no Reaſon to doubt but the reſt muſt return too: Therefore Aſtronomers have a large Field to exerciſe themſelves in for many Ages, before they will be able to know the Number of theſe many and great Bodies revolving about the common Center of the Sun; and reduce their Motions to certain Rules. I thought indeed that the Comet which appear'd in the Year 1532. might be the ſame with that obſerv'd by *Hevelius* in the Year 1661. But *Apian's* Obſervations, which are the only ones we have concerning the firſt of theſe Comets, are too rude and unſkilfull for any thing of Certainty to be drawn from them in ſo nice a Matter. I deſign to treat of all theſe things in a larger Volume, and contribute my utmoſt for the Promotion of this Part of Aſtronomy, if it ſhall pleaſe God to continue my Life and Health.

In the mean time, thoſe that deſire to know how to conſtruct Geometrically the Orb of a Comet by three accurate Obſervations given, may find it at the End of the Third Book of Sir *Iſacc Newton's* Principles of Natural Philoſophy, entituled *De Syſtemate Mundi*, in the Words of its Renowned Inventor. Which have ſince been more fully explained by my very worthy Collegue Dr. *Gregory*, in his Learned Work of *Aſtronomia Phyſica & Geometrica*.

One thing more perhaps it may not be improper or unpleaſant to adverti ſe the Aſtronomical Reader, That ſome of theſe Comets have their Nodes ſo very near the Annual Orb of the Earth, that if it ſhall ſo happen, that the Earth be found in the Parts of her Orb next the Node of a Comet, whilſt the Comet paſſes by; as the apparent Motion of the Comet will be incredibly ſwift, ſo its *Parallax* will become very ſenſible; and the Proportion thereof to that of the Sun will be given. Wherefore ſuch Tranſits of Comets do afford us the very beſt Means, though they ſeldom happen to determine the Diſtance of the Sun and Earth: Which hitherto has only been attempted by *Mars* in his Oppoſition to the Sun, or elſe *Venus* in *Perigæo*; whoſe Parallaxes, though triple to that of the Sun, are ſcarce any ways to be perceived by our Inſtruments; whence we are ſtill in great Uncertainty in that Affair. This Uſe of Comets was the ingenious Thought of that Excellent Geometrician Mr. *Nicolas Facio*. Now the Comet of 1472. had a Parallax above twenty times greater than the Sun's. And if the Comet of 1618. had come down, about the Middle of *March*, to his deſcending Node; or if that of 1618. had arrived a little ſooner at its aſcending Node, they would have been yet much nearer the Earth, and conſequently have had more notable Parallaxes. But hitherto none has threaten'd the Earth with a nearer Appulſe than that of 1680. For by Calculation I find, that *Novemb.* 11°. 1 h. 6'. *P. M.* that Comet was not above the Semidiameter of the Sun to the Northwards of the Way of the Earth. At which Time, had the Earth been there, the Comet would have had a Parallax equal to that of the Moon, as I take it. This is ſpoken to Aſtronomers: But what might be the Conſequences of ſo near an Appulſe, or of a Contact; or laſtly, of a Shock of the Celeſtial Bodies (which is by no means impoſſible to come to paſs) I leave to be diſcuſs'd by the Studious of Phyſical Matters.

COMMENDAM. Before the Reformation, it was common for the Ordinary to grant a Sequeſtration of a Living (eſpecially if in his own Gift, or lapſed to him) for ſix Months Time: And ſuch a Sequeſtration was called *Commenda-Semeſtris*. And this was the only *Commendam* that the Canon Law approved of: tho' *Commendams* for a longer Time, and even for Life, were all along uſed. A Biſhop, *now*, is only capable of holding a Benefice, or other inferior Dignity, by this Title of *Commendam*; which he doth by Licenſe from the Archbiſhop of *Canterbury*, or from the King in *Chancery*. But the Biſhop can't hold any Living in *Commendam* without the Patron's Conſent; as *Watſon* ſaith, *c.* 18. *p.* 141. In Caſe of a *Commendam*, no Inſtitution is neceſſary; and a Biſhop may be Licenſed to hold a Living in his own Gift by theſe Words: *Authoritate ſua propria capere, & apprehendere abſquere Inſtitutione, Inductione, Collatione*, &c.

COMMISURA *Craſſioris Nervi æmula*, is a Medullary Proceſs in the Brain, connecting together the *Corpora Striata*, or the Tips of the *Crura Medullæ oblongatæ*.

COMMUNICATION. Lines of Communication in the Art of Fortification, are Trenches made to continue and preſerve a ſafe Correſpondence between two *Forts* or *Poſts*; or at a Siege, between two *Approaches*, that they may relieve one another on Occaſion.

COMPARTITION, in Architecture, is the uſeful and graceful Diſtribution of the whole Ground-plot of an Edifice, into Rooms of Office, of Reception, or Entertainment.

COMPARTMENT, in Architecture, is a particular Square, or other figured Space (for an Inſcription, &c.) mark'd out in ſome ornamental Part of a Building.

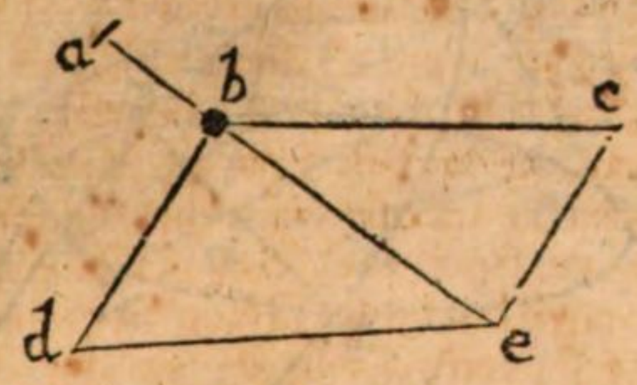
COMPASS: The *Latin* and *Greek* Names uſed for the *Points of the Compaſs*, are as follows:

NORTH. Septentrio.
N. b. E Hypaquilo, Hyperboreas.
N. N. E. Aquilo Gallicus.
N.E.b.N. Meſaquilo Meſoboreas.
N. E. Supernas Borrhapeliotes (Vales.)
E. N. E. Cæcias, Carbas.
E. b. N. Meſocæcias.
EAST. Oriens, Subſolanus.
E. b. S. Hypeurus, Hypereurus.
E. S. E. Vulturnus.
S.E.b.E. Meſeurus.
S. E. Euro auſter, vulg. Notapeliotes.
S.E.b.S. Hypophænix, Hypereanotus.
S. S. E. Eurosnotus, *by* Vegetius, Δλιβόνοτος.
S. b. E. Meſophænix, Meſeuronotus.
SOUTH. Auſter.
S. b. W. Meſolibonotus.
S. S. W. Auſtroafricus.
S.W.b.S. Hypolibonotus, Hyperlibonotus.
S. W. Notolibycus, Auſtro-Zephyrus.
S.W.b.W. Meſafricus, Meſolopus.
W.S.W. Africus, Subveſperus.
W.b.S. Hypafricus.
WEST. Favonius, (Veget.) Subveſpertinus Occidens.
WEST. Occidens.
W.b.N. Meſocorus, Meſargeſtes.
W.N.W. Corus, Caurus.
N.W.b.W. Hypocorus, Hyperargeſtes.
N. W. Corus Eteſiæ, Zephyroboreas.
N.W.b.W. Hypocircius, Meſothracias.
N.N.W. Circius.
N.b.W. Meſocircius.

[*Metius* Lib. V. Doctrin. Sp.

COMPERTORIUM, is a Judicial Inqueſt in the Civil Law, made by Delegates, to find out and relate the Truth of a Cauſe.

COMPOSITION *of Motion.* If a Body as *b*, be impelled or drawn by three different Forces, in the three different Directions, *b a*, *b c*, and *b d*, ſo




that it yield to none of them, but continue in *æquilibro:* Then will thoſe three *Powers* or *Forces* be to one another, as three right Lines drawn parallel to thoſe Lines expreſſing the three different Directions, and terminated by their mutual Concourſes. Let *b e* repreſent the Force by which the Body *b* is impelled from *b* to *a*; then will the ſame right Line *b e* repreſent alſo the contrary equal Force, by which it is impelled from *b* to *e*. But by what hath been ſaid before in Compoſition of Motion, the force *b e* is reſolvable into the two Forces acting according to the two Directions, *b d*, and *b c*, to which the other impelling from *b* to *e*, is as *b e* to *b d*, and *b c* or *d e*, reſpectively. So likewiſe two Forces acting without the Directions *b d*, *b c*, and being equipollent to the Force acting without the Direction *b e*, from *b* to *e*; will be to the Force acting according to the Direction *b e* from *b* to *e*, as *b d*, *b c* to *b d*; and therefore the Forces acting in the Directions *b d*, *b c*, and equipollent to the Force acting in the Direction *b e*, are to the Force acting in the Direction, as *b d*, *b c*, or *d e* to *b e*: That is, if a Body be urged by three different equipollent Powers in the Directions, *b a*, *b d*, and *b c*, theſe three Forces ſhall be to one another, as *b e*, *b d*, and *d e*, reſpectively. *Q. E. D.* And this ſingle Propoſition is the Foundation of all the Mechanicks, as hath been often ſhewn by Geometers.

COMPOSITION *of Quantities*, with reſpect to the Doctrine of *Combinations*, in the joining in any Number of Given Quantities, Letters or Figures, one Row with another Row of the ſame, or with two or three, or more other Rows. See *Combination.*

COMPOSITION *in Painting*, comprehends two Parts, *Invention* and *Diſpoſition*; one of which finds out (by the means of Hiſtory) proper Objects for a Picture; and the other places them aright: the juſt Mixture of which two Things, according to a true Oeconomy, is properly *Compoſition.*

CONATUS *Centrifugus:* This is ſometimes called the *Conatus Excuſſorius*, and is always expreſſed by the verſed Sine of the Angle of Circulation, and theſe *Conatus Centrifugi* of Bodies revolving in equal Circles, with an equable Motion, are in a duplicate *Ratio*, or as the Squares of their Velocities. But if the Bodies revolve in unequal Circles, their *Conatus Centrifugi* will be in a *Ratio*, compounded of the *Ratio* of the Squares of the Velocities *directly*, and the Simple *Ratio* of the *Radii* of thoſe Circles *Inverſly.* If the Body deſcribe equal Areas in equal Times (as is the Caſe of the Planets which revolve in Ellipſes round the Sun) then the *Conatus Centrifugi* will be reciprocally as the Cubes of the *Radii.*

CONATUS *Excuſſorius.* See *Conatus Centrifugus.*

CONGENERES *Muſculi*; are ſuch Muſcles in an Animal Body, as ſerve together to produce the ſame Motion; and they are ſo called, becauſe they aſſiſt one another in their *Action.*

CONGRUITY: That there is ſuch a Property as *Congruity* in the Particles of ſeveral Fluids, is plain from theſe and ſuch like Inſtances: Quickſilver will ſtick to Gold, Silver, Tin, Lead, &c. and unite with them; but will roll off from Wood, Stone, Glaſs, &c. and Water that will wet Salt and diſſolve it, will ſlip off from Tallow, &c. without adhering to it; as it will from a duſty Surface, and from the Feathers of Water-Fowls. Two Drops of Water, or of Mercury, will, on Contact, immediately join and coaleſce: But Oil of Tartar poured on Quickſilver, and Spirit of Wine on that Oil, and Oil of Turpentine on that, and Air over all; tho' theſe are ſtopp'd in a Bottle, and ſhaked never ſo long, they will by no means continue mingled, but will ſeparate and keep diſtinct. Whether the Cauſe of this *Incongruity* be not, that the Particles of the Fluids cannot be brought ſo near to one another, as to come within the Sphere of one another's Attraction; and why they cannot be brought to do ſo by ſhaking, are Enquiries worth purſuing. The Ingenious Dr. *Hook* calls *Congruity* both a *Tenacious* and *Attractive Power*, in which he's certainly right; but perhaps what he takes to be the Effects of *Congruity*, is the Cauſe of it.

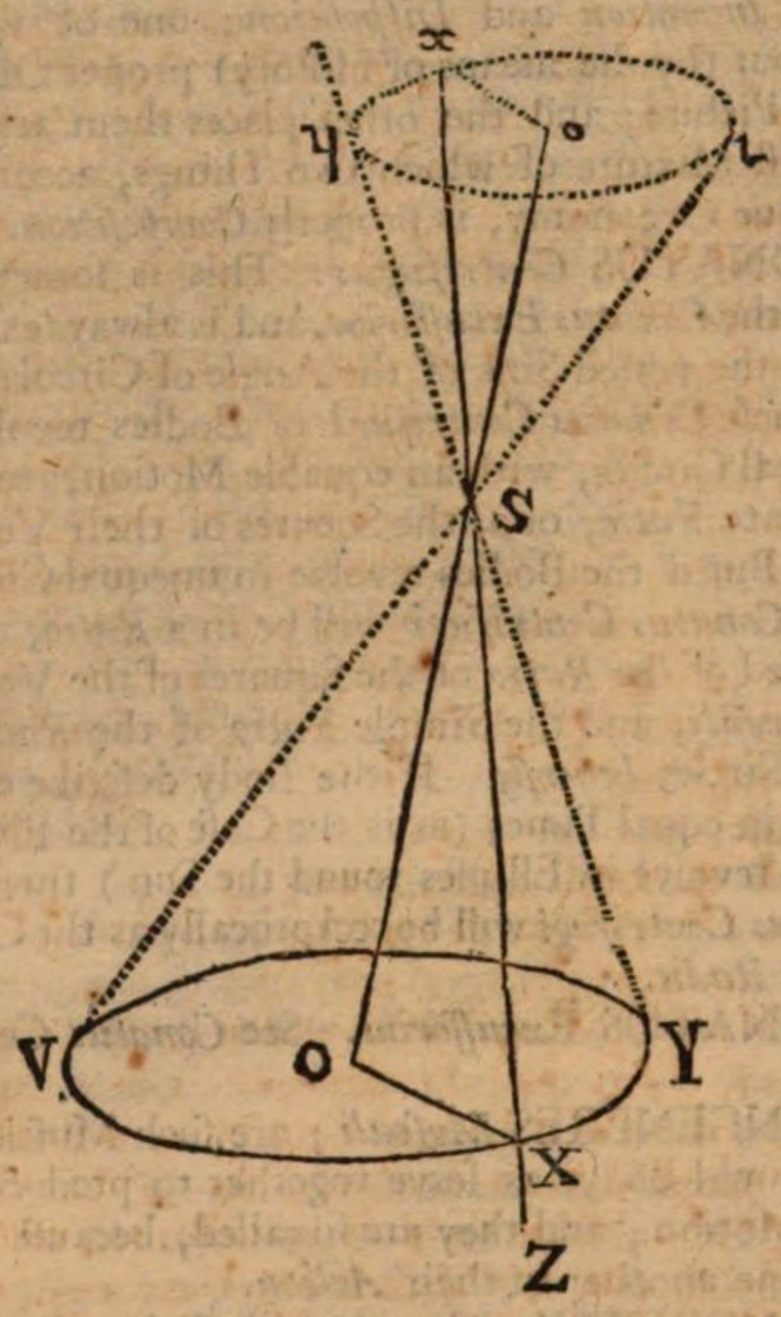
CONICK SECTIONS. I thought fit to give the Reader here a Tranſlation of *L'Hoſpital*'s Sixth Book of Conicks; wherein he will ſee how the Sections and their primary Properties are deduced from the Cone it ſelf, without the tedious Number of Lemmas, which ſome have premiſed about a Line cut Harmonically; whoſe Demonſtrations alone, are

are more than all these Propositions, and not so natural nor easy neither.

## *DEFINITIONS.*

I. If an Infinite right Line, as $x S Z$, having one Part of it, as $S$, fix'd *there* as in an immoveable Point, plac'd above the Plane of the Circle $V X Y$;

*Fig.* 1.




be supposed to move round the Circumference of the said Circle; the Revolution of this Line $x S X Z$, will produce or form what we call a *Conick Surface*; and if the Line be continued each way beyond the immoveable Point $S$, it will generate two *Conick Surfaces*, which are called *Opposite*.

II. The fix'd Point $S$, is called the *Vertex* of *either Surface*.

III. The $\odot V X Y$, is called the Base of the *Cone* $V X Y S$; and the $\odot u x y S$, the Base of the *Opposite Cone*.

IV. For the Solid contain'd under the Base $V X Y$, and that *Conick Surface* which is generated by the Motion of the Line $S X$, is called a *Cone*.

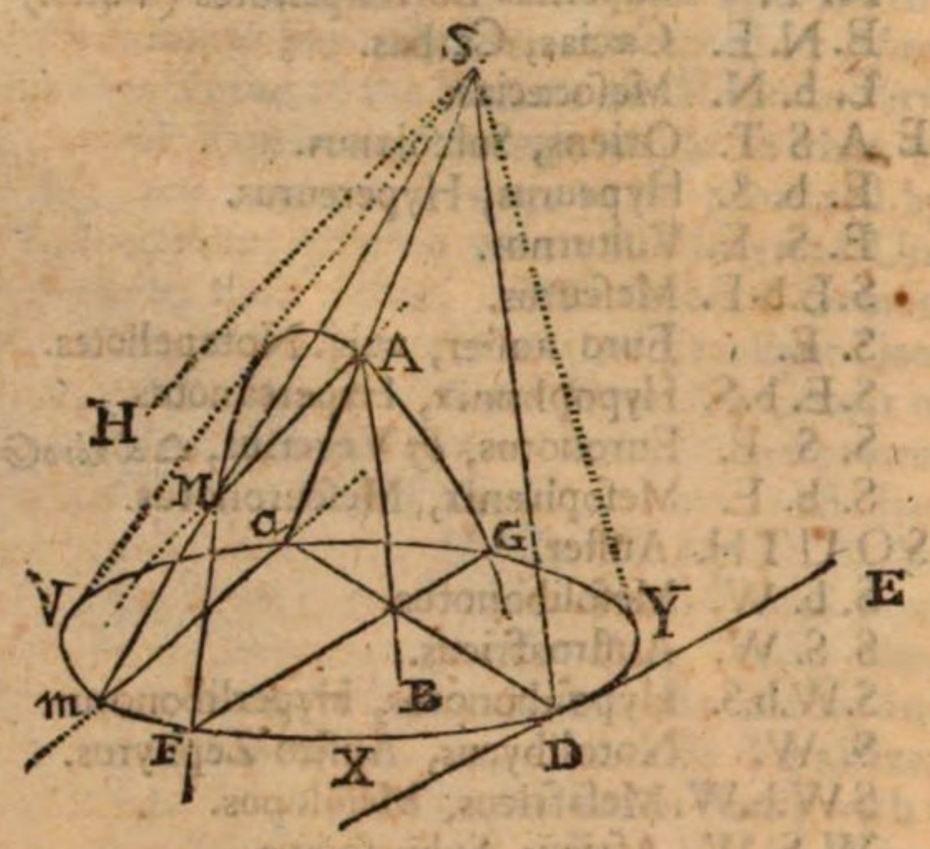
V. The Right Line $S X$, drawn from the *Vertex* to any Point in the Periphery of the Base, is called the *Side* (because 'tis one of the *Sides* of the $\triangle$, which will be formed by cutting the *Cone* thro' the *Vertex*, and by the *Axis*.)

VI. The Line $S O$, drawn from the Centre of the Circle of the Base thro' the *Vertex*, is called the *Axis*.

VII. *A Right Cone*, is that whose *Axis* is Normal to the Plane of its Base; but if it be not so, 'tis called a *Scalene Cone*.

VIII. If a *Conick Surface* be cut by a Plane, which doth not pass thro' its *Vertex*, as $F A G$; and which also is not parallel to the Plane of the Base,

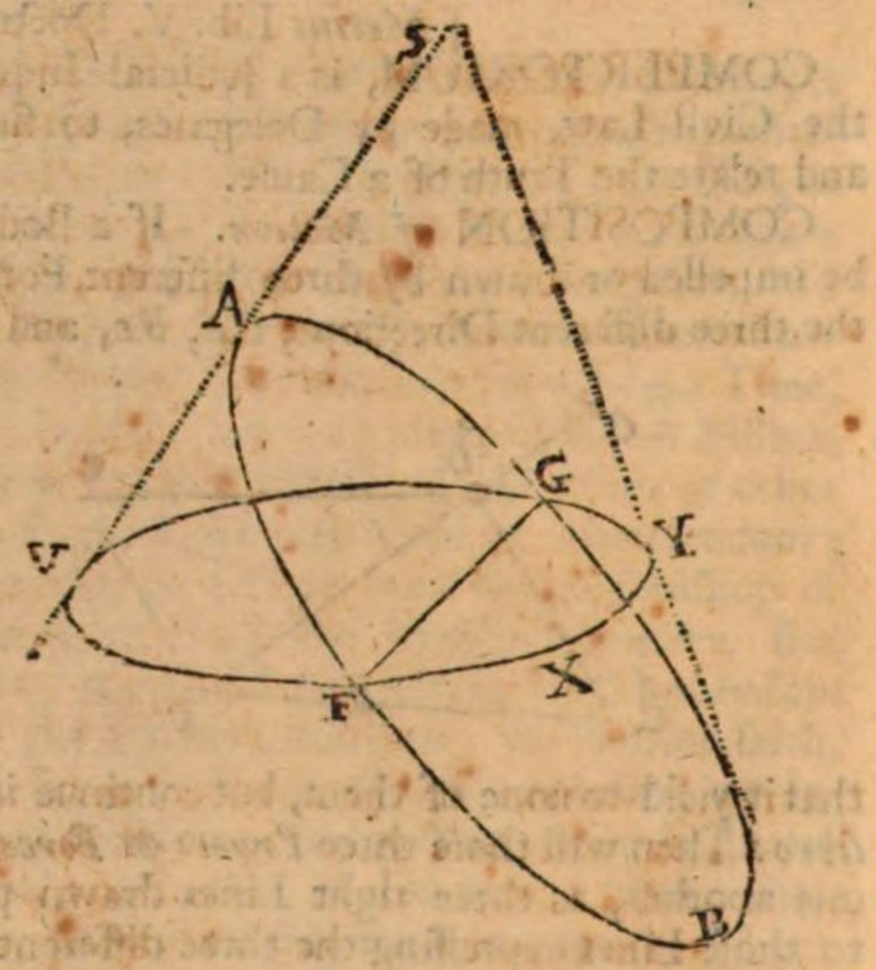
*Fig.* 2.




(for then a Circle will be produced, which though truly a *Conick Section*, is not here consider'd) the Curve Line formed by the Intersection of the Plane $F A G$, with the *Conick Surface*, is called a *Conick Section*.

IX. If thro' the *Vertex* $S$, a Plane be drawn parallel to any *Conick Section*, the Infinite Right

*Fig.* 3.




Line $D E$, which is the common *Section* of that Plane, with the Plane of the Base, is called the *Directrix*.

X. *A Conick Section* $F A G$, is called a *Parabola*, when the *Directrix* $D E$ touches the Circle of the Base of the *Cone* (as in *Fig.* 2.); an *Ellipsis*, when the *Directrix* falls all without the *Cone*; and an *Hyperbola* when the *Directrix* cuts the Circle of Base.

But in this last Case, if the Plane of the *Conick Section* be produced, it must cut the *opposite Conick Surface*; and *there* will form another *Conick Section*, which is called *Opposite*, and both together are called *Opposite Sections*, or *Opposite Hyperbola's*, as $F A G$ and $K N H$, in *Fig.* 4.

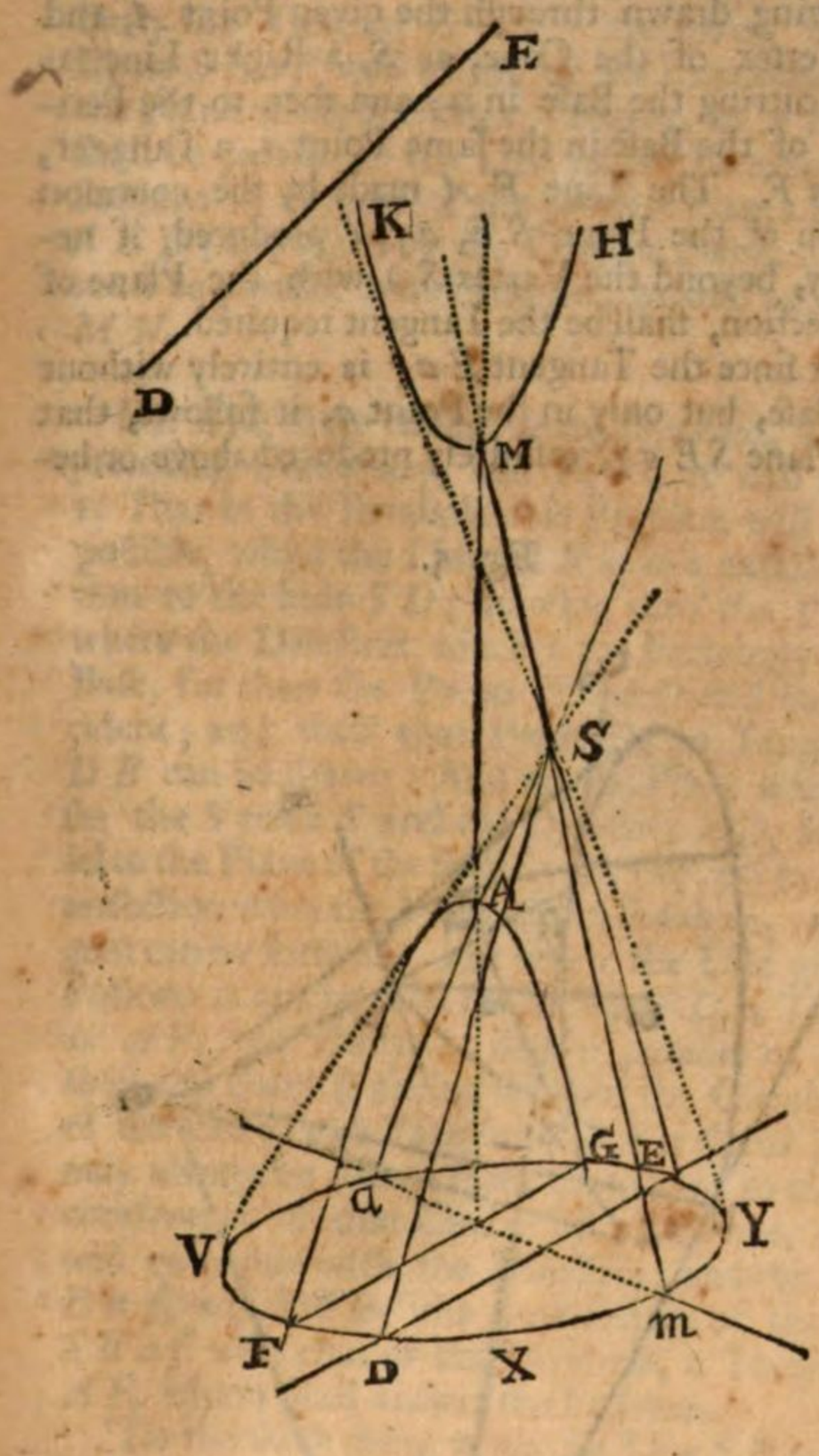
XI. If

XI. If a Line be drawn in the Plane of any *Conick-Sections*, ſo that it meet it only in one Point, and being produced both ways, enters not at all into the *Section*, but falls all entirely without, that Line is called a *Tangent* in that Point.

## *CONSECTARIES.*

I. In the *Parabola*, all the *Sides of the Cone* (*vid. Def.* 5.) being produced infinitely, muſt neceſſarily cut its Plane, except the *Side S D*, drawn

*Fig.* 4.




from the Vertex *S* to the Point *D*, where the *Directrix* touches the Baſe; becauſe no other *Side* but that can be in the Plane *D S E*, which is parallel to the Section; and that all the others cut it in the Point *S*: Whence it is plain, that the *Parabola* will be extended infinitely, and can never return into it ſelf.

II. In the *Ellipſis*, all the *Sides* of the Cone, when produced, muſt cut the Plane of the Section; becauſe the Plane *S D E*, which is parallel to it, is cut by all of them in the Point *S*, (*Fig.* 3.) Whence this Section muſt include a Space, and return into it ſelf.

III. In the *Hyperbola* and the *Oppoſite Sections*, all the *Sides* of the Cone (but *S D*, *S E*, drawn from the Vertex to the Points *D*, *E*, where the *Directrix* cuts the Baſe) being infinitely produced both ways from the *Vertex S*, muſt cut the Planes of the *Oppoſite Sections*: Becauſe there are no other but thoſe two Sides, which can fall in the Plane *S D E* which is parallel to the Sections; and alſo becauſe all the others cut it in the Point *S*.

The Sides of the Portion *S D V E* form the Points of the Hyperbola *F A G*; and thoſe of the Portion *S D Y E* being produced on the other Side of the Vertex *S*, form the Points of the oppoſite Sections *K M H*.

And from hence 'tis clear, That the *oppoſite Hyperbola's* are extended infinitely, and can no more return into themſelves than the *Parabolick Section*.

## Theorem I. PROP. I.

If the *two oppoſite Conick Surfaces* be cut, by a Plane paſſing through the *Vertex*, as *S a m* (in *Fig.* 4.) the Interſection of that Plane, with the two Surfaces, will make two Right Lines *S a*, *S m*, which may be ſuppoſed to be infinitely produced each way from *S*.

For let *a m* be the *Common Section* of this Plane with that of the Baſe: 'Tis plain it will cut the Periphery of the Baſe in the two Points *a* and *m*, becauſe the Plane *S a m* is ſuppoſed to fall *within* the Cone. Wherefore the Sides *S a* and *S m* being produced each way from *S*, muſt be the two common Sections of the interſecting Plane *S a m*, with the oppoſite Conick Surfaces: As appears from the manner of their Generation in *Def.* 1. *Q. E. D.*

## *CONSECTARIES.*

I. As that Part of the Line *a m* joining the two Points *a*, *m*, in the Periphery of the Baſe, falls within the Baſe, and all the reſt of it, if produced, falls without; ſo it follows, that if the Plane *S a m*, be ſuppoſed exfinitely extended all round *S*, that Part of it only which is contained within the Legs of the Angle *a S m*, and its Vertical one beyond *S*, will fall within the two oppoſite Conick Surfaces, and all the reſt of it without them.

II. From whence it follows, That if you join any two Points, as *A M*, in a Conick Section, (*Fig.* 2.) it will be all contained within the Section; and all Parts of it, when produced either way, will fall without it: For drawing from the Vertex *S* two Lines, as *S m*, *S a*, and ſuppoſing them to determine ſuch a Plane as above, 'tis plain the Line *A M* will fall all within the Legs of the Angle *a S m*, *&c.*

III. Wherefore any Line paſſing through the Vertex *S*, and parallel to ſuch a Line as *A M* drawn within the Section, will fall without the *Conick Surface*; and will meet the Plane of the Baſe produced without the Circumference of the Baſe of the Cone.

IV. It follows alſo, (from *Conſect.* I.) That any two Points, one in each of the oppoſite Hyperbola's, (*Fig.* 4.) being joined by a Right Line, as *A M*, that Line will be wholly without and between the oppoſite Sections; but infinitely produced each way, will be ever after entirely within the *Oppoſite Hyperbola's*: For drawing through *S* the Lines *S a*, *S m*, paſſing through the Points *A*, *M*, and ſuppoſing them to determine a Plane, extended every way from *S*, *&c.* it is evident, that *that* Part of the Plane which is contained within the Legs of the Angle *S A*, *S M*, where the Line *A M* falls, is compre-

comprehended between those two Surfaces; and *that* Part of the same Plane which is contained between the Productions of the Line *A M*, from *A* and *M* each way, will fall all of it within the opposite Hyperbola's.

V. From the 2d and 4th *Consectaries* it will follow, that a Right Line can't cut a Conick Section, or the opposite Hyperbola's, in more than two Points.

## PROP. II.

*If either of the opposite Conick Surfaces be cut by a Plane as* o u x y, *(see* Fig. 1.*) which is parallel to the Base* O V X Y, *the Section will be a Circle, whose Centre shall be in* o, *the Point where that Plane cuts the Axis produced as far as is necessary beyond* S.

For in the Base, drawing any where a Radius *O X*; and from the Vertex *S* the Side *S X*; which produced, shall meet the Plane *o u x y* in *x*; the Lines *O X* and *o x* will be parallel: And the Plane *S O X* being produced into the opposite Cone beyond *S*, the △'s *S O X* and *S o x* will be equal; and therefore 'twill always be that *S O* : *O X* :: *S o* : *S x*. But the two first Terms being always the same, the 4th Term *S x* can't change its Length, let the Point *x* fall where it will: Wherefore the Curve *u x y* is a Circle.

## PROP. III.

*If in the Plane of a Parabola, as* F A G *(*Fig. 2.*) you draw from any Point, as* A, *within the Cone, an infinite Right Line, as* A B, *parallel to the Side* S D: *I say, that Line shall always be within the Section; and though infinitely produced towards* B, *can never cut the Parabolick Circumference any more.*

For drawing, or supposing to pass through the Vertex *S* and the Line *A B*, a Plane, as *S A B*; that will, by its Intersection with the Conick Surface form two Sides; one of which shall always be the Line *S D*, (because *A B* is parallel to it) and the other the Line *S a*, which passes through the Point *A*. But the Plane *D S a*, contained between the Sides *S D*, *S a*, produced infinitely from *D* and *a*, will all fall within the Surface of the Cone (by *Conf.* I. *Prop.* I.) Wherefore the Line *A B*, which is always within that Plane, and is parallel to the Side *S D*, will fall all of it within the Parabola, and can cut its Circumference no where but in *B*.

## PROP. IV.

*A Line drawn in the Parabola* F A G, *from any Point, as* A, *within the Cone, and not parallel to the Side* S D, *will, if produced, meet the Parabola in another Point, as* M. *(See* Fig. 2.*)*

For if you suppose a Plane to pass along that Line and the Vertex *S*, as *S A M*, that will be all of it within the Conick Surface, and can't pass by the Side *S D:* Whence it follows, that this Plane will form, by its cutting the Surface of the Cone, the two Sides *S a* and *S m*, (see *Prop.* I.) one of which, *S a*, passes through the Point *A*; and the other, *S m*, is by no means parallel to the Plane of the Section; (for by the Nature of it, only the Side *S D* is so, (see *Def.* X.) Wherefore the Side *S m* produced, must cut the Plane of the Parabola in the Point *M*; through which the Line *A M* passes, which is formed by the Intersection of the Plane *a S m* with that of the Parabola. But 'tis plain, that this Point *M* is one of the Points of the Parabola *F A G*, because 'tis both in the Plane of the Section, and also in the Surface of the Cone: Wherefore, &c.

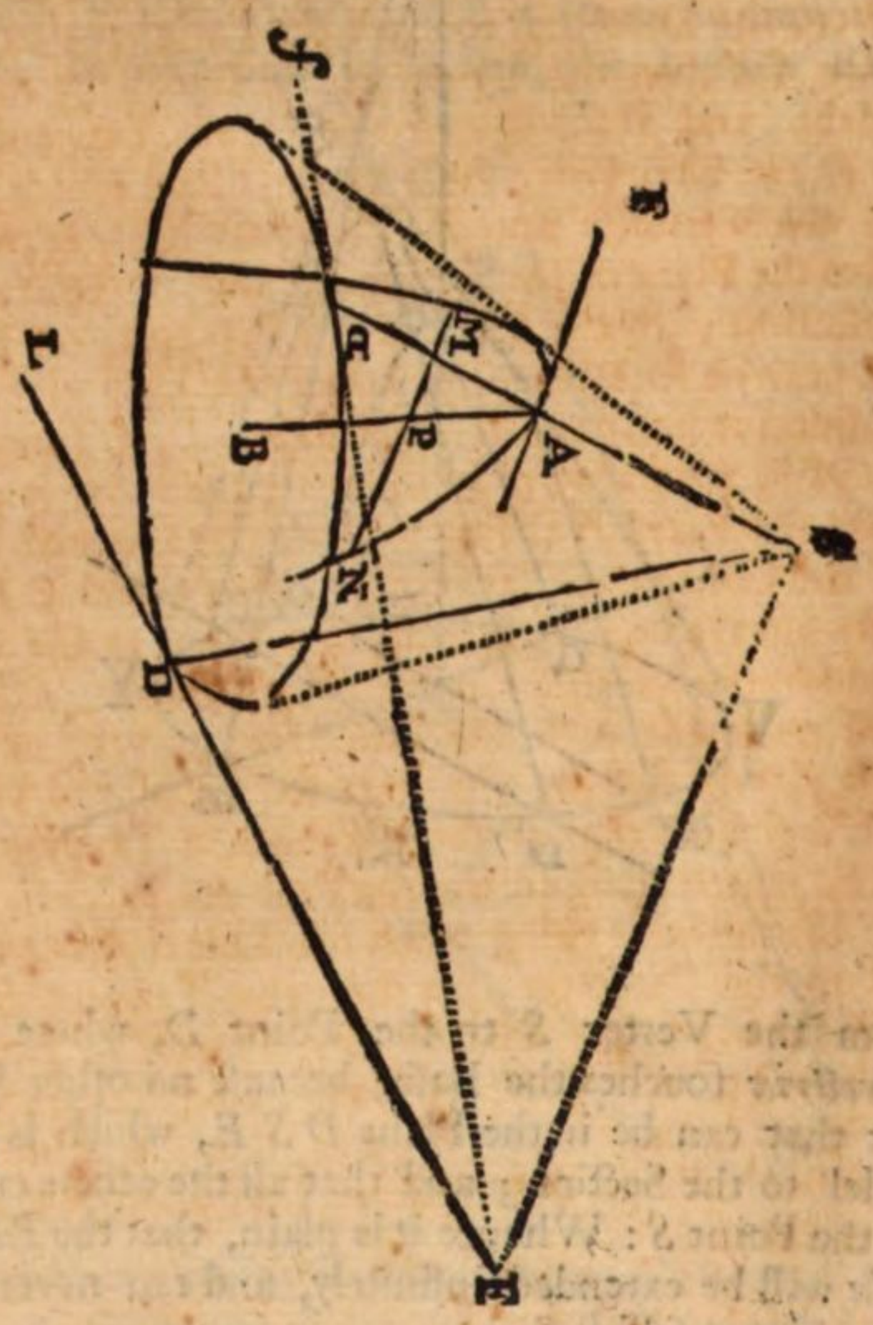
## PROP. V. *Probl.* I.

*Through a Point given, as* A, *in any Conick Section, to draw a Tangent, as* A F, *to the Curve.*

Having drawn through the given Point *A*, and the Vertex of the Cone, as *S*, a Right Line, as *S A*, cutting the Base in *a*; and then to the Periphery of the Base in the same Point *a*, a Tangent, as *E a F*. The Line *F A* made by the common Section of the Plane *S E*, *a f*, (produced, if necessary, beyond the Vertex *S*) with the Plane of the Section, shall be the Tangent required.

For since the Tangent *E a f* is entirely without the Base, but only in the Point *a*, it follows, that the Plane *S E a f*, infinitely produced above or below S, can cut the opposite Conick Surface no where but in the Line *S a*, produced also infinitely either way; and that all the rest of that Plane will be without those Surfaces. Wherefore the Line *A F*, made by the Intersection of that Plane with that of the Section, can interfere with neither of those Surfaces but only in the Point *A*, where the Line *S a* cuts the Plane of the Section: Wherefore 'tis a true Tangent to the Curve in that Point.

*Fig.* 5.




## *CONSECTARIES.*

I. As there can be but one Tangent to the Periphery of the Base in the Point *a*, so there can be but

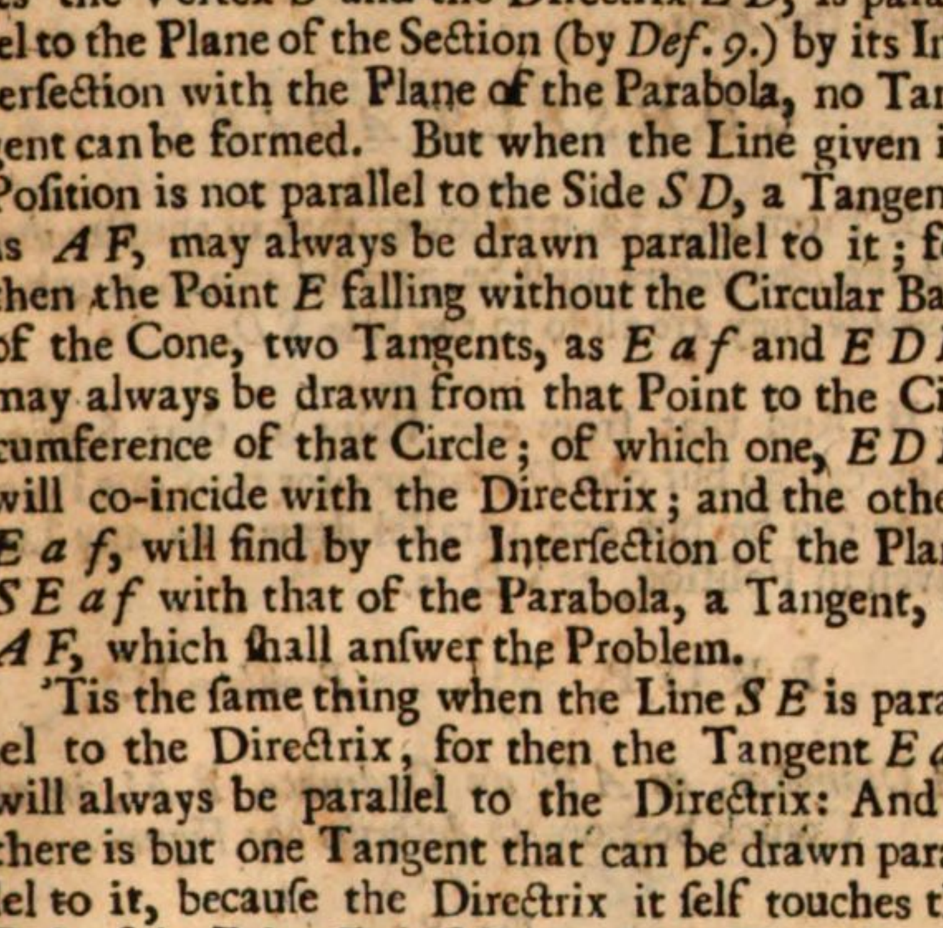
but one to the Point *A* drawn in any of the Conick Sections.

II. Whence ariſes the way of drawing a Tangent, as *A F* parallel; a Right Line, as *M N*, given in Poſition in the Plane of any Conick Section; or in the two oppoſite Sections.

For having drawn through the Vertex *S* a parallel to *M N*, as *S E*, that will either meet with the Directrix in ſome Point, as *E*, or be parallel to it; becauſe that Line *S E* may be parallel to the Plane of the Section, and conſequently may fall in the Plane *S D E*. If it cut it in any Point, as *E*, falling without the Baſe of the Cone; then drawing from the Point *E*, to the Periphery of the Baſe, the Tangent *E a f*; 'tis plain, that the Plane *S E a f* will make, by its Interſection with the Plane of the Section, a Tangent, as *A F*, which ſhall be parallel to the Line *M N*; becauſe the two Sections *A F*, *S E*, of the parallel Planes *M A N*, *S E D*; being cut by the Tangent Plane, *S E a f*, muſt be parallel to one another, as well as *S E* and *M N*.

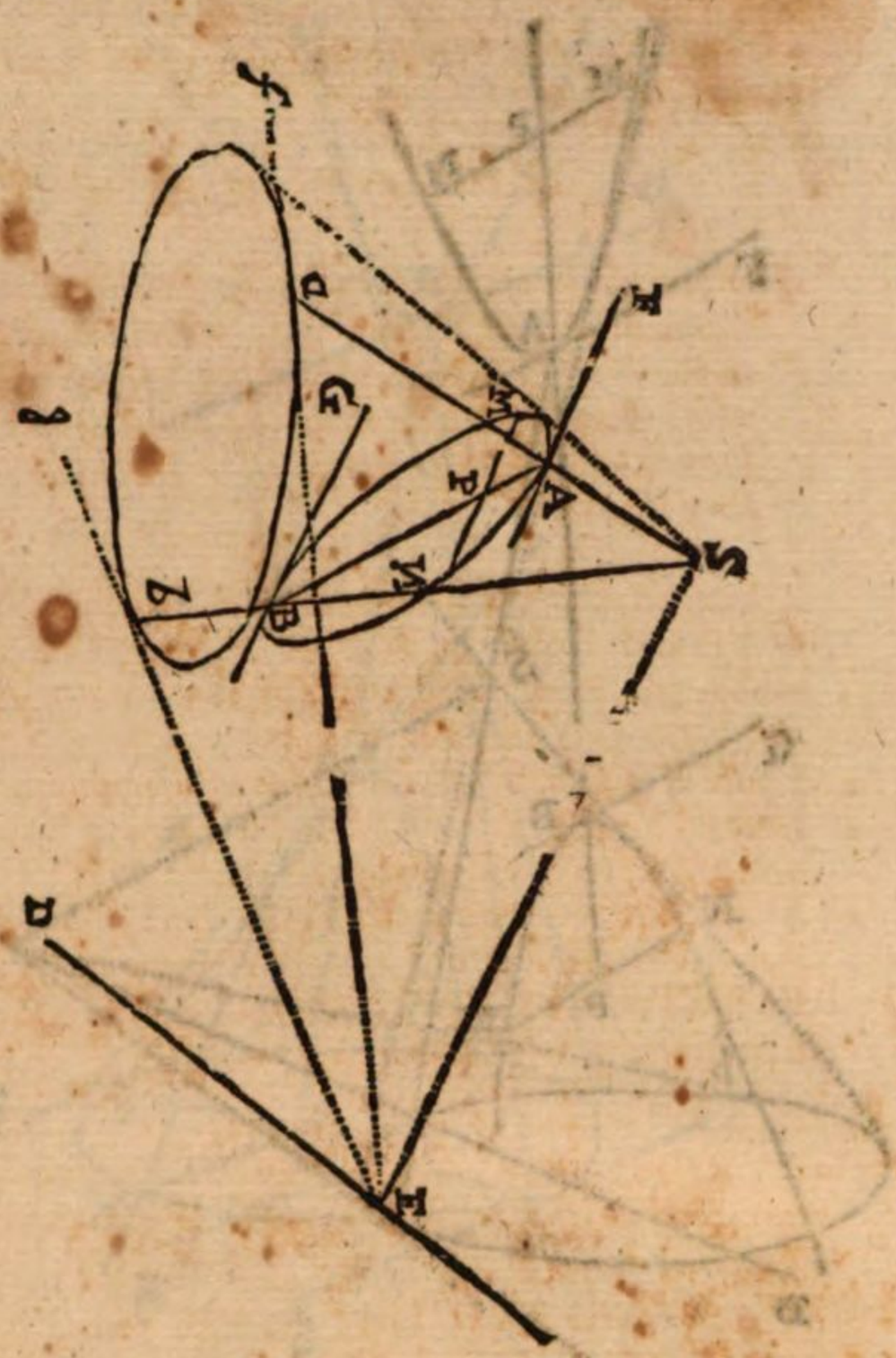
III. The ſame things being ſuppoſed, as in the preceding Conſectary, and *Fig.* 5. it will follow, 1. That in the Parabola this Problem will be impoſſible, when the Line *M N* is in a parallel Poſition to the Side *S D*; drawing thro' the Point *D* where the Directrix touches the Periphery of the Baſe, for then the Points *E* and *D* will be co-incident; and thro' that Point *D*, no Tangent but *D E* can be drawn: And as the Plane which paſſes the Vertex *S* and the Directrix *E D*, is parallel to the Plane of the Section (by *Def.* 9.) by its Interſection with the Plane of the Parabola, no Tangent can be formed. But when the Line given in Poſition is not parallel to the Side *S D*, a Tangent, as *A F*, may always be drawn parallel to it; for then the Point *E* falling without the Circular Baſe of the Cone, two Tangents, as *E a f* and *E D L*, may always be drawn from that Point to the Circumference of that Circle; of which one, *E D L*, will co-incide with the Directrix; and the other, *E a f*, will find by the Interſection of the Plane *S E a f* with that of the Parabola, a Tangent, as *A F*, which ſhall anſwer the Problem.

'Tis the ſame thing when the Line *S E* is parallel to the Directrix, for then the Tangent *E a f* will always be parallel to the Directrix: And as there is but one Tangent that can be drawn parallel to it, becauſe the Directrix it ſelf touches the Baſe of the Point *D*; it follows, that a Tangent may be drawn, &c.




2. In the Ellipſis, there may always be drawn two Tangents, *A F*, *G B*, parallel to the Right

*Fig.* 6.



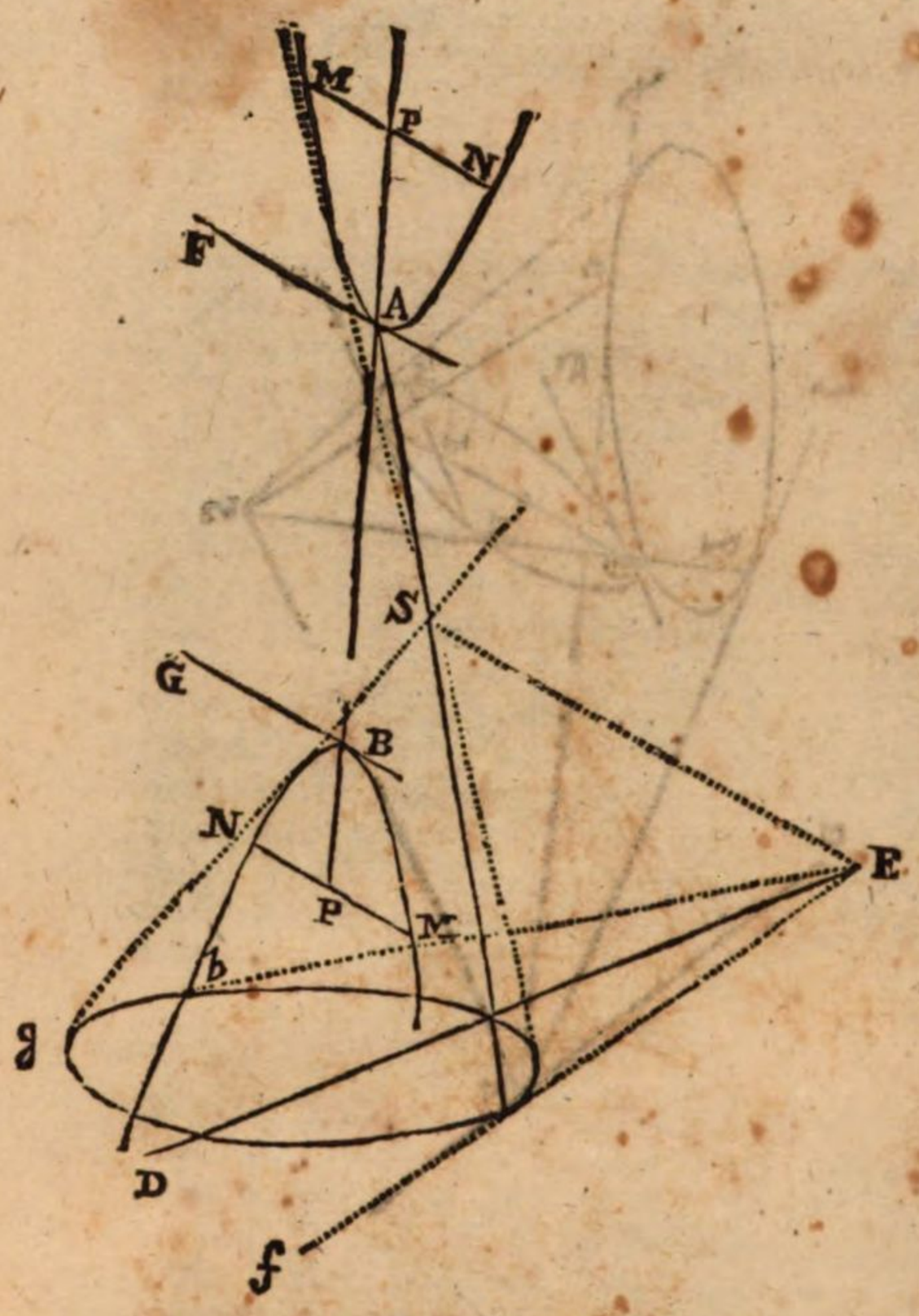

Line *M N*, given in Poſition, and conſequently to one another.

For here all the Points of the Directrix *D E* fall without the Baſe of the Cone; and therefore you may always draw from the Point *E*, two Tangents, *E a f*, and *E b g* to the Circle of the Baſe; and theſe will ſerve, by the Interſection of the Planes *S E a f*, and *S E b g*, with the Plane of the Section on two Tangents, *A F* and *B G*, which will anſwer the Problem.

'Tis the ſame thing when the Line *S E* is parallel to the Directrix, for then inſtead of the Tangents *E a f*, *E b g*, going from the Point *E* in that Directrix, you need only draw two parallel Tangents; which is always poſſible.

In the Hyperbola and oppoſite Sections, the Problem becomes impoſſible, when the Point *E* falls within the Circular Baſe of the Cone; becauſe

*Fig.* 7.




hen no Tangent can be drawn to that Point of the Baſe. But when it falls without, you may always draw two Tangents, *A F* and *A B*, parallel to the Line *M N* given in Poſition: For the Directrix *D E*, cutting the Baſe, you may always draw from the Point *E* two Tangents, as *E a f*, and *E b g* to the Baſe; and which falling on each Side of the Directrix, will make, by the interſection of the Planes *S E a f*, *S E b g*, with the Planes of the Sections, two Tangents *A F* and *B G*, which will anſwer the Problem.

And 'tis the ſame, when the Line *S E* is parallel to the Directrix *D E*: for then inſtead of the two Tangents, *E a f* and *E b o*, you need only draw two Tangents parallel to the Directrix; which is always poſſible.

And here Note, that in this Caſe the two parallel Tangents *A F* and *B G*, will always belong to the oppoſite Sections, and never to the ſame, which is plain; becauſe the two Tangents, *E af* and *E b g*, drawn to the Baſe, fall on each Side the Directrix.

IV. From the laſt Conſectary, it follows, 1. That in the Parabola or Hyperbola, you cannot draw two Tangents which ſhall be parallel one to another: But in the Ellipſis and in the oppoſite Sections; one Tangent being given in Poſition (as ſuppoſe *A F*); you may always draw another, as *G B* parallel to it: (See *Fig.* 6, 7.)

2. When the Line *M N*, given in Poſition, is terminated by the Section; you may always draw in the Parabola one Tangent, which may be parallel to it; and in the Ellipſis and oppoſite Hyperbola's, two Tangents, as *A F* and *B G*; becauſe the Line S *E* drawn from the Vertex, parallel to *M N*, will cut the Plane of the Baſe produced ſomewhere without the Circle, or elſe be parallel to it.

## *DEFINITIONS.*

XII. In the *Parabola* (*vid. Fig.* 5.) a Line, as *A B* drawn from any Point, as *A* parallel to the Side *S D*, which paſſes through the Point *D*, where the Directrix touches the Baſe, is called a *Diameter*; and the Point *A* its *Orgine*.

XIII. *In the Ellipſis* and *Oppoſite Hyperbola's*, (*Fig.* 6, 7.) a Right Line, as *A B*, conecting the Points of Contact of the two parallel Tangents, *A F* and *B G*, is called a *Diameter*; the Points *A* and *B*, its *Extremities*.

XIV. A Line, as *M D*, drawn thro' any Point, as *P*, of the Diameter *A B* produced, if there be occaſion (*Fig.* 5, 6, 7.) terminated by the Section in the two Points *M N*, and alſo parallel to the Tangent *A F*, which paſſes thro' *A*, the *Orgine* of the *Diameter* in the Parabola, or by one or other of the Extremities of it in the *Ellipſis*, or *Oppoſite Hyperbola's*; that Line is ſaid to be an *entire Ordinate* to the Diameter *A B*, being continued on each Side the Point *P*, tho' its half, as *P M* or *P N*, is uſually called an *Ordinate*.

XV. And when the *Ordinates* are at Right Angles with any *Diameter*, that *Diameter* is then called the *Axis*.

## *CONSECTARIES.*

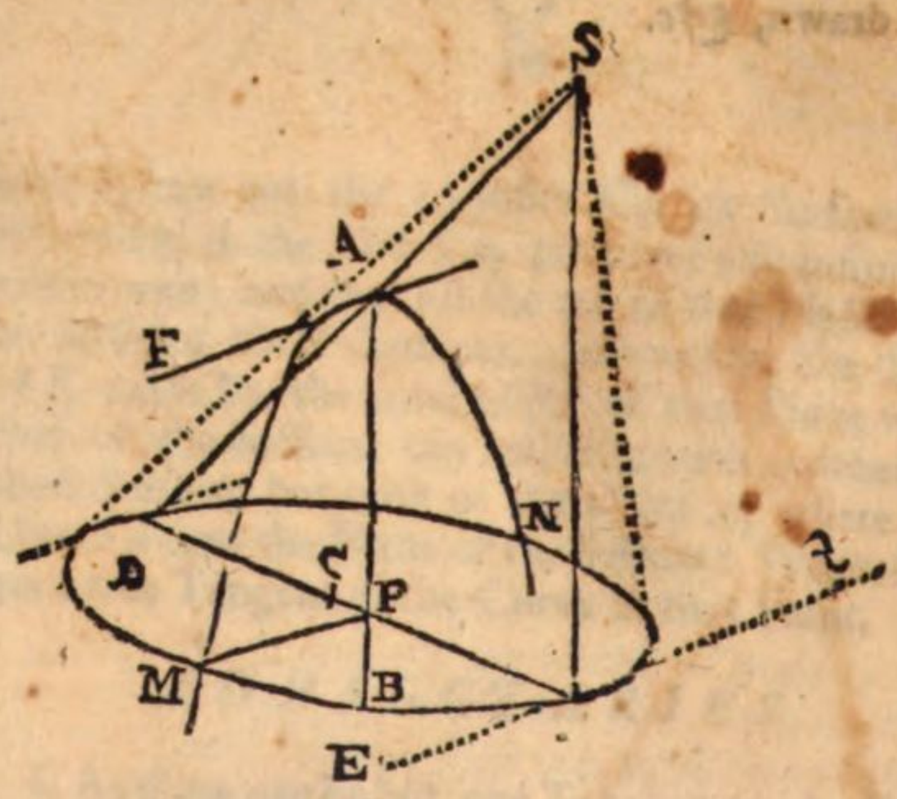
I. From *Def.* 12. it follows, that in the *Parabola* all the *Diameters* muſt be parallel one to another; becauſe they are all ſo to the Side *S D*.

II. And that from one Point in that Section, there can go but one *Diameter*; for thro' one Point, there can be but one parallel drawn to any Line given in Poſition, as *S D* is.

## PROP. VII. *Problem* II.

*A Diameter, as A B, an Ordinate, P M, in any* Conick Section, *to deſcribe the Figure.*

*Fig.* 8.




Thro' the ordinate *P M*, deſcribe any Plane whatever, ſo it be but different from the Plane, *A P M*,

*APM*. Then from the Point *P*, in that Plane draw to *PM* the infinite Part *Pa*, and taking in that Line *Pa*, any Point as *C* for a Centre, with the *Radius CM* deſcribe a Circle, and 'tis done.

1. When the Section is to a *Parabola*, draw, from one of the Points, *a* or *D*, where the Circle of the Baſe cuts the Part *Pa* (viz. *a*) thro' the Orgine of the Diameter, the Right Line *aA*, which ſhall meet in the Point *S*, another Line, as *SD* drawn parallel to *AB*; and then ſuppoſe a Conick Surface deſcribed, whoſe Vertex is the Point *S*, and its Baſe the Circle *DMaG*. I ſay, that it will form, by its Interſection with the Plane *APM*, the Parabola *MAN* required.

For having drawn parallel to *MN*, and through the Points *D* and *a*, the Right Lines *ED* and *fa*; 'tis clear, thoſe Lines will be Tangents, becauſe they are parallel to *MP*, which is to *aP*.

But the Place *SDE* paſſing thro' *S*, the Vertex of the Cone, and thro' the Tangent *DE*, is parallel to the Plane *APM*, becauſe *SD* parallel *AP*, and *DE* parallel *MP*: Wherefore the Section *MAN*, made by the Plane *APM* in the Conick Surface, will be a Parabola, whoſe Diameter is *AB*.

The Tangent Plane alſo, *Saf*, forms in the Plane *APM* (by *Prop.* 5.) a Tangent, as *AF*, which is parallel to *MN*, as being the common Section of the two Planes *Saf*, *APM*, which paſs by the Parallels *af*, *PM*, and conſequently (by *Def.* 14.) the Right Line *PM*, is an Ordinate to the Diameter *AB*.

2. When the Section is to be an *Ellipſis* or *Hyperbola*.

Draw thro' the Point *ab*, where the infinite *Pa* cuts the Circle; and through the Extremes of the Diameter *A*, *B*, the two Right Lines, *aA* and *Bb*, they will meet in the Point *S*, from whence a Conick Surface may be deſcribed, whoſe

*Fig.* 9.

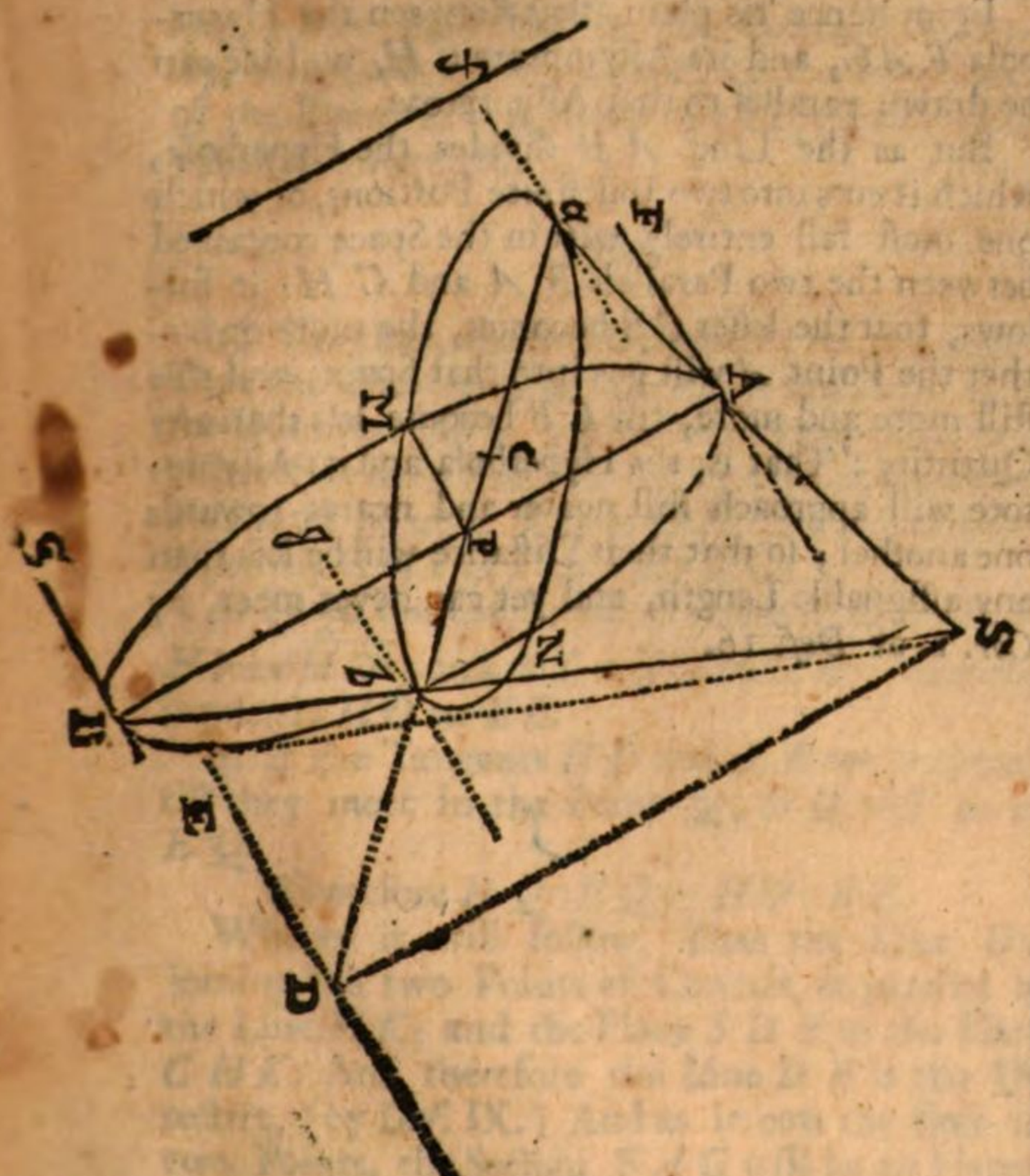
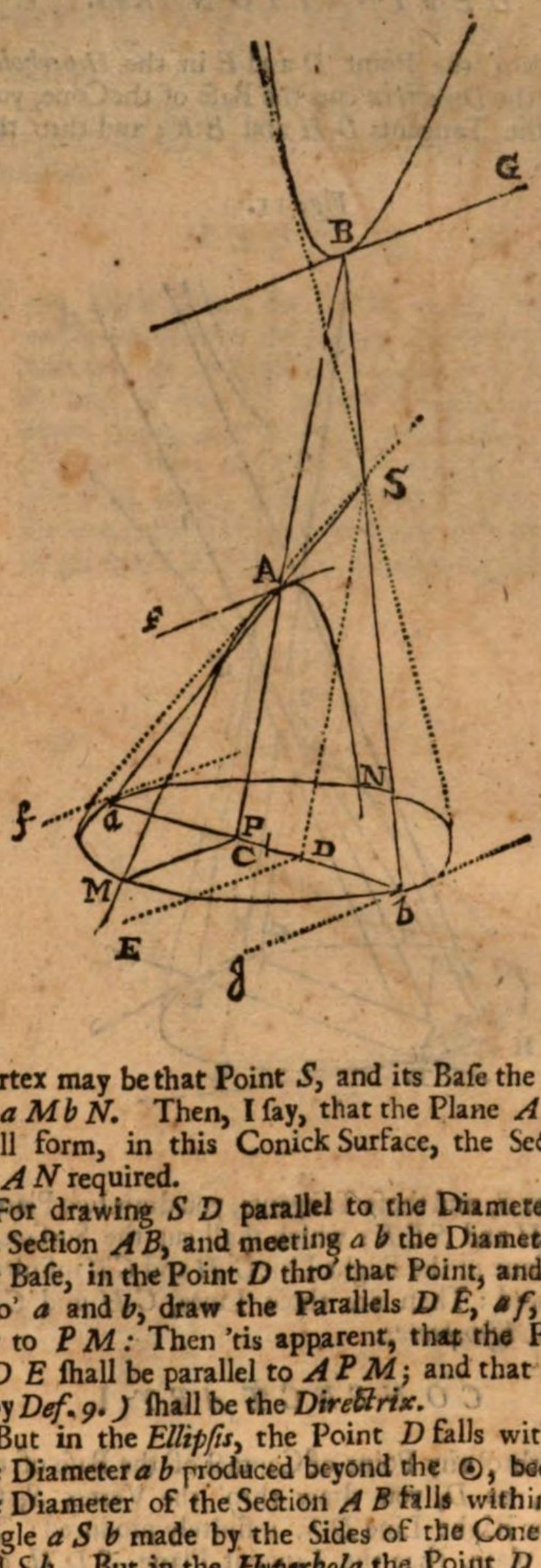



*Fig.* 10.




Vertex may be that Point *S*, and its Baſe the Circle *aMbN*. Then, I ſay, that the Plane *APM* ſhall form, in this Conick Surface, the Section *MAN* required.

For drawing *SD* parallel to the Diameter of the Section *AB*, and meeting *ab* the Diameter of the Baſe, in the Point *D* thro' that Point, and alſo thro' *a* and *b*, draw the Parallels *DE*, *af*, and *bg* to *PM*: Then 'tis apparent, that the Plane *SDE* ſhall be parallel to *APM*; and that *DE* (by *Def.* 9.) ſhall be the *Directrix*.

But in the *Ellipſis*, the Point *D* falls without the Diameter *ab* produced beyond the ⊙, becauſe the Diameter of the Section *AB* falls within the Angle *aSb* made by the Sides of the Cone *aS* and *Sb*. But in the *Hyperbola* the Point *D* falls within the Circle of the Baſe, becauſe then the Diameter *AB* falls within *aSB*; which is the Angle lying on the Side of the Angle *aSb*. Whence it follows, that (according to *Def.* 10.) the Section *MAN*, will in the former Caſe be an *Ellipſis*, and in the latter, an *Hyperbola*.

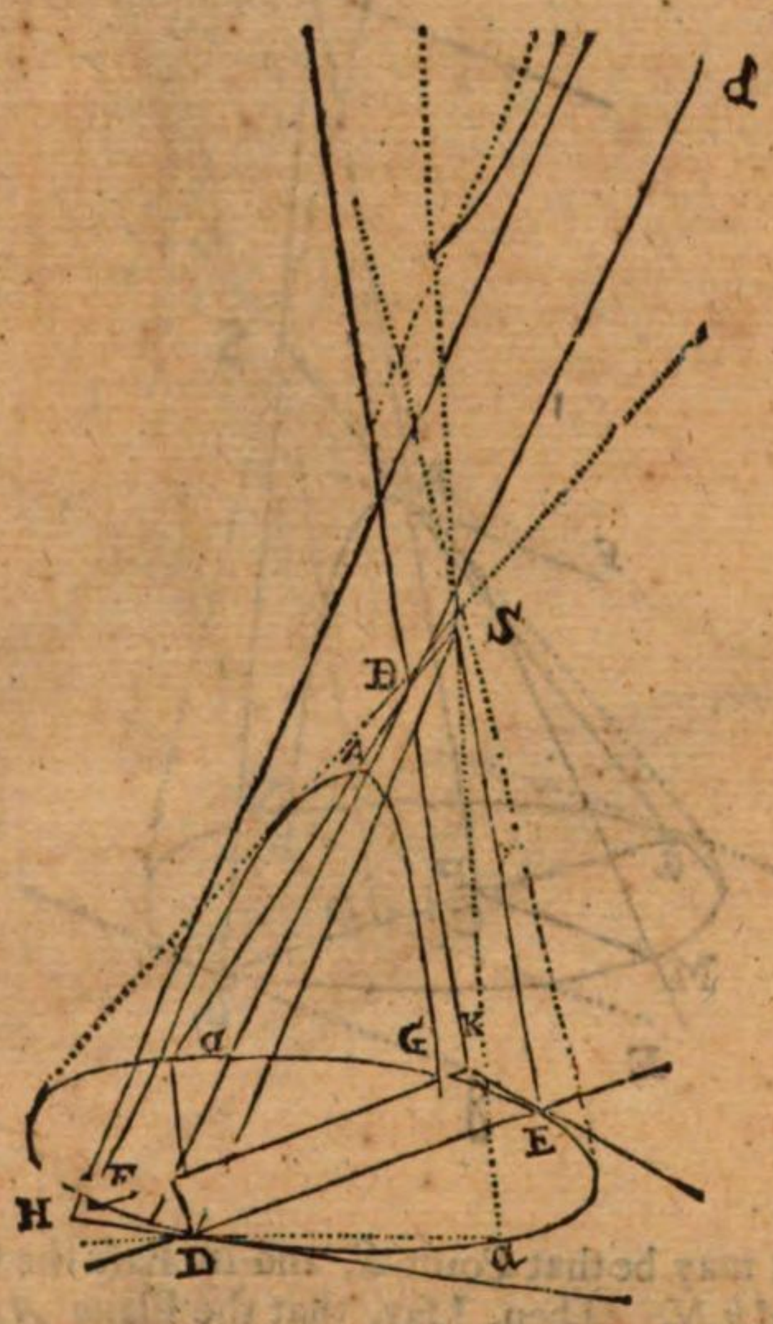
The Tangent *AF* paſſing thro' *A*, the Extremity of the Diameter *AB*; being the common Section of the Tangent Plane *Saf*, and the Interſecting Plane *APM*, which paſſes thro' the Parallel *af* and *PM*, will be parallel to the Ordinate *PM*; and for the ſame Reaſon alſo, the Tangent *BG* will be parallel to *PM*, for that is the common Section of the Tangent Plane *Sbg*, and the Secant Plane *AMP*, which paſs by the two Parallels *bg* and *PM*, ſhall be parallel to *PM*. Wherefore the Line *AB* (by *Def.* 13, 14.) is a *Diameter*, whoſe Ordinate is *PM*.

It may happen in the *Ellipſis*, that the Line *A a* and *b B* may be parallel to one another; but there can be but only one Point in the Line *a b* for *C* the Centre of the Circle of the Baſe.

### *DEFINITION* XVI.

If thro' the Point *D* and *E* in the *Hyperbola*, where the *Directrix* cuts the Baſe of the Cone, you draw the Tangents *D H* and *E K*; and thro' the

*Fig.* 11.




Vertex *S*, and thoſe Tangents, you draw two Planes, *S D H* and *S E K*; which ſhall cut the Surface of the Cone in the Right Line *C H* and *C K* infinitely produced: Then are thoſe Lines, *C H* and *C K*, called *Aſſymptotes*.

### *CONSECTARY* I.

If thro' any Point of Contact of the Baſe of the Cone, as *D*, you draw thro' the Vertex *S*, the Side or Right Line *D S*, infinitely produced: 'Tis then plain, that the Tangent Plane, *S D H*, can have nothing common with the oppoſite Conick Surfaces, but the Side *S D*, becauſe the Points of the Tangent *D H* fall without the Periphery of the Baſe of the Cone, but only *D*. But the Plane *S D E* paſſing thro' the Vertex *S*, and the Directrix *D E*, being parallel to the Planes of the oppoſite Sections; the common Sections, *S D* and *C H* of thoſe Planes, with the ſame Plane *S D H*, muſt be parallel to one another: And therefore the *Aſſymptote C H* muſt fall entirely without and between their oppoſite Conick Surfaces; and conſequently muſt leave the oppoſite Hyperbolas on each Side entirely, without ever touching them or meeting with them. And the ſame thing may be ſhewn of the other *Aſſymptotes C K*: But as two *Aſſymptotes C H*, *C K*, are formed by the Plane *S D H*, *S E K*, which fall on each Side of the ſame Conick Surface, and its oppoſite; it follows, that all the Points of the Hyperbola *F A G* are contained within the Angle *H C K*; and all Points of the oppoſite Section within its vertically oppoſite Angle.

### PROP. VII.

*If thro' any Point, as* B, *in the Aſſymptote* C K, *you draw a Line, as* B A *parallel to the other Aſſymptote* C H; *I ſay, that it ſhall interſect one of the oppoſite Hyperbolas in one only Point as* A: *and being produced infinitely, will be always within it.*

See *Fig.* 12.

For, ſince the Lines *B A* and *S D* are parallel to *C H*, they muſt be ſo to one another, and ſo are both in the ſame Plane; which Plane will enter within the two Conick Surfaces, becauſe it paſſes by one of their Sides *S D*, and makes an Angle with the Tangent Plane *S D H*.

The Plane of the Parallels, *B A*, *S D*, will form in the two Conick Surfaces, two Sides; of which, one is *S D*, and the other the Side *S a*, which muſt neceſſarily cut the Line *B A*, in ſome Point, as *A*; becauſe it lies in the Plane which paſſes thro' the Parallels *S D*, *A B*; and which enters *S D* in *S*.

Wherefore, becauſe the Point *A* is found at the ſame Time in one of the Conick Surfaces, and in the Plane of the Hyperbola's, it muſt be in one of thoſe Hyperbolæ. And ſince the Line *B A* being infinitely produced on the Side of the Point *A*, falls entirely in the Plane *D S a*, contained between the Sides *D S*, *S a*; therefore the Point *A* will be in the Hyperbola *F A G*, and in the vertically oppoſite one *A S D*, when it belongs to the oppoſite Hyperbola: 'Tis apparent, it muſt always fall within *one* of the two Conick Surfaces; and conſequently within the Hyperbola alſo, which is contained in the Section. *Q. E. D.*

### *CONSECTARY.*

From hence 'tis plain, that between the Hyperbola *F A G*, and its Aſſymptote *C H*, no Line can be drawn parallel to that Aſſymptote.

But as the Line *A B* divides the Hyperbola, which it cuts into two indefinite Portions, of which one muſt fall entirely within the Space contained between the two Parallels *B A* and *C H*; it follows, that the leſſer *C B* becomes, the more or farther the Point *A* will get into that Space, and this ſtill more and more, till *C B* become leſs than any Quantity: That is, the Hyperbola and its Aſſymptote will approach ſtill nearer and nearer towards one another; ſo that their Diſtance will be leſs than any aſſignable Length, and yet can never meet, by *Cor.* 1. of *Def.* 16.

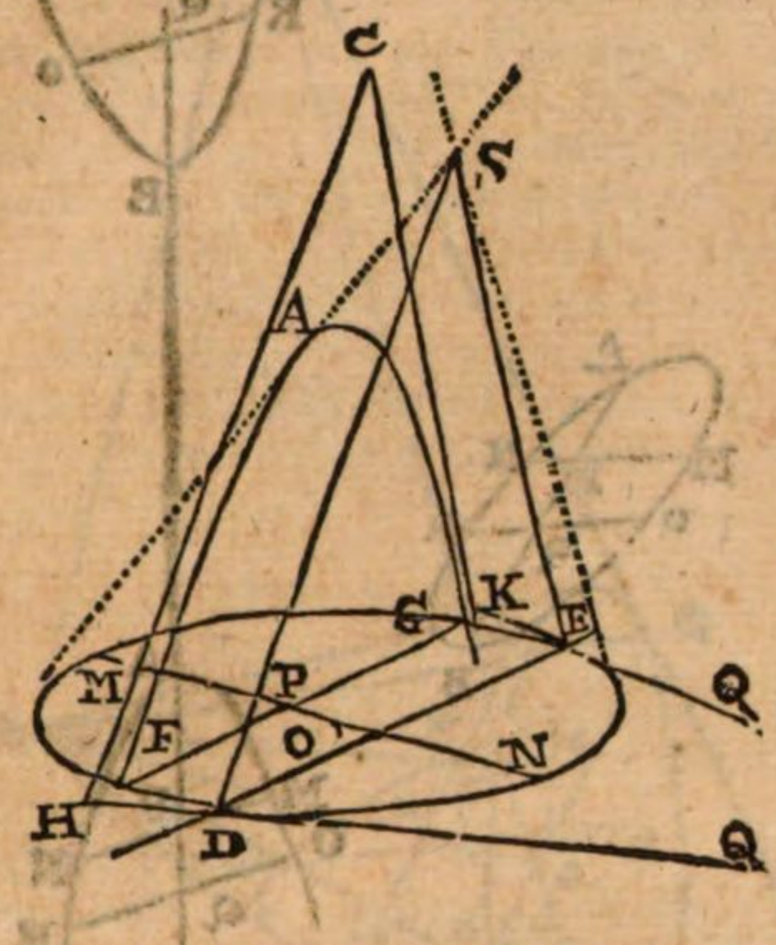
PROP.

## PROP. VIII. *Problem.*

*CH and CK, the Assymptotes of an Hyperbola, FAG, being given, and any Point in the Curve, as F, to describe the Hyperbola.*

Having drawn through the given Point *F* any Right Line, as *HK*, cutting the Assymptotes, make a Plane to pass through that Line, any how

*Fig.* 12.




(so it be different from the Plane of the Assymptotes *HCK*) in which Plane draw through *P* the middle Point in *HK* an infinite Perpendicular, as *MN*. Then on any Point of it, as *O*, as a Centre, and with the Radius *OF*, describe the Circle *FMN*. Then draw through the Points *H* and *K* two Tangents to the Circle; and through their Points of Contact *D*, *E*, draw *DS*, *ES*, parallel to the given Assymptotes *CH* and *CK*. These will meet in a Point, as *S*; from which, as from a Vertex, if you describe a Conick Surface, whose Base shall be the Circle *FMN*; I say, this Conick Surface shall, by the Intersection of the Plane *HCK*, form the Hyperbola *FAG*; which was required.

For,

1. 'Tis clear, from the Property of the Circle, That the Chord *FG* is bissected in the Point *P*, by the Diameter *MN*, which is perpendicular to it. Wherefore since $PH = PK$ (by the Construction) $FH$ must be $= GK$, and $GH = FK$; and consequently $GH \times HF = FK \times KG$.

2. From the Circle also it follows, That $GH \times HF = \overline{HD}^2$, and $FK \times KG = \overline{KE}^2$; and consequently $HD = KE$.

3. If the Tangents *HD* and *KE* are produced, till they meet in the Point *Q*, *DQ* will be $= EQ$.

Wherefore $DQ : EQ :: HD : KE$.

Whence it will follow, That the Line *DE* joining the two Points of Contact, is parallel to the Line *HK*; and the Plane *SDE* to the Plane *CHK*: And therefore the Line *DE* is the Directrix, (by *Def.* IX.) And as it cuts the Base in two Points, the Section *FAG* will be an Hyperbola, by *Def.* X.

'Tis plain also, That this Hyperbola must pass through the Point *F*, since that Point is common both to the Conick Surface, and to the Plane *HCK*, which is that of the Hyperbola: and that Hyperbola shall have the Lines *CH*, *CK* for its Assymptotes, because they are the common Sections of the Tangent Planes *SDH*, *SEK*, with the Plane of the Hyperbola, (*Def.* XV.)

When it happens that the Tangents *DH*, *EK* are parallel, then will also the Lines *DE*, *HK* be parallel.

## PROP. IX.

*If two Right Lines, as MN, AB, terminate within any Conick Section, or within the opposite Sections, do intersect each other in a Point, as P; and if they be parallel to any two other Right Lines, as SE, SD, which are given in Position: I say, the Rectangle MPN is to that of APB, always in a given Ratio; or the Ratio between these Rectangles will always be the same, let the Lines MN, AB, lie where they are.*

*Fig.* 13.

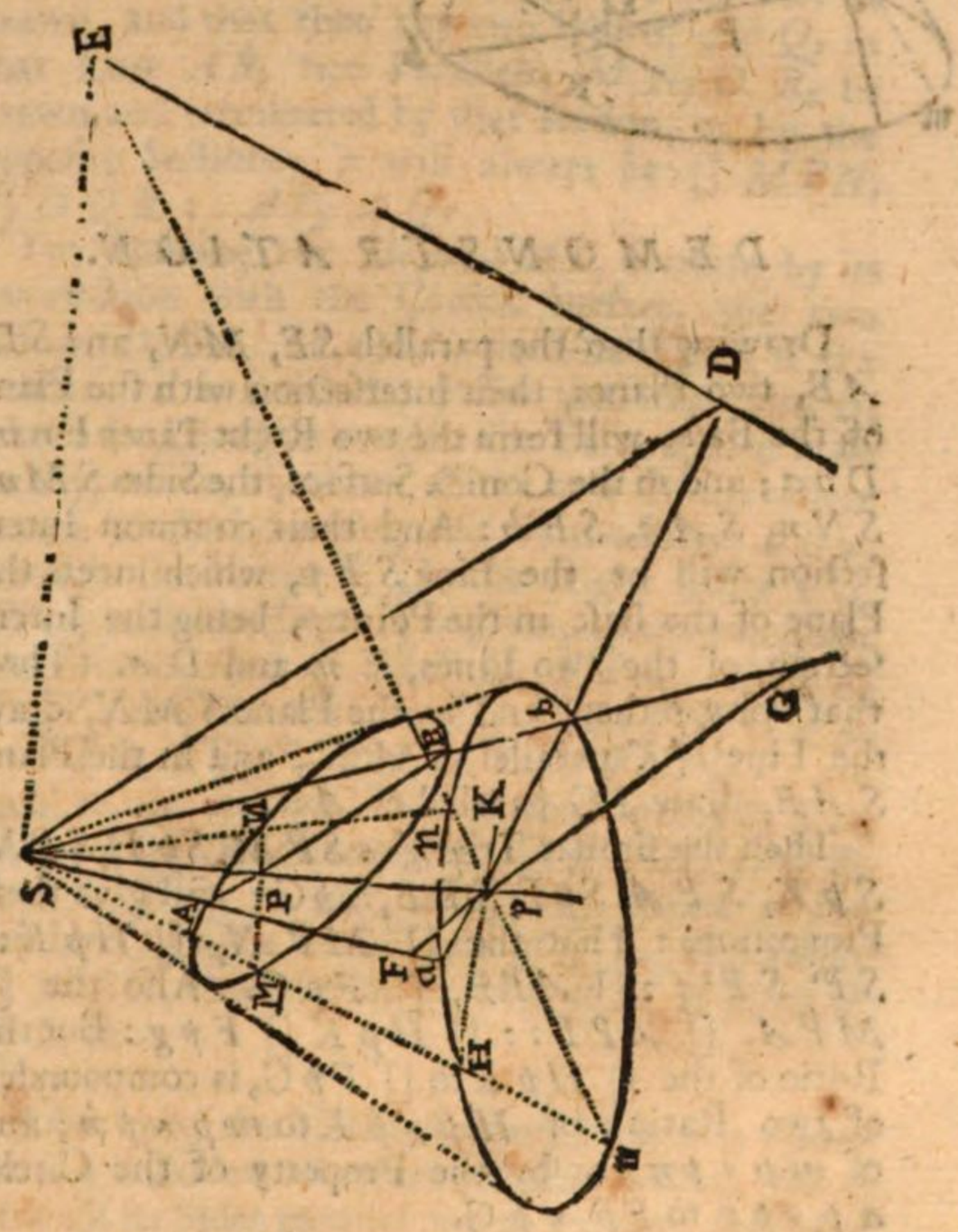
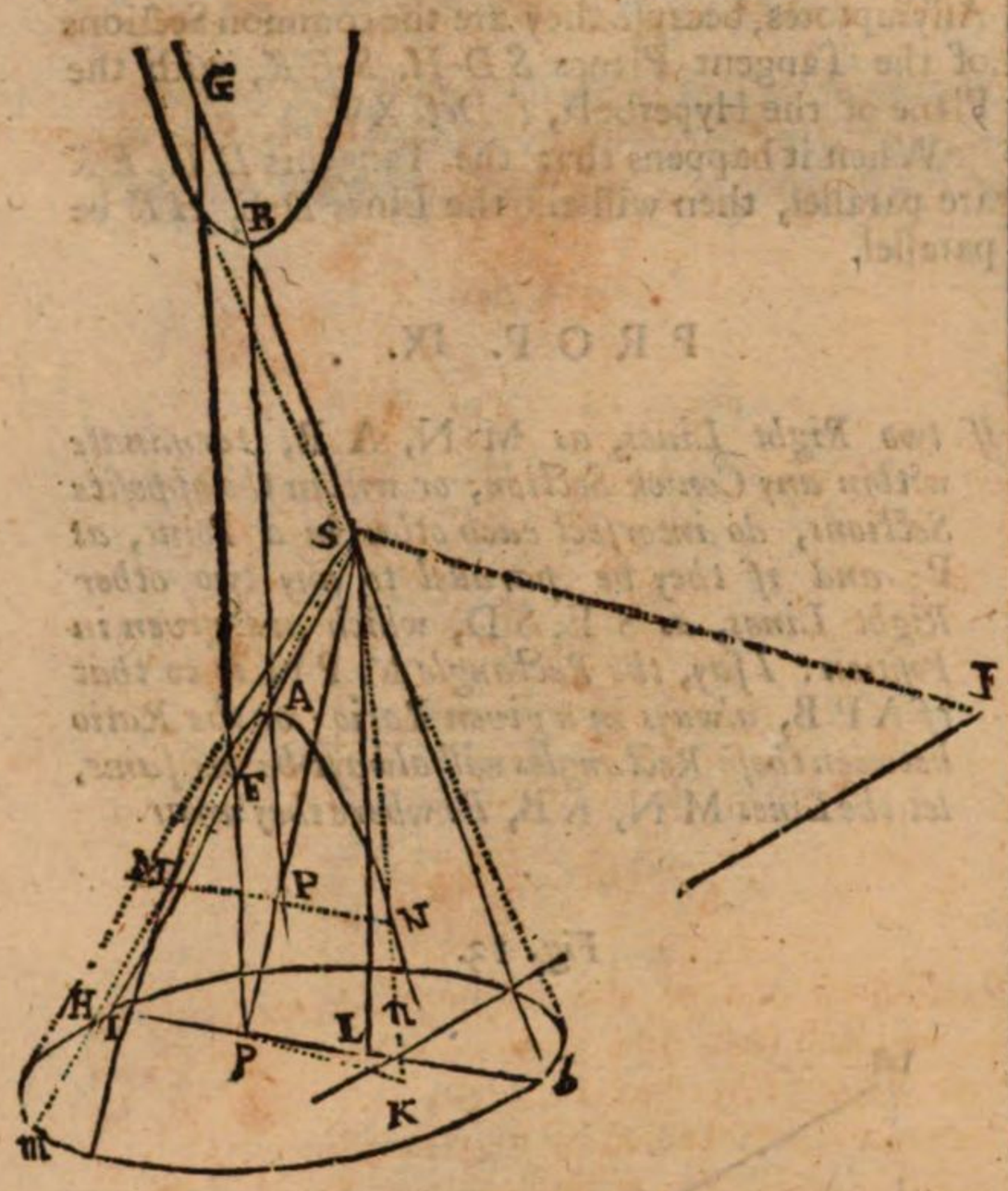



*Fig.* 14.

*Fig.* 14.




## *DEMONSTRATION.*

Drawing thro' the parallels *SE*, *MN*, and *SD*, *AB*, two Planes, their Interſection with the Plane of the Baſe, will form the two Right Lines *E n m*, *D b a*; and in the Conick Surface, the Sides *S M m*, *S N n*, *S A a*, *S B b*: And their common Interſection will be the Line *S P p*, which meets the Plane of the Baſe in the Point *p*, being the Interſection of the two Lines, *E m* and *D a*. Thro' that Point *p* then, and in the Plane *S M N*, draw the Line *H K* parallel to *M N*, and in the Plane *S A B*, draw *F G* parallel to *A B*.

Then the ſimilar Triangles *S P M*, *S p H*, *S P N*, *S p K*, *S P A*, *S p F*, *S P B*, *S p G*; will give theſe Proportions: That the □ *M P N*, □ *H p K*:: *S P*² *S P*² :: □ *A P B*, □ *F p G*. Alſo the □ *M P A*, □ *A P B*:: □ *H p K* □ *F p g*: But the Ratio of the □ *H p K* to □ *F p G*, is compounded of two Ratio's of *H p* × *p K* to *m p* × *p n*; and of *m p* × *p n*; or by the Property of the Circle, *a p* × *p b* to *F p* × *p G*.

But becauſe of the ſimilar Triangles, *H p m*, *S E m*, and *K p n*, *S E n*: It will be *H p*, *m p*:: *S E m E*, and *p K*, *p n*:: *S E*, *E n*.

And then multiplying the Antecedents and Conſequents of thoſe Ratio's, *H p* × *p K*, *m p* × *p n*:: *S E*² *m E* × *E n*.

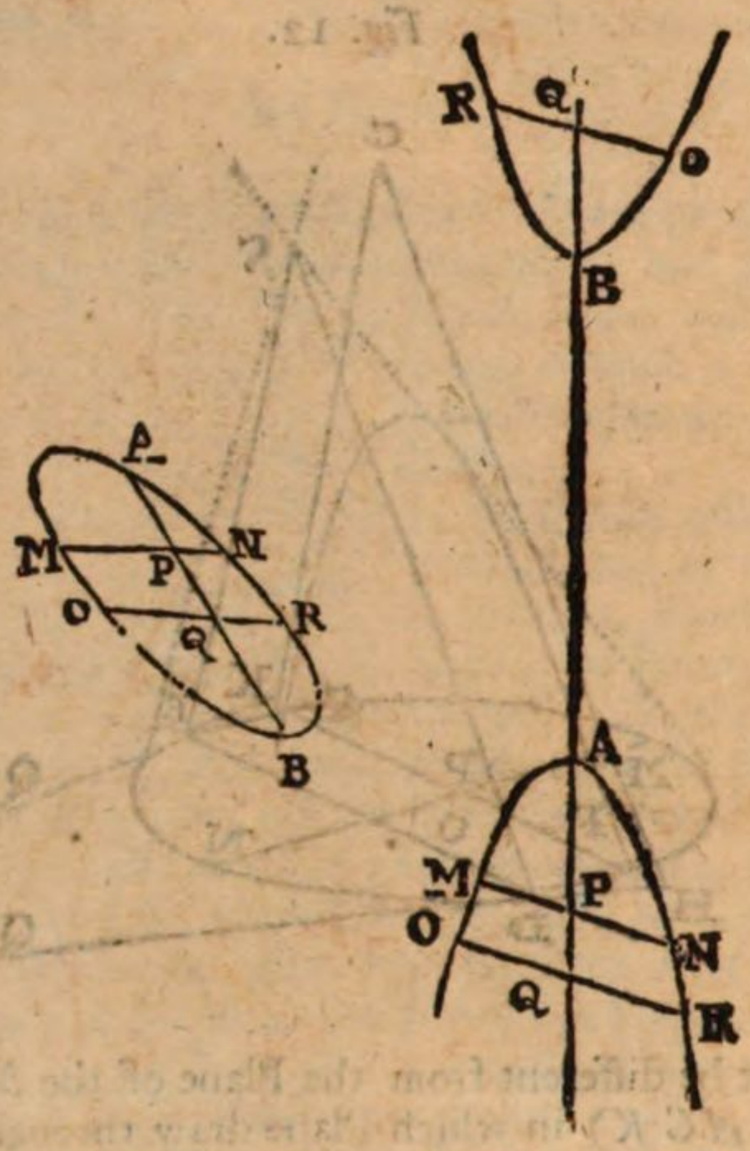
It may be proved alſo from the Similarity of the Triangles *F p a*, *S D a*, and *G p b*, *S D b*: That *a p* × *p b*, *F p* × *p G*:: *a D* × *D b*: *S D*².

'Tis evident therefore, That the Ratio of *P M* × *P N* to *A P* × *P B*, is compounded of two Ratio's of *S E*² to *m E* × *n E*, and of *a D* × *D b* to *S D*²: Which by the Property of the Circle (which Figure the Baſe of the Cone makes) will remain always the ſame, let the Lines *M N*, *A B*, lie how they will, becauſe the Points do not change: Wherefore the Rectangle *A P B*, is always in a given Ratio. *Q. E. D.*

## *CONSECTARY.*

Hence you ſee, that if in any Conick Section, or in the oppoſite Sections, there be two Right Lines, *M N*, *O R*, parallel one to another; and cutting

*Fig.* 15, 16.




a third Line, *A B*, which is alſo terminated within the Section; it will always be □ *M P N* □ *O Q R*:: □ *A P B*, □ *A Q B*.

## PROP. X.

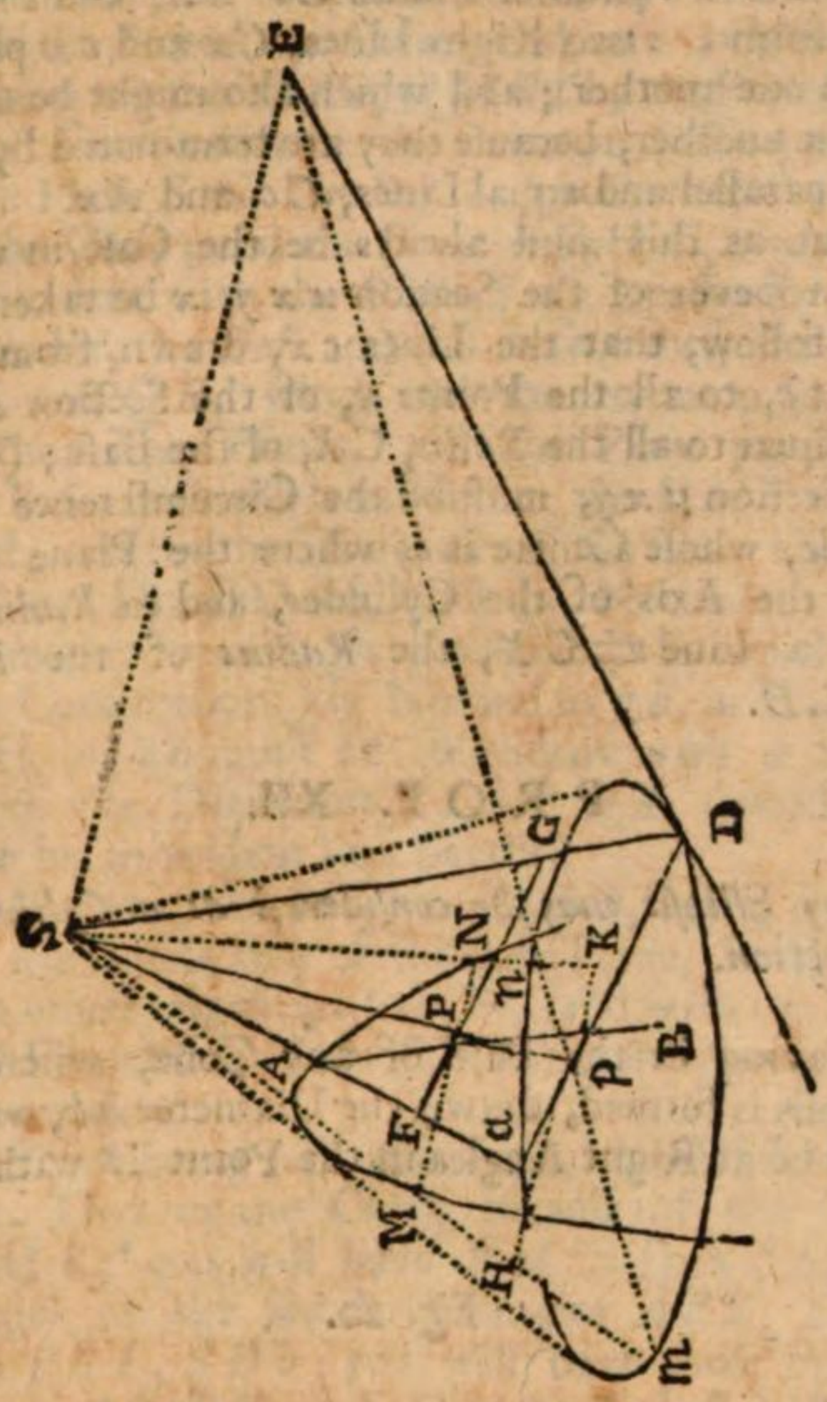
*If thro' any Point, as* A, *of a Parabola or Hyperbola* M A N, *a Right Line, as* A B *be drawn parallel to the Side of the Cone* S D; (*that is, being drawn in the Parabola thro' the Point* D, *where the Directrix touches the Baſe; and in the Hyperbola thro' one of the two Points where the Directrix cuts the Baſe*): *And ſuppoſe thro' any Point, as* P, *in that Line* A B, *a Right Line* M N *be drawn parallel to the Line* S E, *given in Poſition, and terminated by that Section, or the oppoſite Section: Suppoſe alſo another Right Line,* F G, *drawn parallel to the Line* D a, *the common Section of the Plane* S A B *with that of the Baſe, and terminated by the Sides* S a, S D: *Then, I ſay, the Ratio of the Rectangle* F P × P G, *or* F P G *is given,* i. e. *it will be always the ſame, wherever the Point* P *be taken in the Line* A B.

DEMON-

## DEMONSTRATION.

Thro' the Parallel $SE$, $MN$, ſuppoſe a Plane to be drawn, that will form with the Baſe of the Cone, the Right Line $E\,n\,m$, in the Conick Sur-

*Fig.* 17.




face, the Sides $S\,M\,m$, $S\,N\,n$, and in the Plane $S\,D\,a$; the Line $S\,P\,p$, which meets the Baſe in the Point $P$, where the Lines $E\,M$, $D\,A$, interſect each other. Then thro' that, in the Plane $S\,M\,N$, I draw the Line $H\,K$ parallel to $M\,N$.

This being ſuppos'd, the Similar Triangles $S\,P\,M$, $S\,p\,H$, $S\,P\,N$, $S\,P\,K$, $S\,P\,E$, $S\,p\,a$, $S\,P\,G$, $S\,P\,D$ will give us theſe Propoſitions.

$\square\,MPN$, $\square\,Hp\,K :: SP^2\,Sp^2 :: \square\,FPG$, $\square\,ap\,D$; or (by the Property of the Circle) $\square\,m\,p\,n$.

Alſo the $\square\,MPN$, $FPG :: Hp\,k$, $m\,p\,n$.

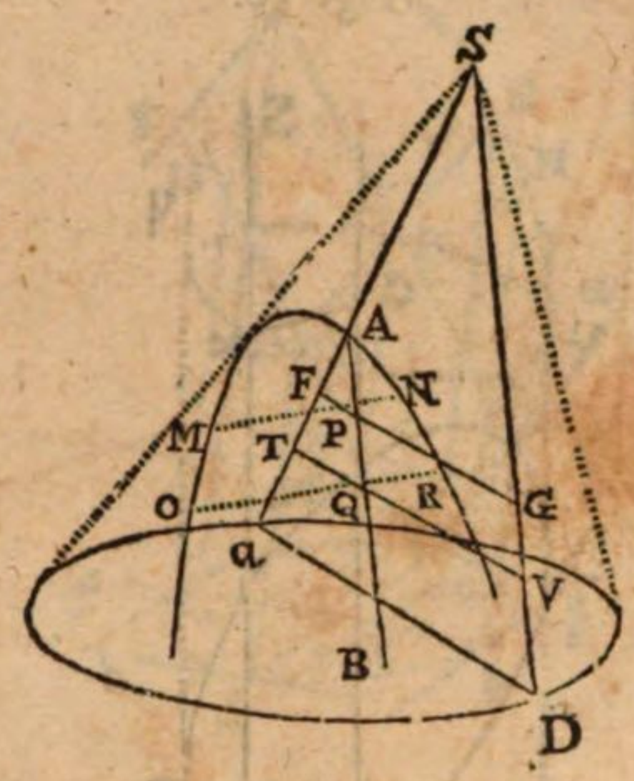
But the Ratio of $\square\,Hp\,k$ to the $\square\,m\,p\,n$, is compounded of the two Ratio's of $Hp$ to $pm$, and of $pk$ to $p\,n$: That is, (becauſe of the Similar Triangles, $Hp\,m$, $SE\,m$, and $Kp\,n$, $SEN$) of the two *Ratio's* of $S\,E$ to $Em$, and of $S\,E$ to $E\,n$; and conſequently $Hp\,K$, $m\,p\,n$, or $MPN$, $FPG :: SE^2\ \square\,m\,E\,n$.

And then, becauſe the Point $E$ varies not, in what Place ſoever the Point $p$ be taken; and ſince all the $E\,m\,n$ are equal, by the Property of the Circle; it will follow, that the Rectangle $M\,P\,N$ muſt be to $\square\,FPG$ in a given Ratio. *Q. E. D.*

## CONSECTARY.

Hence 'tis evident, that if thro' any Point, as $A$ of an Hyperbola or Parabola, $M\,A\,N$, if in the latter, a Diameter, as $A\,B$; or in the former, a

*Fig.* 18.




Parallel to one of the Aſſymptotes, as $A\,B$, be drawn, and that thro' any two Points, $a\,P\,Q$, in that Line $A\,B$, two Parallels, $M\,N$, $O\,R$, be drawn and terminated by that Section, or by the oppoſite Sections; it will always be $\square\,MPN$, $\square\,OQR :: AP$, $AQ$.

For drawing the Plane $S\,A\,B$, forming by its Interſection with the Conick Surface, the two Sides $S\,D$, $S\,a$: of which, the Side $S\,D$, (if the Section be a Parabola) paſſes thro' the Point $D$, where the Directrix touches the Baſe; and if it be an Hyperbola, thro' one of the two Points where it cuts it: And drawing alſo, in the Plane $S\,D\,a$, through the Points $P$, $Q$, the Righr Lines $F\,G$, $T\,V$, parallel to $D\,a$: 'Tis plain, in the precedent Propoſition, that $\square\,MPN$, $FPG :: OQR$, $TQV$; and then alternately, $\square\,MPN$, $OQR$, $:: FPG$, $TQV$. But the Parts $PG$, $QV$, are equal to one another; becauſe the Lines $AB$, $SD$, are parallel: And moreover, $\square\,MPN$, $OQR$, $:: FP$, $TQ$, $:: AP$, $AQ$; by reaſon of the Similar Triangles, $APF$, and $AQT$. Wherefore $\square\,MPN$, muſt be to $\square\,OQR :: AP$, $AQ$. *Q. E. D.*

After this, the Noble Author, becauſe a *Cylinder* is a Solid leſs compounded than a Cone; for it hath all its Sides parallel one to another, inſtead of their terminating in a Point, as they do in the *Cone*; thinks fit to conſider the *Ellipſis* as a *Cylindrick Section*, and from thence demonſtrates the Properties of its Diameters, as alſo thoſe of the *Parabola* and *Hyperbola*.

In order to which, he premiſes theſe Definitions.

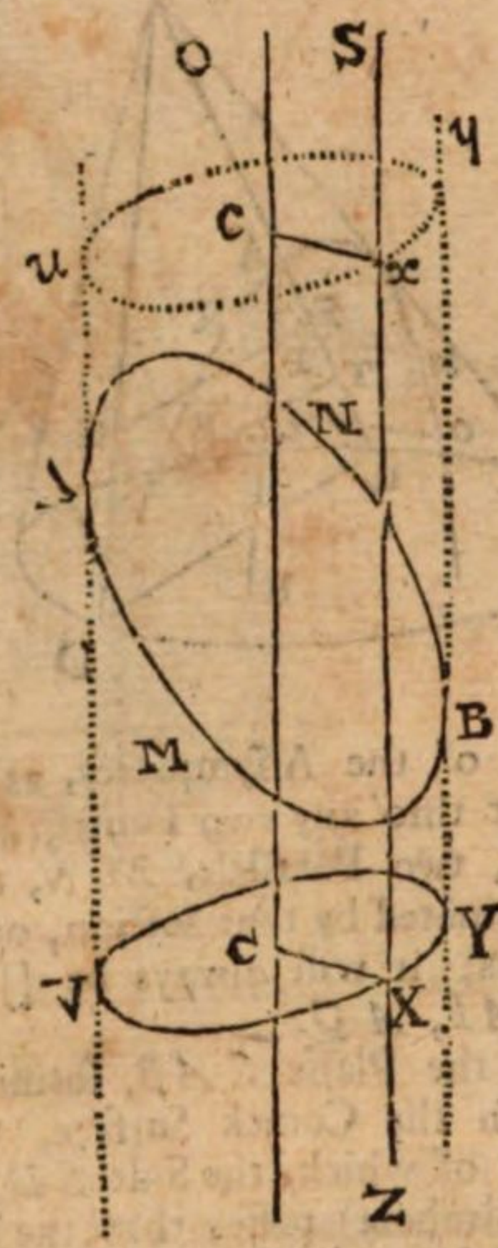
Of

*Of the* Ellipſis *in Particular.*

## *DEFINITIONS.*

XVII. If an Infinite Right Line, as $Sz$, which is without the Plane of the Circle $VXY$, be moved with one of its Points $X$, quite round the Circum-

*Fig.* 19.




ference of that Circle, and keeps always parallel to it ſelf, till it come again to the Place or Point whence it ſet out; then the *Convex Surface*, deſcribed by the Motion of that Line, is called a *Cylindrick Surface.*

XVIII. The Deſcribent Line $SZ$, in any kind of Poſition of its Motion round the Circumference of the Dirigent Circle, is always called the *Side.*

XIX. The Circle $VXY$, is called the *Baſe.*

XX. The Infinite Line $CO$, drawn from the Centre of the Baſe $C$, and parallel to the Sides, is called the *Axis.*

XXI. The Infinite Solid, comprehended under the Baſe $VXY$, and the *Cylindrick Surface*, is called a *Cylinder.*

XXII. If the *Cylinder* be cut by a Plane, neither parallel to its Sides, nor to the Plane of the Baſe, the Curve Line $AMBN$, formed by the Interſection of that Plane with the *Cylindrick Surface*, is called a *Cylindrick Section.*

## PROP. XI.

*If a* Cylinder *be cut by a Plane,* (*ſee* Fig. 147.) *as* u x y, *parallel to the Plane of its Baſe* V X Y; *the Section* u x y, *ſhall be a Circle, whoſe Centre ſhall be the Point* c, *where that Plane interſects the Axis; and its Radius ſhall be the Right Line* c x = C X, *the Radius of the Baſe.*

## *DEMONSTRATION.*

For having drawn through any Point $x$, of the Section $u\,x\,y$, a Side, as $x\,X$, of the *Cylindrick Surface* that ſhall be parallel to the Axis $Cc$; (by *Def.* 20.) wherefore a Plane may be made to paſs through theſe two Lines, which by its Interſection with the two parallel Planes $CV\,XY$; and $c\,u\,x\,y$ will form the two Right Lines, $Cx$ and $c\,x$ parallel to one another; and which alſo might be equal to one another, becauſe they are terminated by the two parallel and equal Lines, $Cc$ and $Xx$.

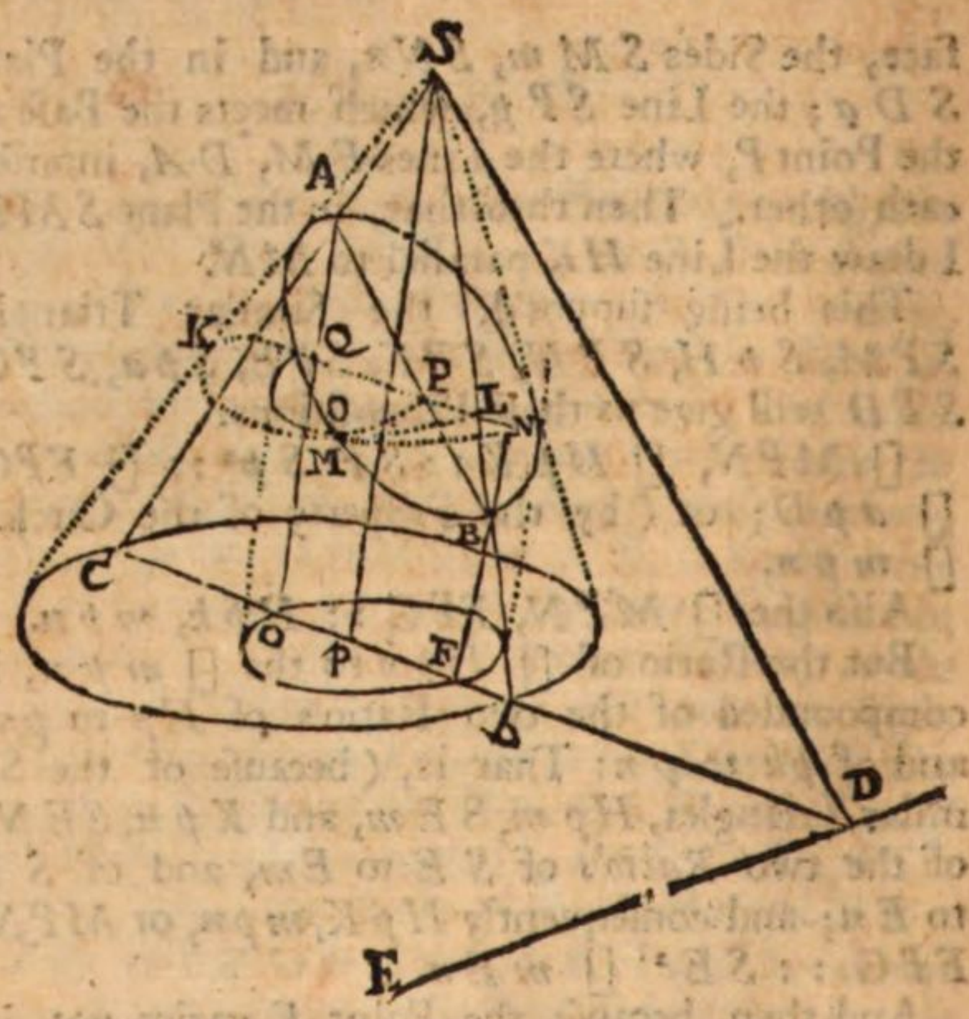
But as this muſt always be the Caſe in what Point ſoever of the Section $u\,x\,y$, $x$ be taken: It will follow, that the Lines $c\,x$, drawn from the Point $c$, to all the Points $x$, of the Section $u\,x\,y$, are equal to all the *Radii*, $C\,X$, of the Baſe; (*i. e.*) the Section $u\,x\,y$, muſt be the Circumference of a Circle, whoſe Centre is $c$, where the Plane $u\,x\,y$ cuts the Axis of the Cylinder, and its *Radius* is $c\,x$, a Line $= C\,X$, the *Radius* of the *Baſe*. *Q. E. D.*

## PROP. XII.

*Every Ellipſis may be conſidered as a Cylindrick Section.*

Having in the Baſe of any Cone, where an Ellipſis is formed, drawn the Diameter $a\,b$, which ſhall be at Right Angles in the Point $D$ with the

*Fig.* 20.




*Directrix* $D\,E$: Let there be drawn alſo in the Conick Surface, the Sides $S\,a$, $S\,b$, meeting the Plane of the Ellipſis in the Points $A$ and $B$, and draw alſo in the parallel Planes $A\,M\,B$, $S\,D\,E$ the Right Lines $A\,B$, $S\,D$.

Then taking $D\,F$, a mean proportional between $a\,D$ and $D\,b$; and drawing to $S\,F$, the Parallels $A\,G$, $B\,H$: Let a Circle be deſcribed on the Plane of the Baſe, whoſe Radius ſhall be $G\,H$; and on that Circle let a Cylindrick Surface be formed, whoſe Sides ſhall be $A\,G$, $B\,H$.

This done, I ſay, that if through any Point, as $P$, in the Line $A\,B$, you draw a Parallel to the *Directrix*

*rectrix* D E, which ſhall cut the Conick Surface in M, and the Cylindrick in O.

Thoſe Two Points, M and O, will be co-incident.

For making a Plane to paſs thro' that Parallel P M, which ſhall be itſelf parallel to the Plane of the Two Baſes, both of the Cone and Cylinder; it will form, by its Interſection of the Conick Surface, the Circle *K M L*, (by *Prop.* 2.) whoſe Centre will be the common Section of that Plane, with the Axis of the Cone; and in the Cylindrick Surface, another Circle, *Q M R*, (by the Precedent) whoſe Centre will be the common Section of the ſame Plane *S a b* (by *Def.* 6.) paſſes thro' the Axis of the Cone; and the Plane A G H B, (which is co-incident with the Plane *S a b*) paſſes thro' the Cylinder, (by *Def.* 20) and conſequently the Lines *K L* and *Q R*, which are the common Sections of thoſe Two Planes, with the Plane parallel to the Baſe, and which paſſes thro' the Line P O, or P M, will be the Diameter of the Two Circles; and that Line P O M, ſhall be Normal to thoſe Diameters, becauſe 'tis parallel to D E, which (by the Conſtruction) is Normal to *a b*, and alſo to G H, which muſt be coincident with *a b*, to which the Diameters *K L* and *Q R*, (which alſo muſt be coincident) are parallel.

Moreover, the Lines *A B*, *S D*, being formed by the Interſection of the ſame Plane, *S a b*, with two others which are parallel, (and with the Plane *S D E*, and that of the Ellipſis) muſt be parallel to one another.

Which being well underſtood, it will follow:

1. That in the Cone, becauſe of the Circle *K M L*, you will have $PM = \square KPL$, and becauſe of the Similar Triangles *A P K*, *S D a*, and *P B L*, *S D b*; you will have thoſe Proportions: *A P*, *P K* :: *S D*, *a D*, and *P B*, *P L* :: *S D*, *D b*; whence it will follow, $AP \times PB$, $KP \times PL$ (or $PM^2$) :: $SD^2$ $aD \times Db$.

2. In the Cylinder, becauſe of the Circle *Q O R*, $PO^2 = \square QPR$, and from the Similar Triangles, *A P Q*, *S D F*, and *P B R*, *S D F*; theſe Proportions will ariſe, *A P*, *Q P*, :: *S D*, *D F*, and *P B*, *P R*, :: *S D*, *D F*: Whence it will follow, that *A P*, *P B*, $QP \times QR$ (or $PO^2$) :: $SD^2$, $DF^2$, (or $Da \times Db$). Wherefore, $PM^2 = PO^2$; and therefore $MP = PO$, and conſequently the Points *M* and *O* will be coincident: And becauſe this will always be the Caſe in what Part ſoever of the Line *A B*, the Point *P* be taken; it will follow, that the Plane of the Ellipſis meets or cuts the Conick and Cylindrick Surfaces in the ſame Points; and therefore the Ellipſis may always be conſidered as a Cylindrick Section.

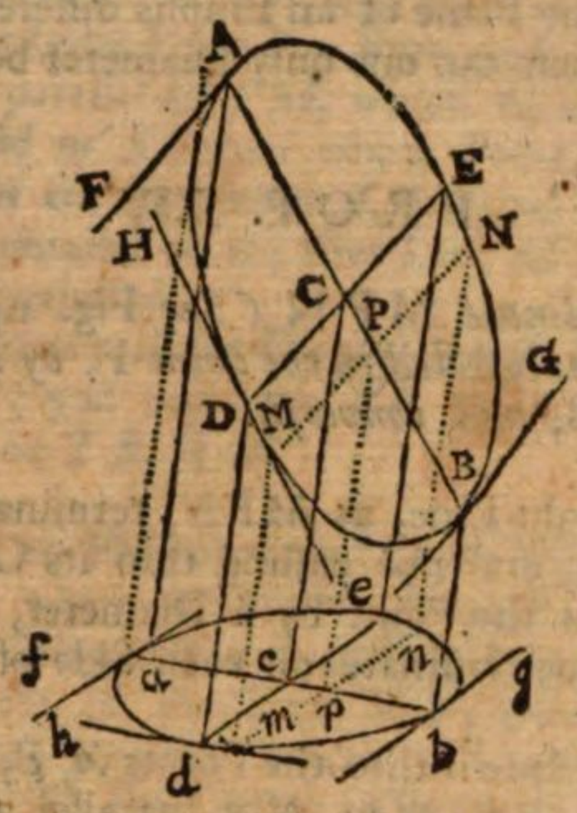
## PROP. XIII.

*All the Diameters of the Ellipſis paſs thro' one only Point: Which is that where the Plane of the Ellipſis cuts or interſects the Axis of the Cylinder, and do there biſect one another: And converſely, all Right Lines paſſing thro' that Point, and terminated at each End by the Ellipſis, are biſected in that Point, and are alſo Diameters of the Ellipſis.*

They call that Point the *Centre* of the *Ellipſis*.

1. Let *A B* be any Diameter whatſoever; ſo let *C* be the Point where the Plane of the Ellipſi

*Fig.* 21.




interſects the Axis of the Cylinder. If you draw the Lines *A a*, *B b*, parallel to the Axis *C c*, 'tis plain (by *Def.* 20.) that they will be the Sides of the Cylindrick Surface; and that the two Planes, *F A a*, *G B b*, paſſing thro' thoſe Lines, and thro' the Tangents *A F*, *B G*, (which according to the Definition of the Diameter, will be parallel to one another) muſt be parallel, and muſt touch the Cylindrick Surface in the Sides *A a*, *B b*. From whence it follows, that thoſe two Planes will form in the Plane of the Baſe, the two Lines *a f*, *b g*, parallel to each other, and Tangents to the Baſe in the Points *a*, *b*; where the Sides *A a*, *B b*, interſect it.

Now from the Elements of Geometry 'tis plain, that the Line *a b*, which connects the Points of the Contact of the two parallel Tangents; *a f*, *b c*, in any Circle, muſt paſs thro' its Centre *c*. Wherefore the Plane *A a b B* will paſs thro' the Axis of the Cylindrick; and the Line *A B*, which is the Interſection of the Plane with that of the Ellipſis, muſt paſs thro' the Point *C*, where that Axis interſects the Plane of the Ellipſis.

Again, by reaſon of the Parallels *A a*, *C c*, *B b*, 'tis plain, that the Diameter of the Ellipſis *A B*, is divided into two equal Parts, or biſected in *C*; becauſe the Diameter of the Circle of the Baſe *a b*, is biſected in its Centre *c*, which was the firſt thing to be prov'd.

2. If thro' the Extremities of any Line, as *A B*, paſſing thro' *C*, where the Plane of the Ellipſis cuts the Axis *C c* of a Cylinder, you draw the *A a*, *B b*, parallel to that Axis, 'tis plain, (from *Def.* 17.) that they will be the Sides of that Cylinder; and that the Plane *A a b B*, muſt paſs thro' its Axis. Whence you ſee, that the Line *a b*, which is the common Section of the Plane, and of the Plane of the Baſe, paſſes thro' *c* the Centre of the Baſe; and alſo that it is cut into two equal Parts, the Line *A B* muſt alſo be biſected in *C*.

Again, the Tangents *a f*, *b g*, which paſs thro' the Extremities of the Diameter *a b*, being parallel; the Tangent Planes *f a A*, *c b B*, muſt be parallel alſo; and will form in the Plane of the Ellipſis two parallel Lines, *A c*, *B G*, which ſhall be Tangents to that Curve in the extreme Points

*A*, *B*, of the Line *AB*; wherefore that Line will be a Diameter.

Which was the Second Point to be prov'd.

### *CONSECTARY.*

Hence 'tis evident, that through any one Point given in the Plane of an Ellipſis different from its Centre, there can one only Diameter be drawn:

## PROP. XIV.

*Every Ordinate* MPN *(See* Fig. 149.*) of an Ellipſis is biſected in the Point* P, *by the Diameter* AB, *and converſly.*

If a Right Line, as *MPN*, terminated within an Ellipſis, and not paſſing thro' its Centre *C*, is biſected in the Point by a Diameter, as *AB*, it ſhall be true Ordinate on each Side of that Diameter.

Having drawn thro' the Points *A*, *B*, *M*, *N*, the Sides *Aa*, *Bb*, *Mm*, *Nn*, parallel to *Cc* the Axis of the Cylinder, and interſecting the Plane of the Baſe in the Points *a*, *b*, *m*, *n*; the Line *Pp*, which is the common Interſection of the two Planes *AabB*, *MmnN*, will be parallel to the Sides of the Cylinder; becauſe all thoſe Sides are parallel to one another. The Plane *AabB* alſo muſt paſs thro' *Cc* the Axis of the Cylinder, becauſe the Diameter *AB* paſſes thro' the Point *C*, where that Axis interſects the Plane of the Ellipſis, and conſequently it will form in the Plane of the Baſe a Line, as *ab*, which will paſs through the Centre *c*, *i. e.* which will be a Diameter.

This being ſuppoſed:

1. Becauſe by the Hypotheſis the Line *MPN* is an entire Ordinate to the Diameter *AB*, it will be parallel to the Tangents *AF*, *BG*, which paſs thro' the Ends of that Diameter; and conſequently the Tangent Planes, *FAa*, *GBb*, will be parallel to the Plane *MmnN*; wherefore the three Lines, formed by thoſe three Planes, by their Interſection with the Plane of the Baſe, as *af*, *bg*, and *mn*, muſt alſo be parallel; and conſequently the Line *mn* will be Normal to the Diameter *ab*, and therefore will be biſected by it in the Point *p*; wherefore, becauſe of the Parallels *Mn*, *Pp*, *Nn*, it will follow, that the Line *MN* muſt alſo be biſected in the Point *P*.

2. And then, as to the Converſe, if you draw in the Plane of the Ellipſis, the two Tangents, *AF*, *BG*, (*Cor.* 4. *Prop.* 5.) parallel to *MN*, and then from the Points of the Contact, the Diameter *AB*. 'Tis plain, (from *Def.* 13, 14.) that from the Right Line *MN*, will be an entire Ordinate to that Diameter, and conſequently will be biſected in *P* by that Diameter.

But as there can but one Diameter be drawn thro' *P*, (by the Precedent) it will follow, That if a Line, as *MN*, terminated within any Ellipſe, and not paſſing thro' its Centre, be biſected in *B*, by a Diameter *AB*, it ſhall be a true entire Ordinate to that Diameter.

## PROP. XV.

*If in an Ellipſis there be two Diameters,* AB, DE, *(See* Fig. 149.*) and one of them, as* DE, *be parallel to the Tangents* AF, BG, *which paſs thro' the Extremities of the other* AB.

I ſay, that the Diameter *AB*, ſhall be parallel to the Tangents which paſs thro' the Extremities of the Diameter *DE*.

*Note*, In this Caſe the Diameter *AB*, and *DE*, are called *Conjugate* one to another.

Having drawn thro' the Points *A*, *B*, *D*, *E*, the Sides *Aa*, *Bb*, *Dd*, and *Ee*, of the Cylinder, which cuts the Plane of the Baſe in the Points *a*, *b*, *d*, *e*: The Planes *AabB*, *DdeE*, will paſs thro' the Axis of the Cylinder, becauſe the Lines *AB* and *DE* are Diameters of the Ellipſis; and conſequently they will form in the Plane of the Baſe, the two Diameters *ab*, *de*. But the Tangent Plane *FAa*, being parallel to the Plane *DdeE*, will form in the Plane of the Baſe a Tangent, as *af*, parallel to the Diameter *de*; which Diameter alſo will be Normal to the Diameter *ab*.

If then, thro' one of the Extremities *d*, of the Diameter *de*, you draw a Tangent to the Circle, as *dh*, that will be parallel to *ab*, and the Plane *hdD*, to the Plane *AabB*. Wherefore the common Sections of thoſe two Planes, with the Plane of the Ellipſis, *i. e.* the Tangent *DH*, and the Diameter *AB*, muſt alſo be parallel one to another.

The ſame thing may be proved with regard to the Tangent that paſſes thro' the other End *E*, or of the Diameter *DE*.

Wherefore the *Propoſition* is proved.

### *CONSECTARIES.*

I. From hence 'tis plain, that if there be two Conjugate Diameters in an Ellipſis, as *AB*, *DE*; the two Planes which paſs thro' thoſe Diameters, and thro' the Axis of the Cylinder, will form in the Plane of the Baſe two Diameters, *ab*, *de*, which ſhall be Normal one to another.

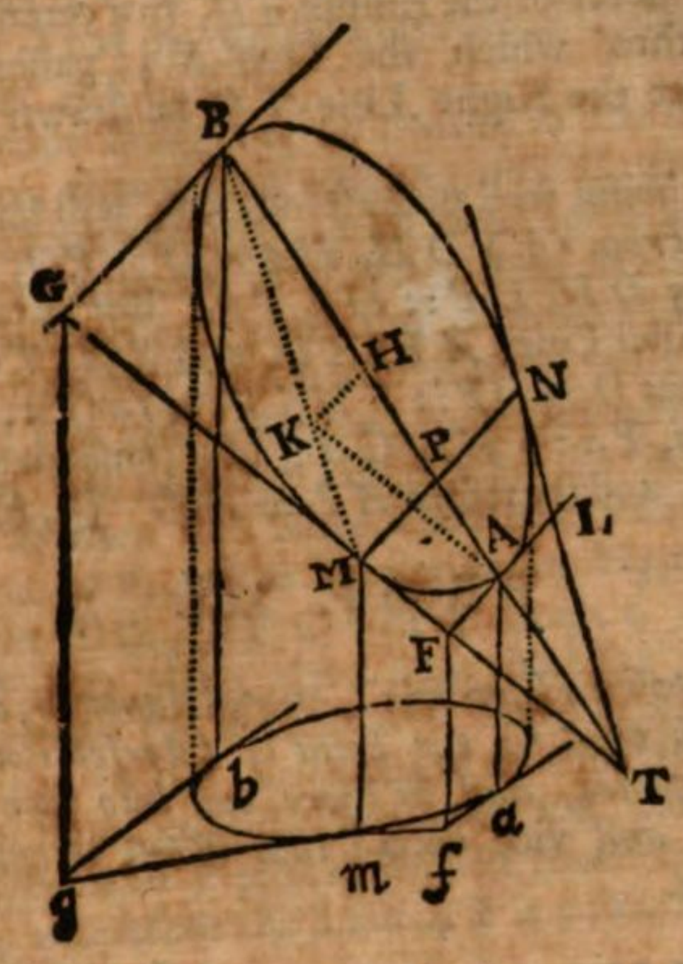
II. It follows alſo from this Propoſition, that if thro' any Point, as *P*, of a Diameter, as *AB*, in an Ellipſis, you draw an entire Ordinate, as *MPN*, that ſhall be parallel to the *Conjugate* Diameter *DE*; and you will have (by *Conſect. Prop.* 9.) theſe Propoſitions; $MP \times PN$, (or $PM^2$) : $DC \times CE$, (or $CD$) :: $AP \times PB$. $AC \times CB$, (or $AC^2$) and that will give us $PM^2$ $AP \times PD$ : : $DC^2$ $AC^2$ : : $\frac{DC^2}{4}$ (or $DE^2$) $\frac{AC^2}{4}$ (or $AB$): That is, the Square of any Semi-Ordinate to the Diameter, that is, *MP* is to the Rectangle *APB* under the Parts of that Diameter: : as the Square of the Conjugate Diameter *DE*, is to the Square of the Diameter *AB*.

## PROP. XVI.

*If thro' any Point, as* M *in an Ellipſis* A M B, *and Tangent* F M G *be drawn, which in the Points* G F, *ſhall interſect any two parallel Tangents, as* A B, B G; *I ſay,* F M, M G :: A F, B G.

For, drawing thro' the Points of Contact, *A*, *B*, *M*, the Sides *A a*, *B b*, *M m*, of the Cylinder; and thro' theſe Sides, and the Tangents *A F*, *B G*, F G, drawing the Planes *F A a*, G *B b*, *F M m*,

*Fig.* 22.




or G *M m*: 'Tis plain, that *F f*, G *o*, the common Sections of the firſt two Planes with the third, muſt be both parallel one to another, and to the Sides of the Cylinder. For the two Planes, *F M m*, *F A a*, paſſing thro' the Sides *M m*, *A a*, which are parallel, will have their common Section *F f*, parallel to thoſe Sides; and for the ſame Reaſon G *o*, the common Section of the two Planes G *B b* and G *M m*, will be parallel to the Sides *B b*, *M m*. Moreover, the Line *a f*, *b g*, which from the parallel Tangent Planes *F a*, G *B b*, with that of the Baſe being parallel: The Parts *f m*, *m o*, of the third Tangent formed in the Plane of the Baſe, by the third Tangent Plane *F M m*, or G *M m*, muſt be (by the property of the Circle) parallel to the Tangents *a f*, *b o*, *vid. f m* parallel *f a*, and *m o* parallel *o b*.

Which being ſuppoſed, by reaſon of the Right Lines *A a*, *F f*, *M m*, G *o*, *B b*, and *A F*, *B B*, and *a f*, *b o*, which are reſpectively parallel to one another, you will have,

*F M*, *M* G :: *f m*. or *f a*, *m o*, or *g h* :: *F A*, G *B*. *Q. E. D.*

### *CONSECTARIES.*

I. If thro' the Points of Contact *A*, *B*, of the two parallel Tangents *A F*, *B* G, a Diameter, as *A B* be drawn, which ſhall interſect in the Point *T*, another Tangent, as *F M* G; and if an Ordinate, as *M P*, be drawn to that Diameter; 'tis plain, that *A P*, *P B* :: *F M*, *M* G :: *A F*, B G :: *A T*, B *T*. And alſo that *P* B — *A P*, *B P* :: *B T* — *A T*, (or B *A*) B *T*.

II. From hence the following manner of drawing to the Point *M* in an Ellipſis, a Tangent, as *M T*, is taken, when the Diameter *A B* is given, with the Poſition of its Ordinates.

From one of the Ends *B*, of the Diameter *A B*, to give a Point *M*, let the Right Line *B M* be drawn: And then having drawn the Ordinate *M P* to the Diameter *A B*, and taken in that Diameter towards the Point *P*, a Part, as *P H* = *P A*, draw *H K* parallel to *P M*, which ſhall interſect the Line *M m K*; thro' which Point, and the other End of the Diameter *A*, drawing *A K*, and then *M T* parallel to it; that Line *M T* ſhall be the parallel required.

For on account of the Parallels *M P*, *H K*, and *A K*, *M T*; you will have *B P*, *D H*, or *P A* :: *B M*, *M K* :: *T B*, *T A*.

III. If in an Ellipſis there be two Tangents, as *M T*, *N T*, which meet in the Point *T*.

I ſay, the Diameter *A B*, paſſing thro' the Point *P*, the middle of the Line *M N*, joining thoſe two Tangents in their Points of Contact; ſhall paſs alſo thro' *T*, their Point of Interſection.

For, *P N* is an Ordinate to the Diameter *A B*, as well as *P M*; and conſequently the (by *Cor.* 1.) Tangents *M T*, *N T*, muſt ſo meet or interſect the Diameter in a Point, as *T*; that *P B* — *A P*, *P B* :: *A B*, *B T*, that is, in the ſame Point.

IV. If to the Point of Contact, *M*, *N*, of two Tangents to the Ellipſis, a Right Line, as *M N* be drawn, and that it have a third Tangent, as *F A L* parallel to it: I ſay, that *F A*, *A L*, the Parts of that third Tangent taken between its Points of Contact *A*; and the two former Tangents will be equal one to another.

For, drawing thro' the Points of Contact *A*, the Diameter *A B*: 'Tis plain, the Line *M N* will be an entire Ordinate to that Diameter, becauſe it is parallel to the vertical Tangent *F L*; and therefore alſo it muſt be biſected in *P*, and (by *Cor.* 3.) will paſs thro' *T*, the Point of Interſection of the two Tangents *M F*, *N L*; or will be parallel to them (by *Prop.* 15.) when the Line *M N* is a Diameter.

But 'tis plain in both Caſes, that *F L* will be biſected in *A*, by the Diameter *A B*; becauſe *M N* is ſo biſected in the Point *P*, by the ſame Diameter.

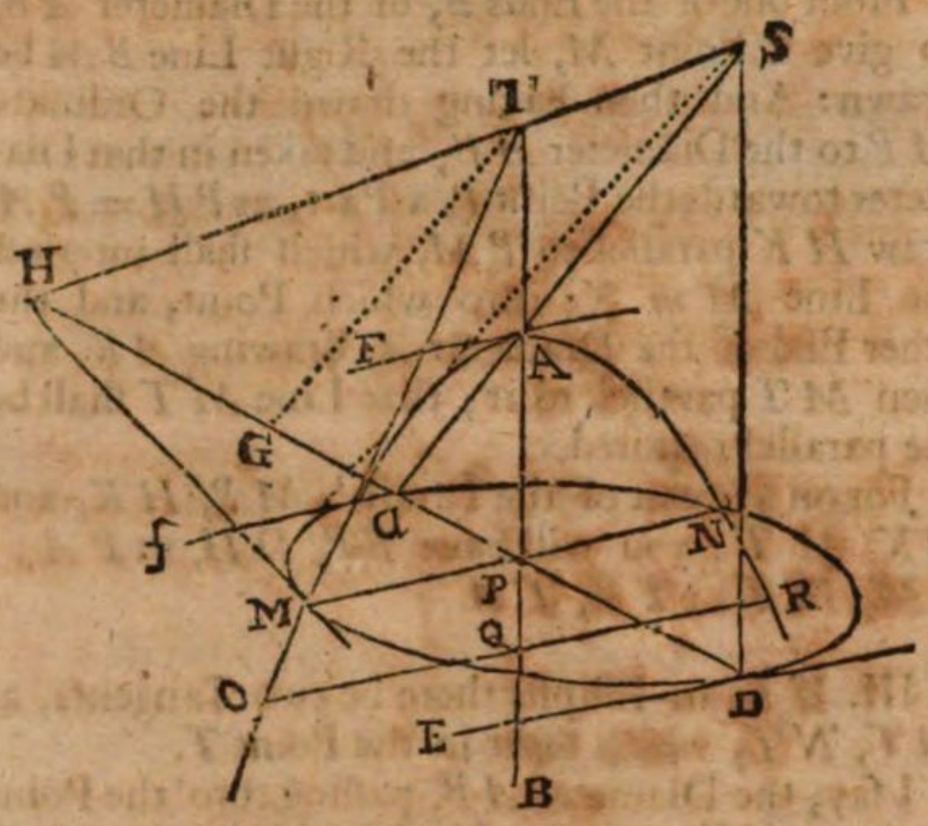
### *Of the* Parabola *and* Hyperbola, *particularly.*

## PROP. XVII.

*In the* Parabola, *every entire Ordinate (as* M P N) *to a Diameter, as* A B, *is biſected by that Diameter in the Point* P, *and* vice verſa.

For having made an Elliptick Plane which ſhall paſs thro' the Line *M N*, that will form with the

*Fig.* 23.




Tangent Plane *S D E*, parallel to the parabolick Plane, a Tangent, as *D E* parallel to *M N*.

Again, the Plane *S A F*, drawn thro' *S* the Vertex of the Cone, and thro' the Tangent *A F*, which paſſes thro' *A*, the Vertex of the Diameter *A B*, will form in the Elliptick Plane, a Tangent, as *f a*; and the Line *D a* jointly, the Points of Contact of the two Tangents *D E*, *a f*, will paſs thro' the Point *P*, becauſe the Diameter *A B* is parallel to the Tangent Side *S D*.

This ſuppoſed,

Becauſe by the Hypotheſis *A F* and *M N*, are parallel, (*vid Def.* 14.) it will follow, that the Tangent *a f*, which is the common Section of two Planes paſſing thro' thoſe Lines, will be parallel to *M N*, and conſequently to *D E*. Whence it appears, that the Line *D a* (by *Def.* 13.) joining the Points of Contact of the two parallel Tangents *D E*, *a f*, is a Diameter of the Ellipſis; and alſo that the Line *M N*, which is parallel to thoſe Tangents, and terminated by the Ellipſis, ſhall be (by *Prop.* 14.) biſected in the Point *P*.

The *Converſe* will thus appear.

Draw in the Parabolick Plane, the Tangent *A F* (by *Cor.* 4. of *Prop.* 5.) parallel to the Line *M N*; and thro' the Point and Contact *A*, a Diameter, as *A B*, the Line *M N* will be an Ordinate rightly apply'd (by *Def.* 14.) and conſequently muſt be biſected in *P*.

And becauſe there is but one only Diameter that can paſs thro' that middle Point *P*; *A B* muſt be it, (by *Def* 15.) and in the following Corollary.

## *CONSECTARY.*

Hence 'tis evident, that if thro' any two Points *P*, *Q*, of a Diameter *A B*, two entire Ordinates, *M P N*, *O Q R*, be drawn; you will always have this Proportion: (by *Conſect. Prop.* X.) That *M P* × *P N*, or *P M*². *O Q* × *Q R* (or *O Q*²) :: *A P*, *A Q*; that is, the Square of any two Ordinates, as of *M P*, *Q O*, to any Diameter, as *A B*, are always as the *Abciſſæ* or intercepted Parts of that Diameter, *A P*, *A Q*.

## PROP. XVIII.

(*See Fig.* 23.)

*If thro'* M *any Point in a Parabola, you draw an Ordinate* M P, *to any Diameter* A B, *and alſo a Tangent* M P, *meeting in* T, *that Diameter produced beyond the Vertex* A; *I ſay,* A P *will always be equal to* A T.

The ſame thing being ſuppoſed, as in the laſt Propoſition: Let there be alſo drawn thro' *S* the Vertex of the Cone, and the Line *M T*, a Tangent Plane *S T M*, which will form in the Elliptick Plane, the Tangent *M H*, which will cut the Diameter of the Ellipſis *a D*, in a certain Point as *H*, thro' which the Line *S U* paſſes: And laſtly, let the Right Line *T G* be drawn parallel to *S A*.

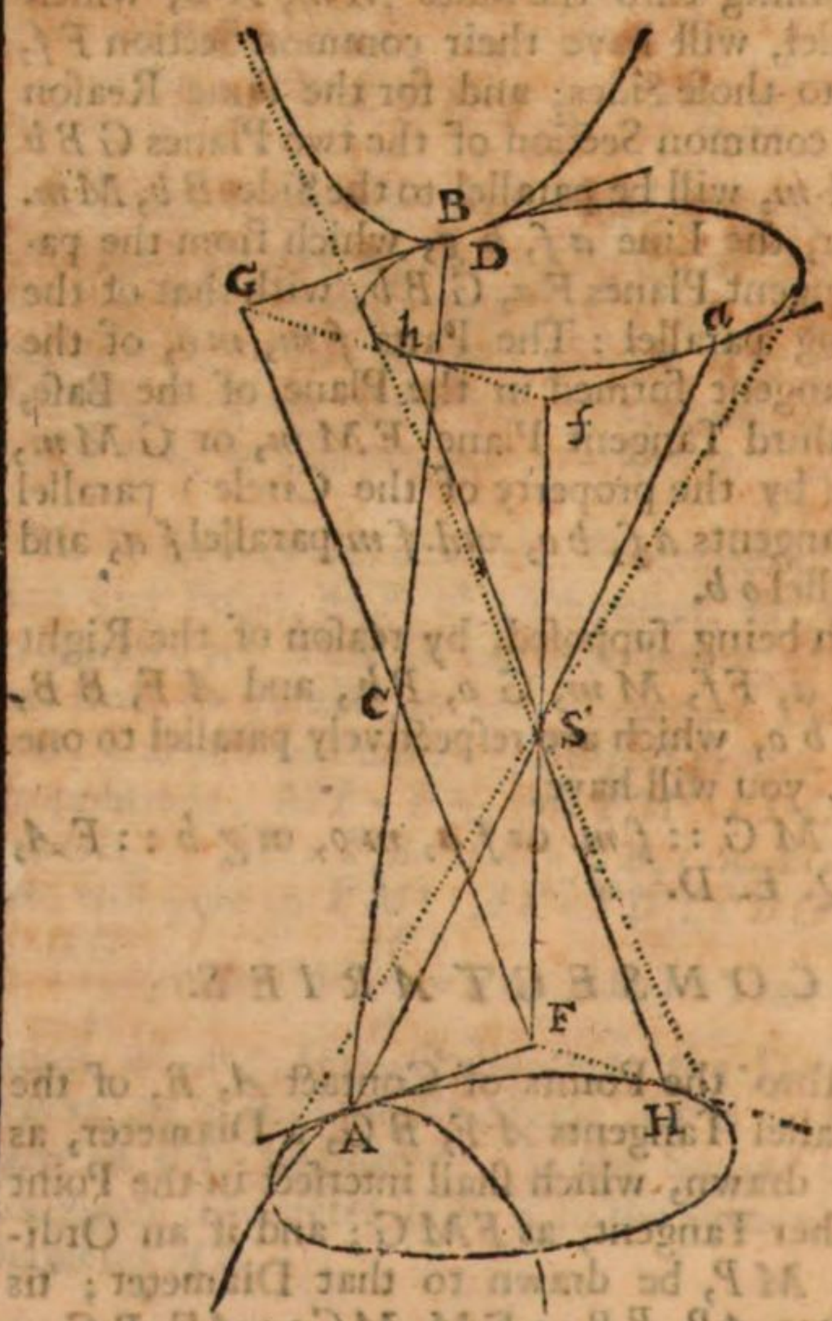
This being well underſtood, you will have (by *Cor.* 1. *Prop.* 16.) *D H*, *H a* :: *D P*, *P a*, and alternately *D H*, *D P* :: *H a*, *P a*. But by reaſon of the parallel Lines *A B*, *S D*, and *S A*, *T G*: 'Tis plain, that *D H D P* :: *S H S T* :: *H a G a*; wherefore *H a*, *P a* :: *H a*, *G a*; and conſequently *P a* = *G a*; and therefore *A P* = *A T*. *Q. E. D.*

## PROP. XIX.

*In the oppoſite Hyperbola's, every Diameter, as* A B, *paſſeth thro'* C, *the Point of Interſection of the Aſſymptotes, and is there cut into two equal Parts, and* vice verſa; *that Point is called the Centre.*

Let *H S h* be one of the two common Sections of a Plane parallel to the Hyperbolick Plane, and the two oppoſite Conick Surfaces, and let the

*Fig.* 24.




Aſſymptote *F G* be formed by the Interſection of the Plane of the Hyperbola, with that which touches the two Surfaces *H S h*.

Let

Let there be drawn thro' the parallel Tangents *A F*, *B G*, which pass thro' the Ends of the Diameter *A B*, and intersect the Assymptote *F G* in the Points *F*, *G*, two parallel Elliptick Planes; and those will form with the Tangent Plane which passes thro' the Side *H S h*, the parallel Tangents *F H*, and *G h f*; and in the Tangent Plane *S A F*, the parallel Tangents, *A f*, *a f*.

This proportion being made, the parallel Lines *F H*, *G h*, being contained between the two other parallels *F G*, *H h*, will be equal. And the similar Triangles, *S H f*, *S h f*, and *S F A*, *S f a*, will give *H F*, *h f* :: *S f*, *s f* :: *F A*, *f a*; and also *H F*, *F A* :: *h f*, *f a* :: (by *Prop.* 16.) to *G G B*. And hence, because *H F*, *H G*; it will follow, that *A F* = *B G*, and because of the similar Triangles, *A C F*, *B C G*; it will follow, that *A C* = *C B*: That is, the Assymptote *F G*, bisects the Diameter *A B* in *C*.

The same thing may be proved of the other Assymptote, that it shall pass also thro' *C*, the middle of the Diameter *A B*; from whence 'tis apparent, That the Diameter *A B* passes thro' *C* the Centre of the two Assymptotes, and is there bisected.

Let there be then a Line, as *A B*, which passing thro' *C* the Intersection of the Assymptotes, shall intersect the opposite Hyperbola's in the Points *A B*. If then you draw thro' the Point *A*, the Tangent *A F*, and to the opposite Hyperbola, a Tangent *D G*, (by *Consect* 4. *Prop.* 5.) parallel to *A F*; 'tis plain, that since the Line *A D* may be proved to be a Diameter, it will pass thro' *C*, the Point of the Intersection of the Assymptotes. It must be co-incident then with *A B*, which (by the *Hypotheses*) passes thro' the same two Points, *A*, *C*; wherefore the Line *A B* is a Diameter, and is bisected in *C*.

## *CONSECTARY.*

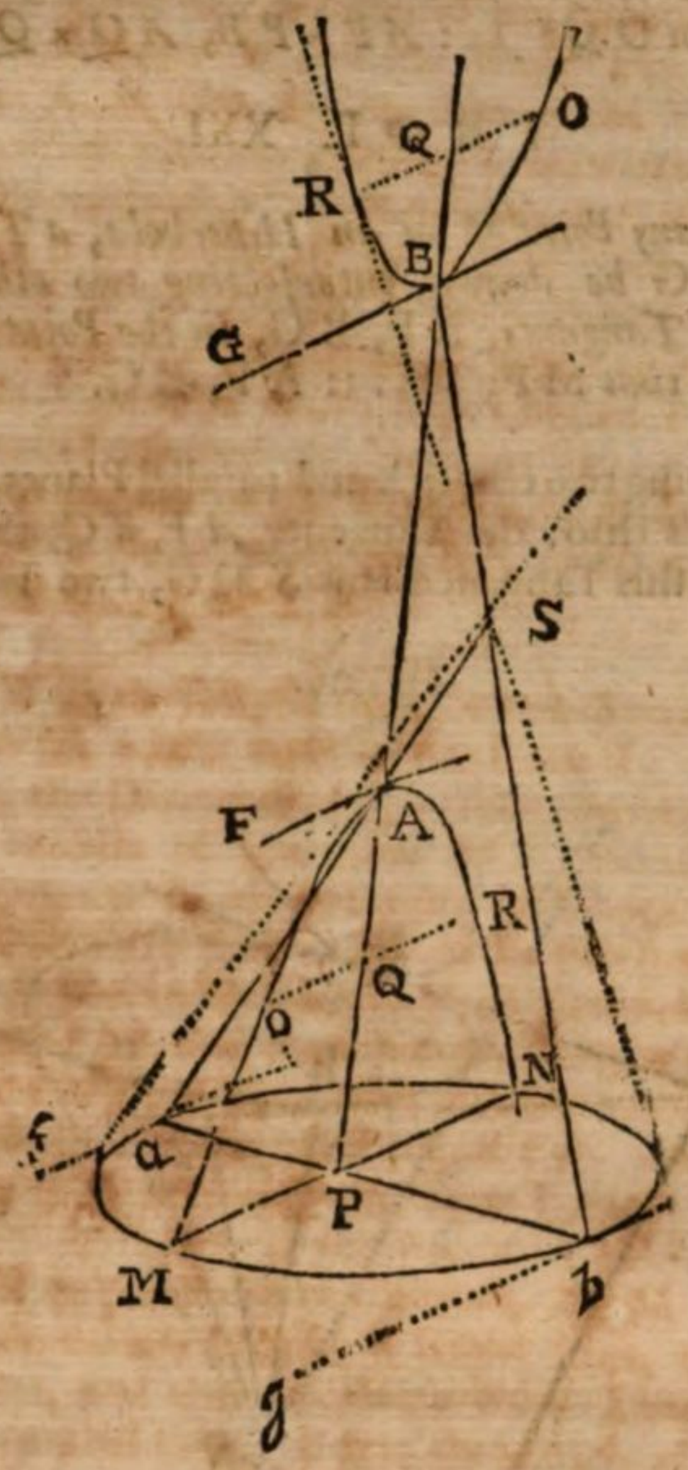
Hence you see that from any Point given within an Hyperbola, there can be but one only Diameter drawn; because no other Line can pass through that Point, and thro' the Centre.

## PROP. XX.

*In the opposite Hyperbola's, every entire Ordinate* M P N, *is bisected in* P, *by its proper Diameter* A B; *and* vice versa.

Having made an Elliptick Plane to pass thro' the Line *M N*, it will form in the two Tangent Planes, *S A F*, *S B G*, the Tangents *a f*, *b g*.

*Fig.* 25.




And the Line *a b* connecting the Points of Contact of those two Tangents, being the common Section of the Elliptick Plane of the Plane *S A B*, will pass thro' the Point *P*.

But because by the Hypothesis, the two Lines *A F*, *M N* are parallel; it follows, That the Line *a f*, which is the common Section of two Planes passing thro' these two Lines, will be parallel to *M N*.

For the same Reason, the Tangent *b g*, which is the common Section of the Elliptick Plane, and of the Tangent Plane *S B G*, which two Planes do pass thro' the two parallels *M N*, *B G*, will be parallel to *M N*.

The Tangents then, *a f*, *b g*, will be parallel one to another; from whence it will follow, that the Line *a b* (by *Def.* 13.) is a Diameter of the Ellipsis; and also that the Line *M N* (by *Prop.* 14.) is bisected in the Point *P*.

And to prove the *Converse*;

Draw in the Plane of the Hyperbola, two Tangents, as *A F*, *B G*, (by *Cor.* 4. of *Prop.* 5.) parallel to the Line *M N*, terminated within the Hyperbola: And then, having drawn thro' their Points of Contact, the Diameter; 'tis plain (from *Def.* 14.) that the Diameter will have the Line *M N* an entire Ordinate rightly apply'd, and that it shall bisect it in *P*. But as there can be but one Diameter pass thro' that Point (by *Cor.* of *Prop.* 20.); it will follow, that if a Line, as *M N* terminated in *P* by a Diameter *A B*; it must be an *entire Ordinate*, and rightly applied in that Point.

### *CONSECTARY.*

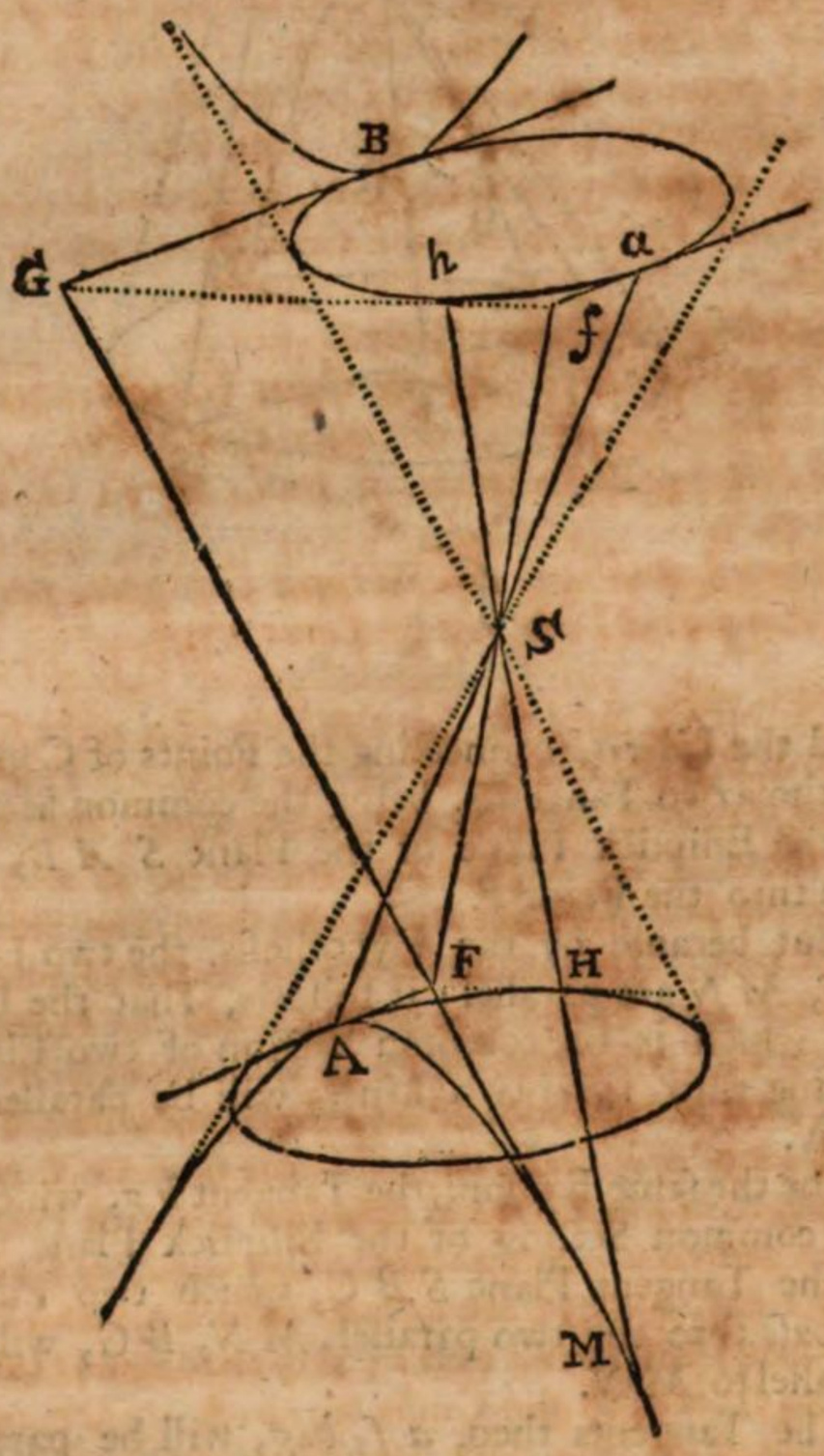
Hence 'tis apparent, that if you rightly apply two entire Ordinates *M P N*, and *O Q R*, to one and the ſame Diameter; it will always be (by *Conſect. Prop.* 9.) *M P* × *P N*, (or *P M*²) *O Q* × *Q R* (or *O Q*²) :: *A P* × *P B*, *A Q* × *Q B*.

## PROP. XXI.

*If thro' any Point* M *in an Hyperbola, a Tangent* M F G *be drawn, interſecting two other parallel Tangents,* A F, B G, *in the Points* F G; *I ſay, that* M F, M G :: A F, B G.

Drawing two elliptick and parallel Planes, which ſhal' paſs thro' the Tangents *A F*, *B G*, they will form in this Tangent Plane *S M G*, two Tangents

*Fig.* 26.




*H F*, *h G*, which will be parallel; and the Elliptick Plane paſſing thro' *B G*, will form in the Tangent Plane *S A F*, a Tangent *a f*, which will interſect the Tangent *h g* in the Point *f*, where the Line *S F* cuts the Elliptick Plane.

This being laid down or ſuppoſed: The Tangents *a f*, *B G*, will be parallel, becauſe each is ſo to the Tangent *A F*. And therefore (by *Conſect.* from *Def.* 15.) you will have *B G*, *G h* :: *a f*, *f h*, (and becauſe of the ſimilar Triangles *S h f*, *S H F*; and *S a f*, *S A F*) :: *A F*, *F H*: Wherefore *B G*, *A F* :: *G h*, *F H* (*i. e.* becauſe of the ſimilar Triangles *M G H*, *M F H*) :: *M G*, *F G*. *Q. E. D.*

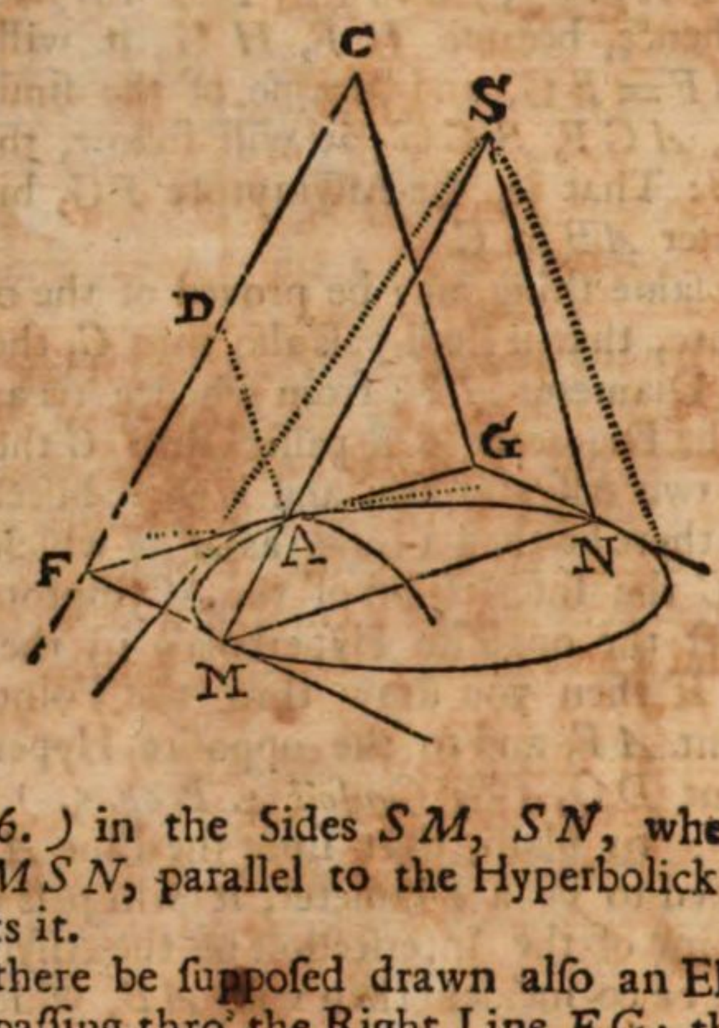
*N. B.* 'Tis evident, That from this *Prop.* the ſame Corollaries may be drawn, as are in the Ellipſis (from *Prop.* 16.): And therefore there is no need to expoſe them at length here.

## PROP. XXII.

*If a Right Line* F G, *terminated between the Aſſymptotes of an Hyperbola, touch the Curve in a Point at* A, *it will always be biſected in that Point.*

Let there be drawn thro' *S* the Vertex of the Cone, and thro' the two Aſſymptotes *C F*, *C G*, two Planes touching the Conick Surface. (See

*Fig.* 27.




*Def.* 16.) in the Sides *S M*, *S N*, where the Plane *M S N*, parallel to the Hyperbolick Plane, interſects it.

Let there be ſuppoſed drawn alſo an Elliptick Plane, paſſing thro' the Right Line *F G*; this will form in the two Tangent Planes, two Tangents, *M F*, *M G*; and in the Plane *M S N*, a Right Line *M N* parallel to *F G*; and connecting the Points of Contact of the two Tangents.

This ſuppoſed, 'tis apparent, that the Line *F G* (by *Conſect.* 4. *Prop.* 16.) is biſected in *A*; becauſe it touches both the Ellipſis, and the Hyperbola in that Point.

### *CONSECTARIES.*

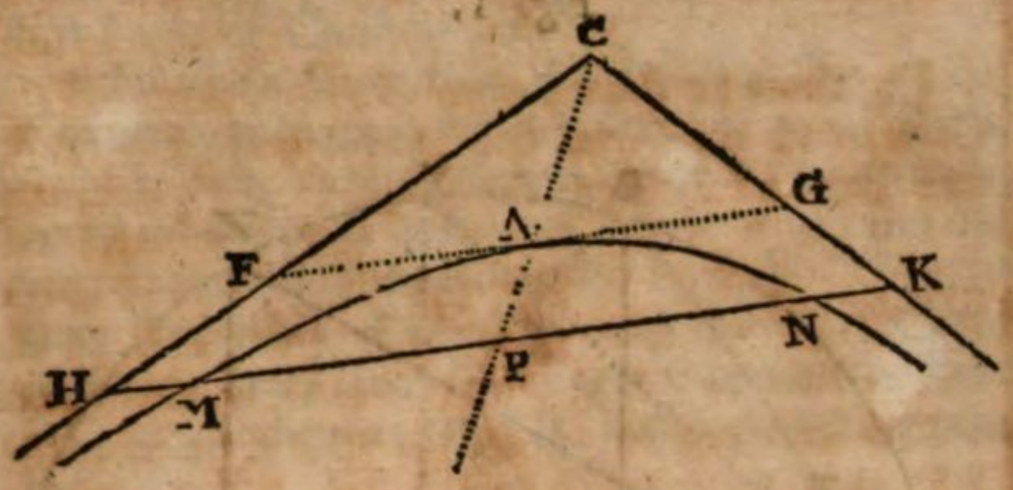
I. As there can be but one Line *F G*, which paſſing thro' a given Point *A*, within any Angle *F C G*, and terminated by its Legs, can be biſected in that Point: It follows, that if a Right Line *F G*, terminated by the Aſſymptotes of an Hyperbola meet the Curve in a Point, as *A*, and be there biſected, it will be a Tangent to the Hyperbola in that Point.

II. Hence 'tis evident, that to draw through a Point given, as *A*, in an Hyperbola, whoſe Aſſymptotes *C F*, *C G*, are given, a Tangent, as *F A G*; you need only draw *A D* parallel to one of the Aſſymptotes *C G*, and terminated by the other; and having then taken *D F* = to *C D*, draw the Line *F A G*, for that ſhall be the Tangent required.

For, by reaſon of the ſimilar Triangles *F C G*, and *F D A*; the Line *F G* muſt be biſected in *A*, becauſe *C F*, (by the Conſtruction) is ſo in *D*.

III. If any two Points *M N*, within an Hyperbola, be joined by a Right Line, as *M N*, interfecting the Aſſymptotes in the Points *HK*: Then

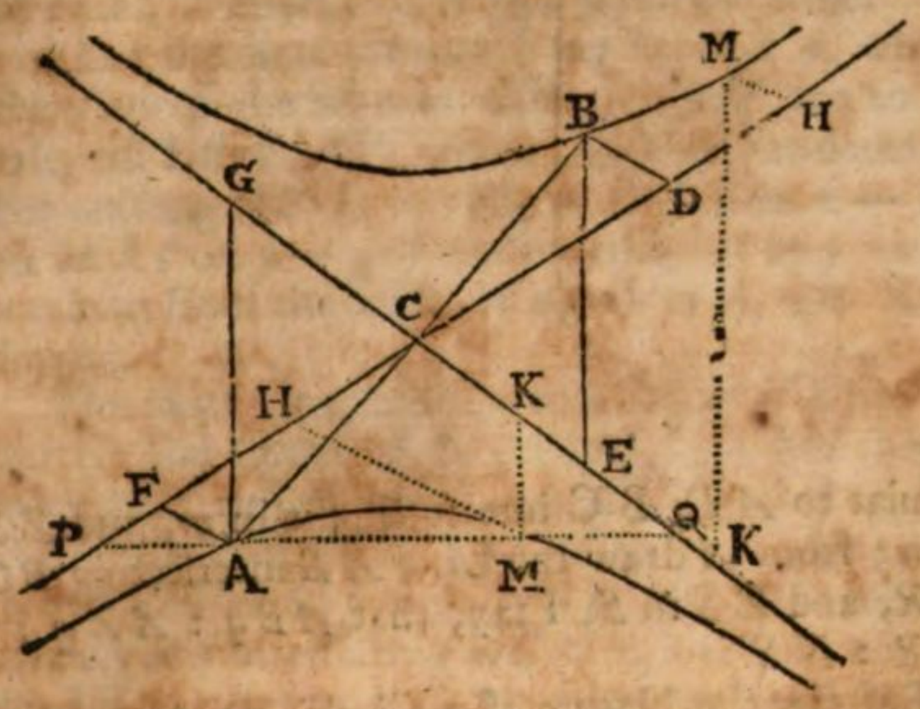
*Fig.* 28.




will the two Lines *M H*, *N K*, being the Parts of *M N*, lying between the Curve and its Aſſymptotes, be always equal.

For having drawn thro' *P*, in the middle Point of *M N*, a Diameter, as *C P*, and thro' the Point *A*, where that Diameter meets the Curve, a Line, as *F G* parallel to *M N*, and terminated by the Aſſymptotes; 'tis plain, that that Line *T G*, *F G*, (by *Prop.* 20.) will be a true Tangent in the Point *A*, and conſequently will be biſected in that Point (by this *Prop.* 22.) Whence 'tis clear, from the Similar Triangles *C AF*, *C PH*, and *C AG*, *C PK*; that *PH* = *P K*, and conſequently (becauſe *M N* is biſected) *M H* = *N K*. *Q. E. D.*

*Fig.* 29.




IV. If thro' any Point, as *A*, in an Hyperbola, two Right Lines, *A F*, *A G*, be drawn and terminated by its Aſſymptotes; and if from any other Point, as *M*, in the ſame Hyperbola, or its Oppoſite, you draw two other Right Lines *M H*, *M K*, terminated alſo by its Aſſymptotes, and parallel to the two former *AF*, *AG*:

I ſay, the Rectangle *F AG*, will always be equal to the Rectangle *HMK*.

For,

1. When the Points *AM*, fall in one and the ſame Hyperbola, having drawn a Right Line joining the two Points *A*, *M*, and cutting the Aſſymptotes in *P* and *Q*; the Similar Triangles *P AF*, *P M H*, and *Q M K*, *Q AG*, will give theſe Proportions: *AF*, *M H* :: *AP*, *M P*, (by *Cor.* 3.) :: *M Q* : *A Q* :: *M K* : *A G*; and then multiplying the Extremes and Means, you have *FA* × *AG* = *HM* × *MK*.

2. When the Points *A*, *M*, fall in the two oppoſite Hyperbola's; having drawn thro' the given Point *A*, and the Centre *C*, the Diameter *A B*, and alſo the two Right Lines *B D*, *B E*, parallel to *A F*, *AG*, and terminated by the ſame Aſſymptotes; 'tis evident, that the Triangles *C A F*, *C B D*, and *C AG*, *C B E*, being not only Similar, but alſo reſpectively equal one to another, becauſe *C A* = *C B*, (by *Prop.* 19.) Therefore *B D* = *A F*, and *B E* = *A G*, and conſequently *B D* × *B E* = *F A* × *A G*. But from the former Caſe, *K M* × *M H* = *D B* × *B E*; wherefore now alſo *FA* × *AG* = *K M* × *H M*.

Authors on the Subject of Conick Sections.

*Archimedis Opera*, *Apollonii Pery*, *Conic. Lib.* 4. *Theodoſ. Spherica methodo nova illuſtrata & Succin. Demonſtrata ab* Iſa. Barrow. Lond. 1675. 4to.

——*Ejuſdem Lectiones Geometricæ.* Lond. 1669. 4to.

*Nouvelle Methode en Geometric parles Sections des Superficies Coniques & Cylindriques per De la Hire a Paris.* 1675. 4to.

*Ejuſdem de Cycloide & Sectionibus Conici.*

*De la Hire Sectiones Conicæ. Paris. Fol.* 1685.

*Barocius de Aſymptotis Conſtruendis.*

*Milner Sectiones Conicæ. Lat.* 8vo.

*Schotenii Organicæ Conicar. Sectionum Deſcriptio Apollonii Pergæi Sectiones Conicæ per Richardum. Folio.*

*Mydorgii Sectiones Conicæ.*

*Gregorii a St. Vincentio Opus Geometricum de Quadrat. Circuli & Sectionum Coni. Fol.*

*Robinſon*'s Tranſlation of *De la Hire's* Conicks, in 12s.

*Traite Analique des Sectione Coniques, per M. la Marquis d l'Hoſpital. Paris* 1707.

CONICK *Surface*. Let the Side of a right Cone be call'd *a*, the Radius of its Baſe *r*: Then by what is prov'd under the word Pyramid, the Area of the Convex Surface of the Cone is = ½ the Periphery of the Baſe multiplied into the Side of the Cone. That is, Since 2 *r* = to the Diameter, and 2 *r e* = to the Periphery, it will be expreſſed by *r e a*. And from hence it will be eaſy to deduce that noble Propoſition of *Archimedes*: *That a Circle whoſe Area is equal to the Convex Surface of the Cone, will have its Radius a mean Proportional between the Side of the Cone and the Radius of the Baſe.* For ſince √ : *ar* is ſuch a mean Proportional between *a* and *r*; if you ſuppoſe that to be the Radius of the Circle required, its Diameter will be 2 √ : *r a* and its Periphery 2 √ *r a e*; and by multiplying the Periphery 2 √ : *r e a* into ½ √ *r a*, the half Radius, the Area will be *r e a*, the very ſame with that of the Surface of the Cone. *Q. E. D.*

The Surface of a right Cone may be eaſily had by having the Radius of the Circle of the Baſe; for as that Radius is to its Periphery, ſo will the Radii of the other Circles up to the Vertex be to their reſpective Peripheries. But all thoſe Radii are the Elements of a right Angle Triangle, whoſe Altitude and Baſe are given, and conſequently its Area is known: Wherefore as any one Radius to its Periphery, ſo will the Area of the Triangle, which is the Sum of all, be to the Sum or Aggregate of all the Peripheries, *i. e.* to the whole Conick Surface, which therefore will be known.

*Conick Surface*, is the Convex Surface of a Cone without its Baſe, and this is formed by the Motion of a right Line fix'd in a Point above and below moved round the Periphery of a Circle. CON-

CONJUGATE *Diameters*, in reſpect of one another in the Ellipſis, are ſuch as are parallel to Tangents meeting the Curve in each others Vertexes.

*Conjugate Sections.* See *Sectiones ſequentes.*

CONSERVATOR, is a delegated Umpire, or ſtanding Arbitrator, which as a third impartial Friend, was choſe and appointed to compoſe and adjuſt all Differences that ſhould ariſe between two other Parties. Dr. *Kennet's Gloſſar.*

CONSISTORY, is the Court Chriſtian, or Spiritual Court. This was held formerly in the Name of the Cathedral Church, or in ſome Chapel, Iſle, or Portico belonging to it, in which the Biſhop preſided, and had ſome of his Clergy for Aſſeſſors and Aſſiſtants: But this Conſiſtory Court is now, half by the Biſhop's Chancellor or Commiſſary, and by Archdeacons or their Officials.

CONSTITUENT Particles of any Natural Body, are thoſe ſmall Particles of which it is compos'd. See *Particles.*

CONSTITUM, in the Civil Law, is a Promiſe for a Debt upon a Nude Covenant, without Stipulation.

CONSTRUCTION *of Equation*, an eaſy way of conſtructing Cubic and Biquadratick Equations without the Parabola, communicated by the Ingenious *J. P.* M. A.

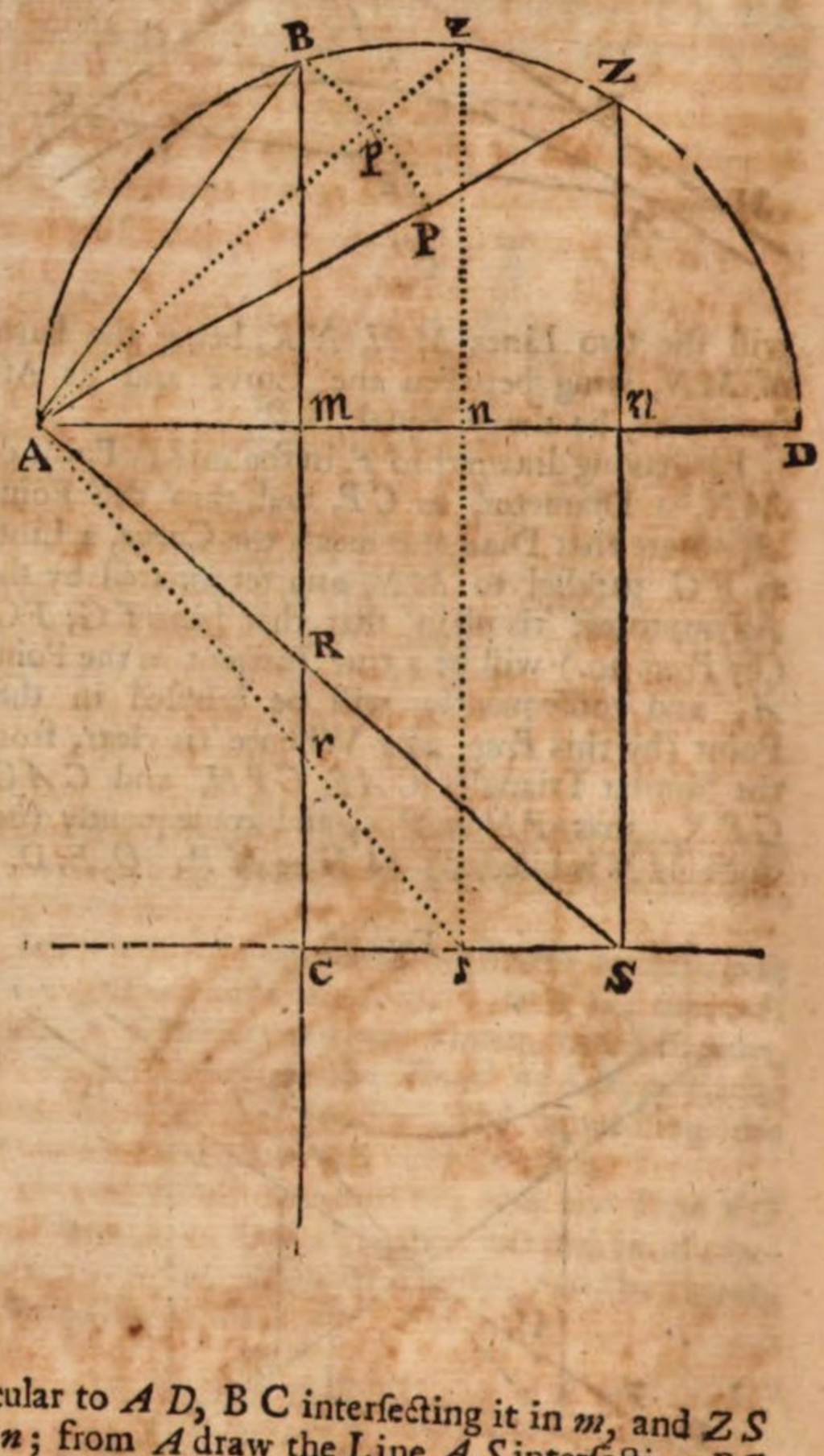
In order to this Method of Conſtruction, I conſider each Side of the Equation, as the Product of two Multipliers, the one of two Dimenſions, the other of one, (each Term in a Cubick Equation being ſuppoſed of three Dimenſions.) *E. G.* In this Equation $x\,x\,x + \overline{p\,x\,x} = n$; I conſider it as in this Form $x\,x \times x + p = n = b^2 \times c$, (*b* being taken at pleaſure for any Number whoſe Square is leſs than *n* divided by *b b* gives *c.*) Or elſe in this Form, $\overline{x\,x + p}\,x \times x = n = b^2 \times c$; either of which Forms may be made uſe of, as ſeems leſs for Conſtruction. And becauſe *x* is yet unknown, and muſt be taken by gueſs, I put *z* inſtead of *x* the Multiplier of two Dimenſions, and *y* for *x* in the other of one Dimenſion; and then the former Equation will ſtand thus $\overline{z\,z \times y + p} = b^2 \times c$; or (the other way,) $z\,z + p\,z \times y = b^2 \times c$. In both which Forms, the given Quantity $b^2 \times c = n$, is the ſame as in the firſt Equation, and conſequently the Reſult or Value of the other Terms is the ſame alſo.

The Deſign then, of this Method is, by taking a Number or Line by gueſs (ſuppoſe *z*) to repreſent *x* in one of the Multipliers of the given Equation, to find another Number or Line (*y*) which ſhall repreſent *x* in the other Multiplier; and then if *z* and *y* be not equal, to bring them by Tryals to Equality, which in moſt Caſes, is eaſily done, obſerving their Difference and the Nature of the Scheme or Figure.

Before I give Examples, I will premiſe this Lemma, which ſhews the Ground and Demonſtration of this way of Conſtruction.

Let *A B D*, be a Semi-circle on the Diameter *A D*, *A B* and *A Z*, two Subtenſes drawn at pleaſure from the end of the Diameter *A*, from B and *Z* are drawn the infinite Lines B C and *Z S* perpen-

*Fig.* 1.




dicular to *A D*, B C interſecting it in *m*, and *Z S* in *n*; from *A* draw the Line *A S* interſecting *BC* in *R*, and *Z S* in *S*; I ſay, that $AB\,q : AZ\,q :: m\,R : N\,S$.

For (by the Nature of a Circle) $D\,A \times m\,A = A\,B\,q$, and $D\,A \times n\,A = A\,Z\,q$; then $D\,A \times m\,A : D\,A \times n\,A :: m\,A : n\,A :: m\,R : n\,S$; that is, $A\,B\,q : A\,Z\,q :: m\,R : n\,S$.

Multiply the extreme and middle Terms, and 'tis $A\,B\,q \times n\,S = A\,Z\,q \times n\,R$; if therefore we ſuppoſe $A\,B = b$, $n\,S = c$, $A\,Z =$ to the Square Root of the Multiplier of two Dimenſions (in a Cubick Equation reduc'd into the Form above directed) then will *m R* be equal to the other Multiplier of one Diviſion. So in the firſt Form above, ($\overline{z\,z \times y + p} = b^2 \times c$) if $A\,Z = z$, then is $m\,R = y + p$, and in the Second Form $\overline{z\,z + p}\,z \times y = b^2 \times c$, if $A\,Z = \sqrt{\overline{z\,z + p}\,z}$, then is $m\,R = y$, and if $y = z$, then $z = x$ in the given Equation.

*Example* I.

Suppoſe I would conſtruct this Cubick Equation $x\,x\,x - 4\,x\,x = 72$, or $x\,x\,x - p\,x\,x = n$. I take 16, as a convenient Square Number, (which I call *b b*) and therewith I divide 72; the Quotient

Quotient is $4\frac{1}{2}$ which I call $c$, [$\frac{n}{bb} = c$, and $b\,b\,c = n = 72$] I deduce alſo the other Side of the Equation into two Multipliers (as above) and then 'tis $z\,z \times 4 - p = 72 = 16 \times 4\frac{1}{2}$, which is the firſt Form of Conſtruction.

I deſcribe a Semicircle $A\,B\,D$, (See Fig. 1.) of a convenient bigneſs for my Scale of equal Parts, (which here, for this Figure, is of 24 in an Inch, 10 of which parts make an Unite or 1.) and having drawn the Diameter $A\,D$, I take 4 (Units or large Diviſions) off the Scale, and draw the Chord $A\,B = 4 = b$; from B I draw the infinite Line $B\,C$, perpendiculiar to $A\,D$, and interſecting it in $m$.

I take $4\frac{1}{2}$ ($= c$) off the Scale, and ſet that Diſtance with the Compaſſes from $m$ to C, and thro' C I draw $C\,S$ parallel to $A\,D$.

For the firſt Tryal I conſider that the Root $x$ muſt be bigger than 4 or $p$, (elſe the Negative Term $-4\,xx$, wou'd take away more than $xxx$, and ſo the given Quantity wou'd be Negative;) therefore taking 4 ($= p$) from the Scale, with Center A, and Radius $A\,p = 4$, I deſcribe the little Arch $P\,p$; and then (at a venture) draw the Chord $A\,z$ ($= z$) interſecting the Arch $P\,p$ in $p$; ſo is $A\,p = p = 4$, and the Line $p\,z = z = p$ or $z - 4$. From $z$ I draw $Z\,S$ perpendicular to $C\,S$, and interſecting it in $S$, and then the Line $AS$ interſecting $M\,C$ in $r$. So is $M\,r = y - 4$. or $y - p$, (the other Multiplier in the Equation) which being greater than the Line $p\,z$ (to which it ſhould be equal, it ſhews that $z$ was taken too little.

After the ſame manner I try another $z$, which the view of the Scheme will now direct me to limit, till I find $A\,Z$, which Anſwers the demand. For making $A\,Z = z$, then is $P\,Z$ ($= z - 4$) $= M\,R$ ($= y - 4$) conſequently $Z = y = x$, $z$ taking from the Scale, is equal to 6, the Root ſought.

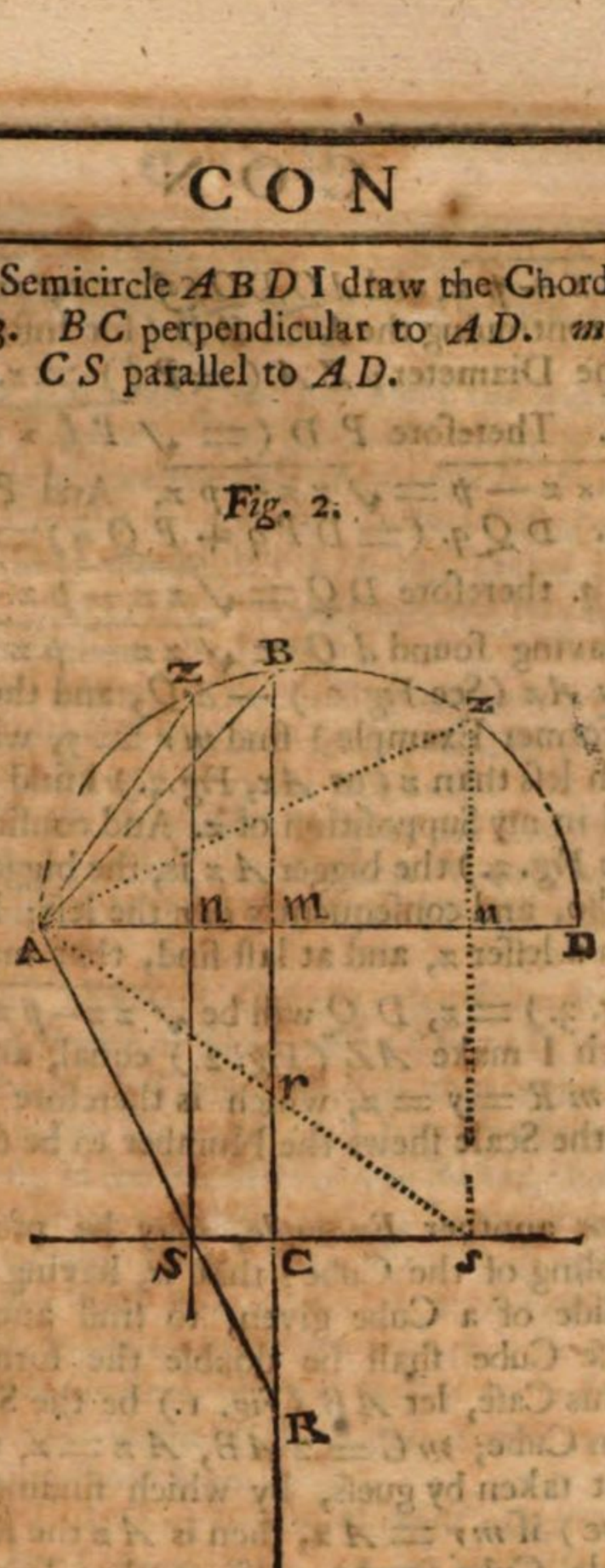
The ſame Concluſion would follow if I had inverted the Order of proceeding, and had begun with $M\,r$, and thereby found $A\,z$ (in a firſt tryal,) for in this Caſe I muſt have taken a Line for $y$ (by gueſs) and made $m\,r = y - p$, and then having drawn $A\,S$ interſecting $m\,C$ in $r$, and $C\,S$ in $S$. Alſo $S\,Z$ parallel to $B\,C$, touching the Semicircle in $z$, I draw $A\,z$ which will be equal to $z$; ſo is the Line $p\,z = z - p$, which ought to be equal to $m\,r$; but not being ſo, another Trial muſt be made.

## EXAMPLE II.

Suppoſe I would find the Root of this Equation $x\,x\,x - 3\,x\,x + 2\,x = 24$. or $x\,x\,x - p\,2\,x + q\,q\,x = n$. I take for $b\,b$, 9. by which dividing 24, it gives $C = 2\frac{2}{3}$, and then I put the Equation into this Form $z\,z - p\,z + q\,q \times y - b\,b \times C$.

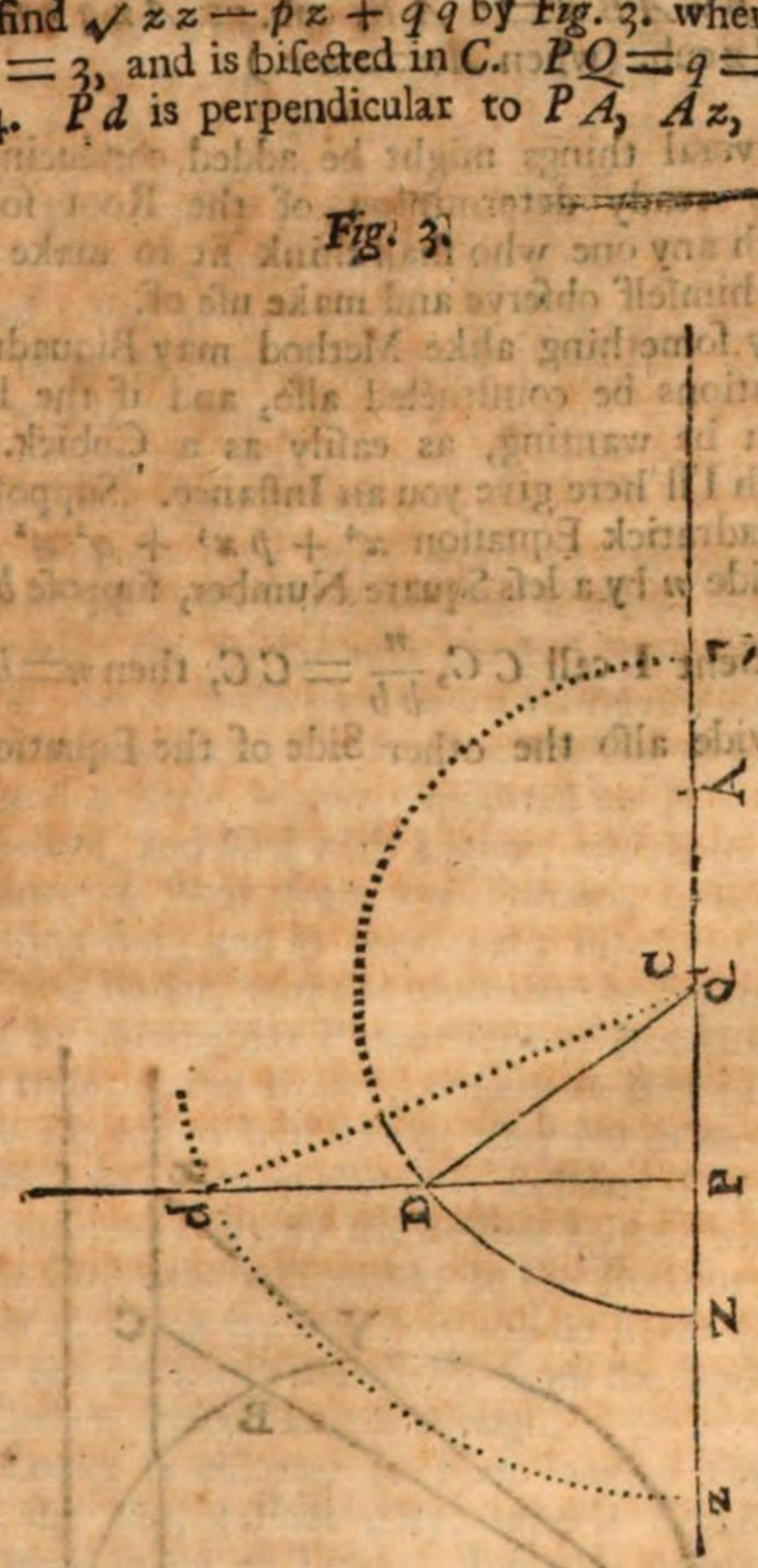
In the Semicircle $A\,B\,D$ I draw the Chord $A\,B = b = 3$. $B\,C$ perpendicular to $A\,D$. $m\,C = C = 2\frac{2}{3}$. $C\,S$ parallel to $A\,D$.

Fig. 2.




I find $\sqrt{z\,z - p\,z + q\,q}$ by Fig. 3. where $AP = p = 3$, and is biſected in C. $PQ = q = \sqrt{2} = 14$. $P\,d$ is perpendicular to $P\,A$, $A\,z$, $A\,Z$,

Fig. 3.




&c. are Lines taken by gueſs for $z$. $z\,d$, $Z\,D$, &c. are Arches of Circles drawn with Centre C and Radius $C\,z$, $C\,Z$, &c. So are $P\,d$, $P\,D$, &c. $= \sqrt{z\,z}$

$\sqrt{zz-pz}$, and $dQ, DQ$, &c. $=\sqrt{zz-pz+qq}$ (For continuing the Arch $ZD$ (for Inſtance) to $\zeta$ in the Diameter; $ZA\,(=P\zeta)=z$. $PZ=z-p$. Therefore $PD\,(=\sqrt{P\zeta \times PZ})=\sqrt{z\times z-p}=\sqrt{zz-pz}$. And $PQ$ being $=q$. $DQq.\,(=DPq+PQq)=zz-pz+qq$. therefore $DQ=\sqrt{zz-pz+qq}$.)

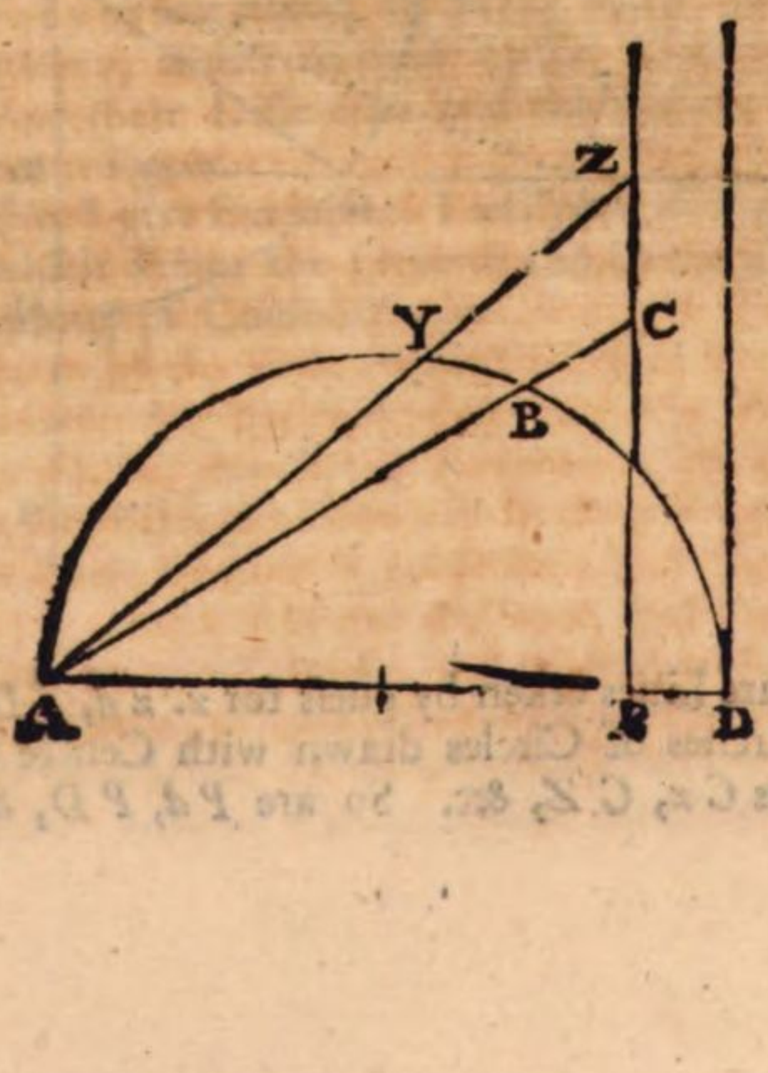
Having found $dQ=\sqrt{zz-pz+qq}$; I draw $Az$ (See *Fig.* 2.) $=dQ$, and then (as in the former Example) find $mr=y$, which being much leſs than $z$ (or $Az$, *Fig.* 3.) I find that I have err'd in my Suppoſition of $z$. And conſidering that (See *Fig.* 3.) the bigger $Az$ is, the bigger will $dQ$ be alſo, and conſequently $mr$ the leſs; I try again with a leſſer $z$, and at laſt find, that making $AZ$ (*Fig.* 3.) $=z$, $DQ$ will be $\sqrt{zz-pz+pq}$, to which I make $AZ$ (*Fig.* 2.) equal, and thereby find $mR=y=z$, which is therefore the Root, and the Scale ſhews the Number to be $6=x$.

For another *Example*, may be propos'd the doubling of the Cube; that is, having the Root or Side of a Cube given, to find another Line whoſe Cube ſhall be double the former Cube. In this Caſe, let $AB$ (*Fig.* 1.) be the Side of the given Cube; $mC=2AB$, $Az=z$, the ſought Root taken by gueſs, by which finding $mr$ (as above) if $mr=Az$, then is $Az$ the Root of the double Cube ſought; elſe another Trial muſt be made

$AB\,Q : Azq :: mr : nS=mc=2AB$ theref.
$2AB\times ABq=2AB$, cub. $=Azq\times mr=Az$ cub. (when $Az=mr$.)

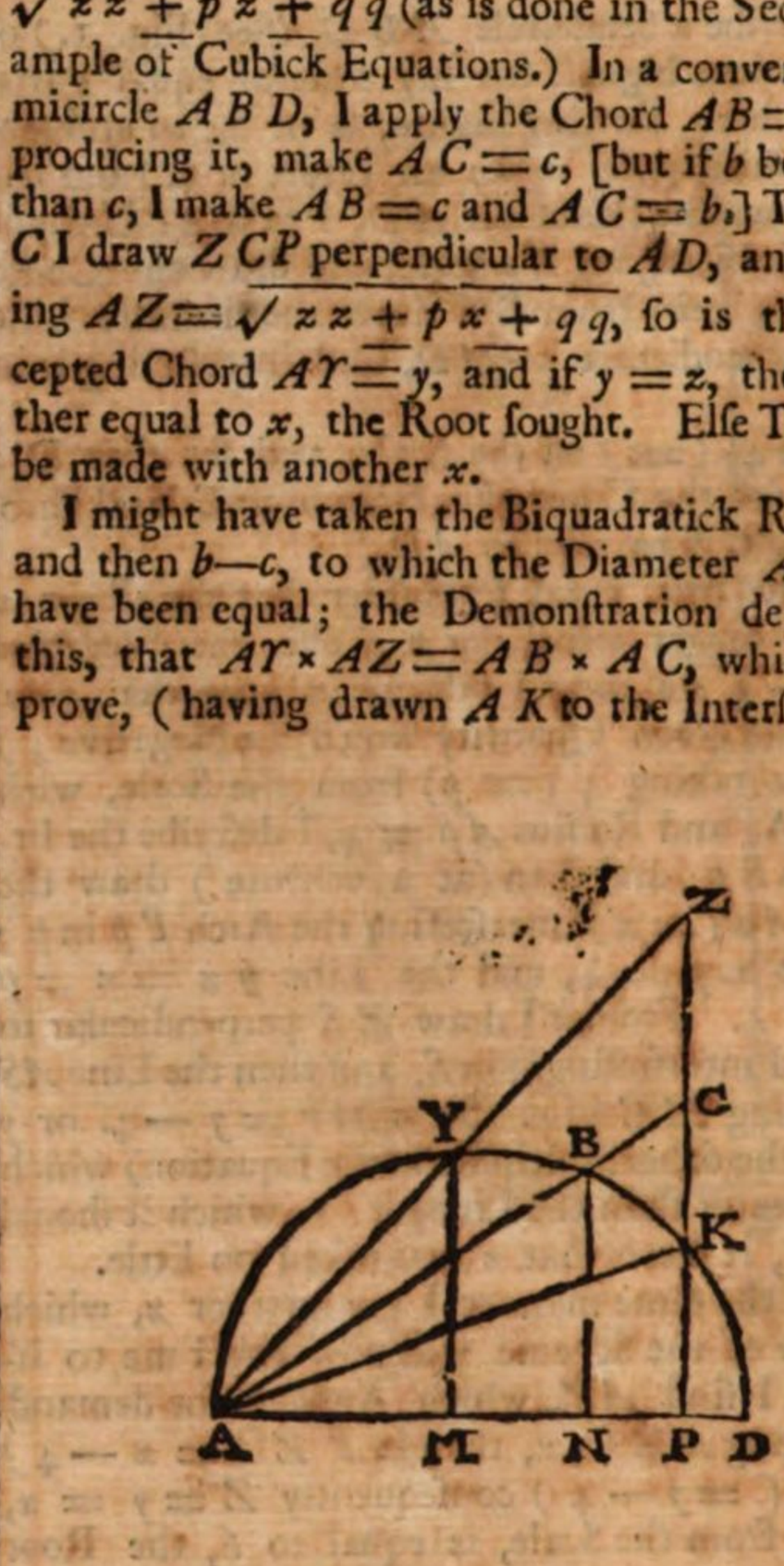
Several things might be added conducing to a more ready determining of the Root ſought; which any one who ſhall think fit to make trial, may himſelf obſerve and make uſe of.

By ſomething alike Method may Biquadratick Equations be conſtructed alſo, and if the loweſt Term be wanting, as eaſily as a Cubick. Of which I'll here give you an Inſtance. Suppoſe this Biquadratick Equation $x^4+px^3+q^2x^2=n$. I divide $n$ by a leſs Square Number, ſuppoſe $b^2$ the Quotient I call $CC$, $\frac{n}{bb}=CC$, then $n=b^2C^2$. I divide alſo the other Side of the Equation in-




to two Multipliers, *viz.* $x^2\times 2x^2\pm px\pm qq=b^2\times C^2$, whence $x\times\sqrt{x^2\pm px\pm qq}=b\times C$. Or, Subſtituting $y$ and $z$ for $x$ (as I do in Cubes) while $x$ is unknown) $q\times\sqrt{zz\pm pz\pm qq}=b\times C$. I take $z$ by gueſs, and therewith find $\sqrt{zz\pm pz\pm qq}$ (as is done in the Second Example of Cubick Equations.) In a convenient Semicircle $ABD$, I apply the Chord $AB=b$, and producing it, make $AC=c$, [but if $b$ be greater than $c$, I make $AB=c$ and $AC=b$.] Thorough $C$ I draw $ZCP$ perpendicular to $AD$, and applying $AZ=\sqrt{zz\pm px\pm qq}$, ſo is the intercepted Chord $AY=y$, and if $y=z$, then is either equal to $x$, the Root ſought. Elſe Trial muſt be made with another $x$.

I might have taken the Biquadratick Root of $n$, and then $b-c$, to which the Diameter $AD$ muſt have been equal; the Demonſtration depends on this, that $AY\times AZ=AB\times AC$, which I thus prove, (having drawn $AK$ to the Interſection of




$ZP$ with the Semicircle) $ABq : AKq :: (An : AP ::) AB : AC \therefore AB\times AC=AKq$. By a like Reaſon $AYq : AK :: (AM : AP ::) AY : AZ \therefore AY\times AZ=AKq=AB\times AC$.

The ſame Method will hold for compleat Biquadraticks, but will be too operoſe.

See Mr. *Halley*'s Conſtruction of Cubicks and Biquadraticks, in *Phil. Tranſ.* N°. 188, 190. As alſo *Bernoulli*'s Animadverſions on the *Carteſian* Geometry, in the *Act. Erud. Lip.* 1. for *June* 1688. And his *True Geometrical Conſtruction of Solid, and more than Solid Problems by Right Lines and Circles only*, for the Month of *Sept.* 1689.

Dr. *Gregory*, in his Preface to his Excellent *Oxford Euclid* in G. L. ſhews that all Quadratick Equations may be conſtructed from the 58 and 59 of *Euclides Data*.

CONTRARY *Flexion and Retrogreſſion of Curves*, when a Curve Line as $AFK$ (*Vid. Hay*'s Fluxions, *pag.* 153.)

CONTRARY *Legg'd Hyperbola*, is an Hyperbola, ſo called by Sir *Iſaac Newton*, becauſe its Legs are convex towards contrary Parts, and run contrary ways. *See* Curves.

CONTRASTE, is a *French* Term uſed in Painting and Sculpture, and ſignifies the due placing of the different Objects and Parts of the Figures; and produces that Variety which is ſo pleaſing in the Attitudes, as if in a *Groupe* of three Figures, one ſtand out forward, the other backward, and the third appear to the middle between them, they

ſay 'tis well *Contraſted:* So they ſay alſo, that to render the Attitudes of Figures agreeable and juſt, they muſt be natural and active, varied in their Actions, and *Contraſted* in their Members: So that for Figures to be well *Contraſted*, is for them to be lively, and to expreſs the Motion proper to the Deſign of the whole piece, or of any particular *Grouppe*.

CONVERGING *Hyperbola*, is one whoſe Concave Legs bend in towards one another, and run both the ſame way. See *Curves*.

*Converging Series*, is a Method of Approximation ſtill nearer and nearer towards the true Root of any Number or Equation, even tho' it be impoſſible to find any ſuch true Roots in Numbers. See *Approximation* and *Square Roots* in *Vol.* I.

COPPERAS. The way of making *Copperas* is as follows; *Copperas* Stones, which ſome call Gold Stones, are found on the Sea-ſhore in *Eſſex*, *Hampſhire*, and ſo *Weſtward*. There are great Quantities in the Clifts, but not ſo good as thoſe on the Shore, where the *Tides* Ebb and Flow over them.

The beſt of them are of a bright ſhining Silver Colour; the next, ſuch as are of a Ruſty deep Yellow; the worſt are ſuch as have Gravel and Dirt in them, of a ſadder Umber Colour.

In the midſt of theſe Stones are ſometimes found the ſhells of Cockles, and other ſmall Shell-Fiſhes; ſmall pieces of the Planks of Ships, and pieces of Sea-coal.

In order to the making of Copperas, they make Beds according as the Ground will permit; thoſe at *Deptford* are about 100 Foot long, and 15 Foot broad at the Top, and 12 Foot deep, ſhelving all the way to the Bottom.

They ram the Bed very well, firſt with ſtrong Clay, and then with the Rubbiſh of Chalk, whereby the Liquor which drains out of the Diſſolution of the Stones, is convey'd into a Wooden Shallow Trough, laid in the middle of the Bed, and covered with a Board; being alſo boarded on all ſides, and laid lower at one End than the other, whereby the Liquor is convey'd into a Ciſtern under the Boiling-Houſe.

When the Beds are indifferently well dryed, they lay on the Stones about two Foot thick.

Theſe Stones will be five or ſix Years before they yield any conſiderable Quantity of Liquor; and before that, the Liqour which they yield is but weak.

They ripen by the Sun and Rain; yet Experience proves, that watering the Stones, although with Water prepared by lying in the Sun, and poured thro' very ſmall holes of a Watering-pot, doth retard the Work.

In time, theſe Stones turn into a kind of Vitriolick Earth, which would ſwell and ferment like Leavened Dough.

When the Bed is come to Perfection, then once in four Years they refreſh it, by laying new Stones on the Top.

When they make a new Bed, they take a good Quantity of the old fermented Earth, and mingle it with new Stones, whereby the Work is haſtned. Thus the old Earth never becomes uſeleſs.

The Ciſtern before-mentioned, is made of ſtrong Oaken Boards, well joined and calked. That at *Deptford* will contain 700 Tun of Liquor. Great care is taken, that the Liquor doth not drain thro' the Beds, or out of the Ciſtern. The beſt way to prevent the ſame, is to divide the Ciſtern in the middle, by Oaken Boards calked as before; whereby one of them may be mended in caſe of a Defect.

The more Rain falls, the more but the weaker will be the Liquor: The goodneſs whereof is tried by Weights prepared for that purpoſe. Fourteen-penny Weight is rich; or an Egg being put into the Liquor, the higher it ſwims above the Liquor, the ſtronger it is. Sometimes the Egg will ſwim near half above the Liquor.

Within one Minute after an Egg is put in, the ambient Liquor will boil and froth; and in three Minutes the Shell will be quite worn off.

A drop of this Liquor falling on the Manufactures of Hemp, Flax, or Cotton Wooll, will preſently burn a hole thro' it. As alſo in Woollen and Leather.

Out of the aforeſaid Ciſtern, the Liquor is pumped into a Boiler of Lead, about 8 Foot Square, containing about 12 Tuns, which is thus ordered. Firſt, they lay long Pieces of Caſt Iron, 12 Inches Square, as long as the Breadth of the Boiler, about 12 Inches one from another, and 24 Inches above the Surface of the Fire. Then Croſs-wiſe they lay ordinary flat Iron Bars as cloſe as they can lie, the Sides being made up with Brick-work. In the middle of the Bottom of this Boiler is laid a Trough of Lead, wherein they put at firſt 100 Pound Weight of old Iron.

The Fewel for boiling is *New-Caſtle* Coals. By degrees, in the boiling, they put in more Iron, amounting in all to 1500 pound Weight in a boiling. As the Liquor waſtes in boiling, they pump in freſh Liquor into the Boiler: Whereby, and by a Defect in ordering the Fire, they were wont to be above 20 Days before it was enough; when that is, they try, by taking up a ſmall Quantity of Liquor into a ſhallow Earthen Pan, and obſerving how ſoon it will gather and cruſt about the Sides thereof. But now of late, by the Ingenious Contrivance of Sir *Nicholas Criſp*, the Work is much facilitated. For at his Work at *Deptford*, they boil off three Boilers of ordinary Liquor in one Week; which is done, firſt by ordering the Furnace ſo, as that the heat is convey'd to all Parts of the Bottom and Sides of the Furnace.

Then, whereas they were wont to pump cold Liquor into the Boiler to ſupply the waſte in boiling, whereby the Boiler was checked ſometimes 10 Hours. Sir *Nicholas* hath now a Veſſel of Lead, which he calls a Heater, placed at the end of the Boiler, and a little higher, ſupported by Bars of Iron as before, and fill'd with Liquor, which, by a Conveyance of Heat from the Furnace, is kept near Boiling-hot; and ſo continually ſupplies the waſte of the Boiler, without hindring the boiling. Thirdly, by putting due Proportions of Iron from time to time, in the Boiler; as ſoon as they perceive the Liquor to boil ſlowly, they put in more Iron, which will ſoon quicken it. Beſides, if they do not continually ſupply the boiling Liquor with Iron, the Copperas will gather to the Bottom of the Boiler and melt it; and ſo it will do if the Liquor be not preſently drawn off from the Boiler into a Cooler, ſo ſoon as it is enough.

The Cooler is oblong, 20 Foot long, 9 Foot over at the top, 5 Foot deep, taper'd towards the Bottom, made of Terras. Into this they let the Liquor run ſo ſoon as it is boil'd enough. The Copperas herein will be gathering or ſhooting 14 or 15 Days, and gathers as much on the ſides

as in the Bottom; *ſc.* above 5 Inches thick. Some put Buſhes into the Cooler, about which the Copperas will gather: But at *Deptford* they make no uſe of any.

That which ſticks to the Sides and to the Buſhes, is of a bright Green; that in the Bottom, of a foul and dirty Colour.

In the end of 14 Days, they convey the Liquor into another Cooler, and reſerve it to be boil'd again with new Liquor.

The Copperas they ſhovel on a Floor adjoining: So that the Liquor may drain from it into a Cooler.

The Steam, which comes from the boiling, is of an Acrimonious ſmell.

Copperas may be boiled without Iron, but with Difficulty; without it, the Boiler will be in danger of melting.

Sometimes in ſtirring the Earth upon the Beds, they find pieces of Copperas produc'd by lying in the Sun.

CORBETT, in Architecture, is a ſhort piece of Timber placed in a Wall, with its end ſticking out 6 or 8 Inches, as occaſion ſerves. The under Part of the end thus ſticking out, is ſometimes cut into the Form of a *Boultin*, ſometimes of an *O--G--*, and ſometimes of a *Face*, &c. according to the Workman's Fancy; the upper Side being plain and flat. Theſe *Corbets* are uſually placed for Strength's Sake, immediately under the Semigirders of a Plat-form, and ſometimes under the Ends of *Camber Beams*; in which latter Caſe they are commonly placed a Foot or two below the Beam, and have a piece of Timber ſtanding upright, cloſe to the Wall, from the *Corbet* to the Beam.

*Corbets*, alſo is a Term uſed by ſome Architects, for the hollow Nicks in Walls, which are left for Images or Figures, or Statues to ſtand in.

CORNAGE, in our Law ſignifies a kind of grand Sergeantry; the Service of which Tenure is to blow a Horn, when an Invaſion of a *Northern* Enemy is perceived: And by this many hold Land in the *Northern* Parts about the Wall, *i. e.* the old *Picts* Wall.

CORNEA *Tunica*. The Figure of it is of a greater Convexity than the reſt of the Globe of the Eye; and it conſiſts of ſeveral Laminæ, which are nouriſhed by ſo ſmall Blood Veſſels, as to obſtruct very little of the Light; 'tis of a very exquiſite Senſe, that on any light touch, the Tears may be ſqueez'd out of the Lachrimal Glands, to waſh it and clean it.

CORONA, in Anatomy, is that Edge of the Glans of the *Penis*, where the *Præputium* begins.

CORONARE *Filios*, The ancient Villains were forbidden *Coronare Filios*, that is, to let their Sons receive their firſt *Preparatory Tonſure*, or to begin to be ordained Prieſts; becauſe after that they are Freemen, and can be by their Lords no longer claimed as Servants in Villenage.

CORPORA *Pyramidalia*, when the Blood hath diſcharg'd it ſelf of the Seed into the Teſticles, it returns by the Veins, which riſing in ſeveral Branches from the *Teſtes*, tends towards the *Abdomen* in the Production of the *Peritoneum*, the ſame way the Arteries came down. In their Progreſs, their Branches frequently inoſculate and divide again, till they come near the *Abdomen*, and then they all unite in one Trunk; and therefore becauſe of their Shape are called *Corpora Pyramidalia*.

CORPORAL of a Ship, is an Officer that hath the Charge of ſetting the Watches and Centries, and relieving them; and who ſees that all the Soldiers and Sailors keep their Arms neat and clean; he teaches them alſo how to uſe them, and hath a Mate under him.

CORPUSCLES. The admirable Sir *Iſaac Newton* ſhews a way of gueſſing with great accuracy, at the Sizes of the component Corpuſcles or Particles of which Bodies are conſtituted, in the ſecond Book of his Opticks, *pag.* 3. See more of this under the Word *Colour* and *Particles*.

CORSNED, in the *Saxon*, is *Ordeal Bread*, *Panis Conjuratus*: For the *Saxons* had a Superſtitious way of purging themſelves of an Accuſation, by taking a piece of Bread and eating it with ſolemn Oaths and Execrations, that it might prove their Poiſon, *&c.* if they were guilty; which way of ſpeaking is retain'd in ſome Places to this Day, eſpecially in *Kent*.

CORVUS, was a Machine invented by the *Romans*, in the time of their Conqueſts of *Sicily*, when they firſt engag'd the *Carthaginian* Fleet, and was framed (as *Polybius* deſcribes it, *Lib.* 1.) after this manner.

On the *Prow* of their Ships they erected a round piece of Timber about 1½ Foot in Diameter, and 12 Feet in Length, on the top of which was a Block or Pulley; round this piece of Timber was a Plat-form of Boards 4 Feet in Length, and about 18 Foot long, well framed and faſtned with Iron: The Entrance was long ways, and it was moveable round the aforeſaid upright piece of Timber, and could alſo be hoiſted up and down within 6 Foot of the top; about this Frame was a ſort of Parapet Knee high, which was defended with upright Bars of Iron, ſharp at the Ends, and towards the top there was a Ring, by the help of which and a Pulley or Tackle, it was hoiſted and lowered at Pleaſure: With this moveable Gallery they Boarded the Enemies Ships (when they did not lie Side by Side) ſometimes on their Bow, and ſometimes in the after Part of the Ship; the Soldiers keeping the Boſs of their Bucklers level with the top of the Parapet, *&c.* and by the Means of this new Engine, got the Day of the *Carthaginians*, in their firſt Sea Fight with them, tho' the Enemy were long before well ſkill'd in Naval Affairs, and the *Romans* perfectly raw and unſkill'd.

COTLAND, is Land held by a Cottager, whether in Soccage or Villenage.

COUCH, is a Term in Painting, ſignifying the ground Bed, or Baſis on which any Colour lies; and is diſtinguiſh'd from the *Field*, which is always *Horizontal* and upon the *Flat*; whereas the *Couch* may be upright or vertical, and in any other Poſition.

COVING-*Corniſh*, in Architecture, is ſuch a Corniſh that hath a great Caſement or Hollow in it, which is commonly lathed and plaiſtred upon Compaſs Sprockets or Brackets; alſo when Houſes are built projecting out over the Ground-Plot, and then turn'd with a Semi-arch of Timber, which is lathed and plaiſtred, they call that *Coving-Work*.

COURT-*Chriſtian*, or Eccleſiaſtical, is ſo call'd in Oppoſition to the Civil Court, or Lay Court, or *Curia Domini Regis*: Theſe Courts of Chriſtianity were not only held by the Biſhops in Synods, and the Arch-Deacons and Chancellors in Conſiſtories: But they were alſo the Rural Chapters where the Rural

Rural Dean or Dean of Christianity presided, and the Clergy were Assessors and Assistants. Dr. *Kennet's Glossary.*

CRASIN-*Mill*; See *Craze-Mill.*

CRAYONS, are Pencils of several Colours made purposely to paint withal: They are chiefly used in Portraicts; and Pictures done after this way of Painting, are said to be done with *Crayons.*

CRAZE-*Mill*, or *Crazing Mill*, is a Mill (in all respects like a Grist Mill to Grind Corn) and is so call'd by the Tin Miners, who use it to Grind their Tin, which is yet too great, after Trambling; and then 'tis Trambled only; See Tin.

CRIMEN *Ambitus*, is getting into Publick Offices by Bribing with Money or other Gifts, or by Canvasing with Intreaties; as the Civilians Define it.

*Crimen Falsi*, in the Civil Law, is a fraudulent Suppression or Imitation of Truth to the Prejudice of another; so that the Commission of this Crime consists in three points, *Corruption of Truth*, *Deceit*, and *Damage* to another.

*Crimen fraudatæ ennonæ*, is the abusing Markets by raising the Price of Victuals unreasonably, by Forestalling, Monopolizing, &c.

*Crimen Peculatus*, (*a Pecore*, *Cattle*, in which Riches consisted before the use of Money) in the Civil Law, is the Crime of Stealing the Publick Treasure, or Cheating in the publick Accounts. And much of the same Nature is what they call,

*Crimen Residui*, which is applying the publick Money to other Uses and Purposes than those the Government orders and appoints, or else not applying to any Use at all.

CROOTES, is a Substance found about the Oar in the Lead Mines in *Mendip*, being a mealy, white, soft Stone matted with Oar.

CROSS-*Multiplication*, is a Kind of Multiplication much used by Workmen in measuring their Work; and 'tis so call'd because they multiply across, Feet by Inches, &c.

As suppose it were required to multiply 5 Foot, 3 Inches and 6 Parts, or $\frac{6}{12}$ of an Inch, by 2 Foot, 4 Inches and 6 Parts. They set the Number down thus:

| | F. | In. | Pa. |
|---|---|---|---|
| | 5 | 3 | 6 |
| | 2 | 4 | 6 |

| | | | | |
|---|---|---|---|---|
| Then say, twice 5 Feet is 10 Feet, which they write down first of all, as you see under Feet. | 10 | : | : | : |
| Twice 3 Inches is 6 Inches—— | — | : | 6 | : |
| Twice 6 Parts is 1 whole Inch—— | — | : | 1 | : |
| Then working with 4, 4 times 5 Feet is 20 Inches. | 1 | : | 8 | : |
| Four times 3 Inches give 12 Primes, or one Inch. | — | : | 1 | : |
| Four times 6 Parts or Primes give 24 Seconds or 12th of the 12th of an Inch, which makes two Twelfths. | — | : | : | 2 : |
| Six times 5 Feet gives 30 Inches— | — | : | 2 | : 6 : |
| Six times 3 Inches is 18 Parts — | — | : | : | 1 : 6 Seco. |
| Six times 6 Parts produce 36 thirds or 12ths of a Second, which makes | — | : | : | : 3 Seco. |
| | 12 | : | 6 | : 9 : 9 |

And this Method they are very fond of (tho' it be very absurd in Reality; for to multiply Inches by Feet, &c. *i. e.* a thing of one Name or Denomination by another, is Nonsense;) and I believe they generally use it because of its Dispatch.

CROSS-*Staff.* The Description and Use of this Instrument is as follows:

The *Staff* is usually above 3 Foot long, having 4 Sides square to one another about $\frac{1}{4}$ an Inch over; and each is graduated like a Line of Tangents, and to every Side belongs a peculiar Cross-piece. The *Staff* may be divided either by a Table of Natural Tangents, or Geometrically by the Divisions in the Quadrant of a Circle. Then the Half of the Cross-piece being supposed Radius, the Graduation on the *Staff* will be the Natural Co-Tangents of the half Arches.

The Uses of this Instrument are, to take the Altitude of the Sun, or of a Star; to take the Distance between two Stars, or of any Star from the Moon, &c. and 'tis us'd by some to take Distances by Land.

*To observe the Altitude of the Sun or Stars.*

There are four Crosses belonging to the *Staff*, one called the *Tencross*, which belongs to that Side where the Graduation begins 3 *deg.* and ends with 10 *deg.* another called the *Thirty-cross*, belonging to that Side of the *Staff* where the Divisions begin with 10, and end with 30 *deg.* The Third is the *Sixty-cross*, which belongs to that Side where the Degrees begin at 20, and end at 60 *deg.* And the last is called the *Ninety-cross*, belonging to that Side where the Graduations begin at 30, and end at 90 *deg.*

Now, according as you can guess the Sun's Altitude to be, you must use the proper Cross: If the Altitude be under 10 *deg.* use the Ten-cross; if under 30, use the Thirty-cross; if under 60, the Sixty-cross; but if above that, use the Ninety-cross.

And the Way of observing is thus: Having fitted on your proper Cross, place the flat End of the Staff to the Outside of your Eye, and as near to your Eye as you can: Then look at the Sun, or Star, with the upper End of the Cross, and at the Horizon with the lower End, moving or sliding the Cross to and fro till you can do this exactly; for then the Degrees and Minutes cut by the inner Edge of the Cross, on the proper Side of the Staff for that Cross, will give you the present Altitude of the Sun or Star.

Unless it be hazy and thick Weather, the Observation can hardly be made without Prejudice to the Eye: To prevent which, some put a coloured Glass on the Top of the Cross; and then they observe the upper Limb of the Sun, and subtract his Semidiameter from the Altitude.

There is a Way also of making a backward Observation of the Sun's Altitude with the Cross-Staff, as thus: Fix a Horizontal Vane on the Eye-End of the Staff, and a Shoe of Brass to the End of any of the Four Crosses; which will serve instead of a Sight Vane. Having done this, and fitted the Cross on upon the Staff, turn your Back to the Sun, and looking through the Slit in the Brass Shoe, lift up or down the End of the Staff, till the Shadow made by the upper End of the Cross fall on the Slit in the Horizon Vane, and that likewise at the same time you can see the Horizon through

the Horizontal Vane at the End of the Braſs; then will the Degrees cut on the proper Side of the Staff, be the Sun's Altitude required.

*To obſerve the Diſtance between Two Stars, or the Moon's Diſtance from a Star.*

Place the flat End of the Staff to the Edge, as in the Firſt Obſervation, and looking to both Ends of the Croſs, draw it to and fro, till the Ends will cut the Two Stars, or one the Moon, and the other the Star; then will the Croſs cut the Diſtance between thoſe Objects on the proper Side of the Staff.

Becauſe there may be a Miſtake in placing the Staff to the Eye, take this Rule to know when it is right: Put the Sixty-croſs on 30 Degrees on its proper Side of the Staff, and likewiſe the Ninety-croſs on 30 Degrees on its outſide; and then when, by moving the Staff higher or lower, you have placed it ſo, that you can ſee the upper End of the Two Croſſes in one and the ſame right Line, and the Two lower Ends in another, the Staff is placed right.

CROWNS *of Colours*, are certain *coloured Rings* which like *Halo's* appear, but of the Colours of the Rainbow, and at a leſs Diſtance than the common *Halo's*, about the Body of the Sun or Moon. Theſe Sir *Iſaac Newton*, in his *Opt. Book* 2. *p.* 4. ſhews to be made by the Suns ſhining in a fair Day, or the Moon in a clear Night, through a thin Cloud of Globules of Water or Hail, all of the ſame bigneſs: And according as the Globules are bigger or leſſer, the Diameters of theſe Crowns, or Rings, will be larger or ſmaller; and the more equal theſe Globules are to one another, the more Crowns of Colours will appear, and the Colours will be the more lively.

CROWN-*Poſt*, is a Poſt which in ſome Buildings ſtands upright in the middle, between two principal Rafters; and from it there go *Strutts* or *Braces* to the middle of each Rafter. This is alſo by ſome called the *King-piece*, and the *Joggle-piece*.

CRUCIFORM *Hyperbola*, is a Curve by that Name; which is ſo called by Sir *Iſaac Newton*, becauſe it cuts its *Conjugate* croſs-wiſe.

CRYPTOGRAPHY, called alſo *Steganography*, is the Art of ſecret Writing: On which Subject many Books have been publiſh'd; as, by the Abbot *Trithemius*, in his *Steganographia*, *Francf.* 1608. *4to.* by *Guſtavus Selenus*, in 9 Books in *Fol.* printed at *Luneburgh*, 1624. *cum Fig.* by *Schottus*, in his *Schola Steganographica*. Biſhop *Wilkin's Secret and Swift Meſſenger*.

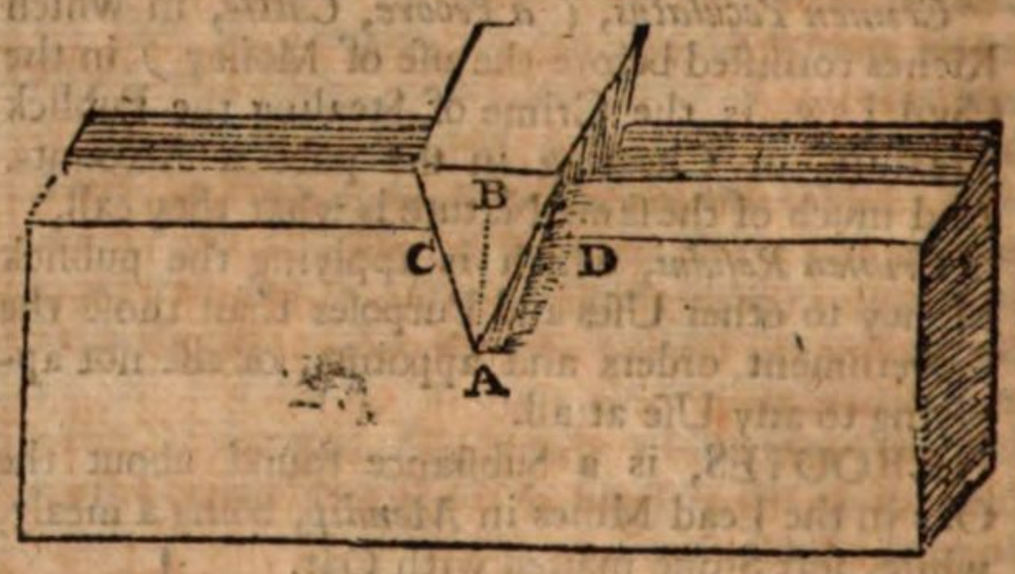
CUBICAL *Paraboloid*. See *Paraboloid* and *Curves*.

CUL-PRIT, are Words uſed by the Clerk of the Arraignments, when a Perſon is indicted for a Criminal Matter. For after the Indictment is read in Court (which is the Crown's Charge) againſt the Priſoner at the Bar, he is put upon his Plea, or aſked, *Art thou Guilty, or not Guilty?* If he pleads or anſwers, *not Guilty*, there is next a Replication from the Crown, by continuing the Charge of Guilt upon him, according to the Tenour of the Indictment; which is expreſs'd by pronouncing the Words *Cul-Prit*: *Cul* being an Abbreviation of the *Latin* Word *Culpabilis*, *Guilty*; and *Priſt*, or *Prit*, (now *Pret*) is the old *French* Word for *Ready*. From theſe two Aſſertions therefore of the Clerk of the Arraignment, that the Priſoner is *Culp*, or *guilty* of the Crime charged on him, and that the Crown is *Prit* or *ready* to prove it upon him; this Word *Cul-Prit* is derived.

And that this is the true Explanation of the Terms *Cul-Prit*, is evident from the Form of the Entry of the Record of the Trial when drawn up at large; which, as to the Replication pronounced by the Clerk, as aforeſaid, in the Words *Cul* and *Prit*, run thus: *Et Prædictus A.* (the Clerk) *pro Domina Regina dicit, Quod Prædict. B.* (the Priſoner) *eſt Culpabili*, &c. *Et hoc paratus eſt verificare*, &c.

CULVERTAIL, the ſame with *Dovetail*; which ſee.

CUNEUS. The *Wedge*, one of the five Mechanical Powers, is in the Form of a *Priſm*, whoſe Top and Sides are Parallelograms, but its Ends Iſoſceles Triangles; whoſe Altitude is called the *Altitude of the Wedge*, as the Baſe of each ſaid Triangle is the *Thickneſs of the Wedge*. The right Line connecting the *Vertices* of the Two Triangles, is called the *Edge*; as the Parallelogram which joins their Baſes, is called its *Dorſum*, or *Back*.




The Power of this Engine is eaſily eſtimated; and is (when directly applied to the *Top* or *Dorſum* of the Wedge) to the Reſiſtance to be overcome, as the Thickneſs of the Wedge is to its Altitude. In the Figure, *B A* is the way of Power, and *C D* the way of the Impediment or Reſiſtance: So that while the Wedge is driven down into the Wood, &c. by its whole Altitude, the Wood is divided by the entire Thickneſs of the Wedge, and this every where proportionably, as follows from the Nature of a Triangular Figure. Wherefore a Wedge, whoſe Thickneſs is to its Altitude or Length in a little greater Proportion, than as the Power applied is to the Reſiſtance or Tenacity of the Wood, will cleave or divide it.

CUNETTE, See *Cuvette*.

CUPULO, in Architecture is an Arched Room or Turret ſtanding on the very Top of a *Dome* or great Building, in Form either Circular or Polygonal; ſome call it a Lanthorn.

CURATOR, in the Civil Law, is a Perſon regularly appointed to take care of another; as ſuppoſe of a Minor, by his Conſent from 24 Years of Age, to 35; on the Determination of a Trial at Law, where the Magiſtrate may appoint a *Curator* for the Minor. The Magiſtrate alſo might appoint a *Curator* for a Madman, a Prodigal, Deaf or Dumb Perſon, as alſo for the Eſtates of Debtors, and of Perſons dying without Heirs.

CURIA, a Word uſed formerly in different Senſes. Sometimes it ſignified the Perſons or Feudatory Tenants, who did their Suit and Service at the Court of the Lord.

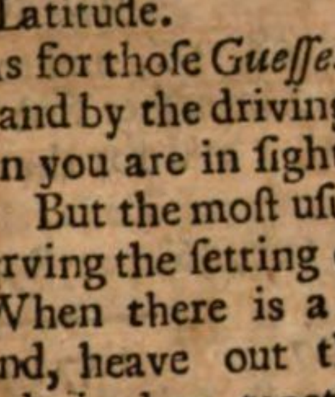
Sometimes it ſignified a Houſe, as *Curia Canonicorum*, the *Convent* or *Conventional* Houſe. *Curia Perſonæ Eccleſiæ*, the Parſonage Houſe. And ſometimes it was uſed for the Service it ſelf, of coming to the Court of the Lord; *Curiæ adventus*. Dr. *Kennet*.

CURRENTS, are certain Progreſſive Motions of the Water of the Sea in ſeveral Places, either quite down to the Bottom, or to a certain determinate Depth; by which a Ship may happen to be carried forward more ſwiftly, or retarded in her Courſe, according to the *Direction* or *Setting* of the Current in, with, or againſt the Courſe or Way of the Ship.

The firſt thing therefore to be known, is, *which way* the Current ſets; and if its Motion be ſwift, great and ſtrong, this will be beſt diſcovered by keeping an exact Account of the Ships Way both outward and homeward, according to the beſt Method of what the Seamen call their *Dead Reckoning*, being very curious in obſerving the way the Ship makes by the Log-line; for 'tis not the correct Account, but the *Dead Reckoning*, that muſt here aſſiſt you. Therefore you muſt be very careful to obſerve how the Ship goes by it, when you Sail near the *Meridian*; how ſhe is drawn from her Courſe: As alſo, when ſhe is ſteered directly *Eaſt* and *Weſt*, take good Notice whether ſhe alter her Latitude.

As for thoſe *Gueſſes*, by the *Ripplings* of the Water, and by the driving of Froth, *&c.* along Shore, when you are in ſight of it, they will be of little uſe. But the moſt uſual and the moſt uſeful way of obſerving the ſetting of a Current is thus:

When there is a ſmooth Sea, and not much Wind, heave out the Boat, with three or four Hands in her, together with a Compaſs, a Log-line, and Half-minute Glaſs, with alſo a Line or ſmall *Warp* of about an Hundred Fathoms long; to the End of which Line faſten a Triangular Piece of Board, as *a b c*, and to one of the Angles faſten a good heavy Piece of Lead to ſink it. Some uſe inſtead of this Board a Kettle tied by the Bail, (which may do tolerably well).




When you are off from the Ship, caſt over your Board or Kettle, letting it ſink at leaſt 60 Fathom; and if you have Line enough, let it down 100 or 120 Fathom: Then belaying the Line faſt about her Stern, it will bring her up, and make her ride as if ſhe were at an Anchor. Then caſt over your Log, turn up the Glaſs, and as you veer out the Log-line, ſet the Drift of the Log with your Compaſs: So ſhall you know whether there be any Current or no; and if any, how it ſets; as alſo the Rate of its driving. Only remember to add always to the Drift, if the Line ſhe ride be of 60 Fathom, $\frac{1}{3}$ Part; if of 80 Fathom, $\frac{1}{4}$; if of 100 Fathom, the $\frac{1}{5}$ Part, *&c.* of the Drift more, for the Drift of the Boat; for though the Boat may ſeem to ride or lie ſtill, yet ſhe is found by Experience to drive at the ſame Time.

*N. B.* Whether theſe Allowances be the *very Truth*, or not, I cannot ſay: They are ſaid to agree with Experience, and therefore may be us'd till better Obſervations of theſe things may be made. Only this is certain, That the bigger the Board and Weight is that the Boat is to ride by, the leſs will be her Drift. *Sir* J. Moor's *Navig.*

If a Current ſet exactly with the ſame Direction, as is the Courſe of the Ship, then it muſt augment her Motion forward in Proportion to the Velocity of the Drift.

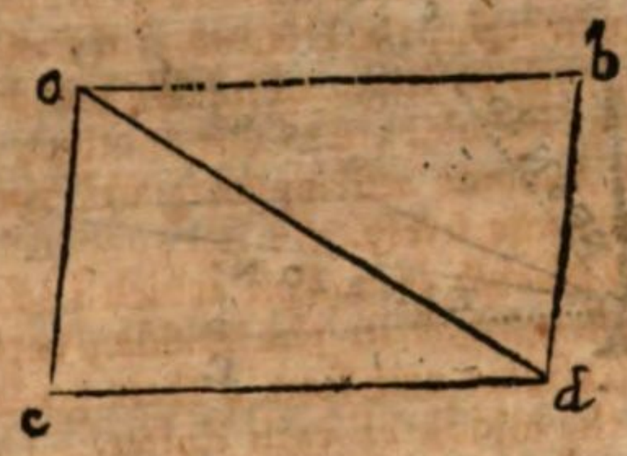
As if a Ship ſail N. N. E. 20 Miles, in a Current ſetting the ſame way, and in the ſame time 8 Miles, her true Courſe will be N. N. E. 28 Miles in the ſame time.

But if the Current ſet directly againſt the Ship's Courſe, it will abate of her Motion forward in Proportion to the Velocity of the Drift.

As if a Ship ſail N. E. 49 Miles in a Current, ſetting S. W. 10 Miles in the ſame time; the Ship's Courſe or Diſtance run in that time will be but 39 Miles. So if a Ship ſail N. E. 49 Miles in a certain time, in a Current that ſets S. W. 59 Miles in the ſame time; her true Courſe will be S. W. 10 Miles; that is, ſhe will fall aſtern 10 Miles in that time.

But if a Ship ſail a-croſs any Current, her Motion will be compounded with that of the Current; and her Velocity augmented, or retarded proportionably to the Angle of her Direction, with that of the Direction of the Current; according as ſhe goes in Part with it or againſt it.

As ſuppoſe the Ship's Courſe were from *a* to *c*, and the ſetting of the Current from *a* to *b*; the Ship will, by the Compoſition of thoſe two Motions be carried from *a* to *d* in the Diagonal *a d*: See *Compoſition of Motion*.




Wherefore if a Ship ſails N. E. 110 Miles, in a Current which ſets S. W. 30 Miles in the ſame time, and her true Courſe and Diſtance ſailed be requird, you may proceed thus:

*1ſt. Geometrically.*

1. Set off 4 Points from N. towards E. and draw A C equal to 110 Miles.

2. From C draw C B, parallel to the Line N. N. E. and equal to 30 Miles.

3. Draw A B, which will be the Ship's true Courſe; to find which

*Trigonometrically,*

In the Triangle A B C, there is

Given { A C 110 / 7 at C 22 30 / B C 30 } and it will be by Caſe 1. Sect. 4.

A+CBC: AC—BC :: t, $\frac{1}{2}\angle A+B$ : t, $\frac{1}{2}\angle B-A$, *i. e.*
As the Sum of A C and B C 140 2.1461280

To their Difference 80 4.9030900
So is the Tangent of 78° 45' 10.7013382

To the Tangent of 70 49 10.4583002

Now 78° 45' — 70° 49' = 7° 56' = ∠ C A B.

Hence it appears that her true Course is N E 7° 56' Easterly.

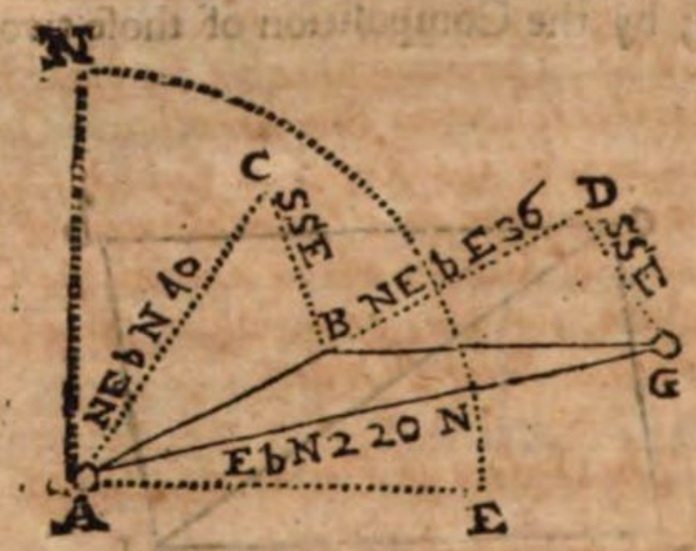
But for her Distance it will be by Case 1. Sect. 4.
s, ∠ A : B C :: s, ∠ C : A B. *i. e.*
As the Sine of the Angle at A 7°, 56' 9.1399445

To the Drift of the Current B C 30 1.4771212
So is the Sine of the Angle at C 22° 30' — 9.5828397

To the Distance run 83, 2 Miles 1.9200164

*Ex.* 2. If a Ship from the Latitude 36° 30' S Sails N E b N 40 Miles, then N E b E 36 Miles, in a Current that sets S S E 20 Miles in the time that the Ship sails 38 Miles, and it be required to find the direct Course and Distance between the Ship and her first Place, as also the Latitude the Ship is in.

1*st.* Having constructed it, as in the former.




In the Triangle *A C B*, are
Given { *A C* 40, ∠ at *C* 56°, 15', *B C* 21, 05 } To find *A B*, and the Angles at *A* and *B*.

It will be, by *Case* the 4th of *Sect.* the 4th.
*A C + B C : A C — C B :: t*, $\frac{1}{2}\angle A + \angle B$ : *t*, $\frac{1}{2}\angle B - \angle A$; *i. e.*
As the Sum of *A C* and *B C* 61, 05 1.7856857

To their Difference 18, 95 1.2776092
So is the Tangent of 61°, 52½' 10.2720432

To the Tangent of 30, 08½ 9.7639667

Now, 61°, 52'' — 30°, 08½' = 31°, 44' = ∠ *C A B*; therefore the Ship's first Course is N. E. by E. 9°, 14', Eastwardly.

For the Distance, it will be, by *Case* the 1st of *Sect.* the 4th,
*s, C A B : C B :: s, A C B : A B*; that is,
As the Sine of the ∠ *C A B* 31°, 44' 9.7209581

To *C B* the Drift of the Current 21, 05 1.3232521
So is the Sine of the ∠ at *C* 56°, 15'. 9.9198464

To the Distance run, 33, 28. 1.5221404

2. In the Triangle *B D G*, are given
*B D* 36, ∠ at *D* 78°, 45', *D G* 18, 95 } To find *B D* and the ∠s *D B G* and *D G B*.

Wherefore,
As the Sum of *B D* and *D G* 54, 95 1.7399677

To their Difference 17, 05 1.2317244
So is the Tangent of 50°, 37' 10.0856980

To the Tangent of 20°, 42' 9.5774547

Hence the Angle *D B G*, will be found 29°, 55'; wherefore the Ship's second Course is E. by N. 7°, 25'. Eastwardly, and consequently the Angle *A B G* = 159°, 19'.

But for *B G*, the Distance run, it will be
As the Sine of the Ang. *B D G* 29°, 55'. 9.6978747

To *D G* the Drift of the Current, 18, 95 1.2776092
So is the Sine of the Angle *B D G* 78°, 45 9.9915739

To *B G* the Distance run, 37, 27 1.5713090

3. In the Triangle *A B G*, are
Given { *A B* 33, 28, ∠ *A B G* 159°, 19', *B G* 37, 27 } Whence must be found ∠ *B A G* and *A G*, and 'twill be,
As the Sum of *A B* and *B G* 70, 55 10.8484970

To their Difference 3, 99 0.6009729
So is the Tangent of 10°, 20'' 9.2612203

To the Tangent of 00°, 36' 8.0136962

Hence the Angle *B A G* is 10°, 56', and consequently the bearing of the Ship from her first Port is E. by N. 2°, 20'. Northerly; and for the Distance it will be,
As the Sine of the Angle *B A G* 10°, 56'. 9.2789911

To the Distance run *B G* 37, 27 1.5713090
So is the Sine of the ∠ *A B G* 159°, 19'. 9.5480240

To the Distance between the Ship and her Port 69, 24 } 1.8403419

Now for the Difference of Latitude, it will be
as the Radius 10.0000000

To the Distance sail'd, 69, 24 1.8403571
So is the Co-Sine of the Course, 76°, 25' 9.3708079

To the Difference of Latitude 16, 26 1.2111650

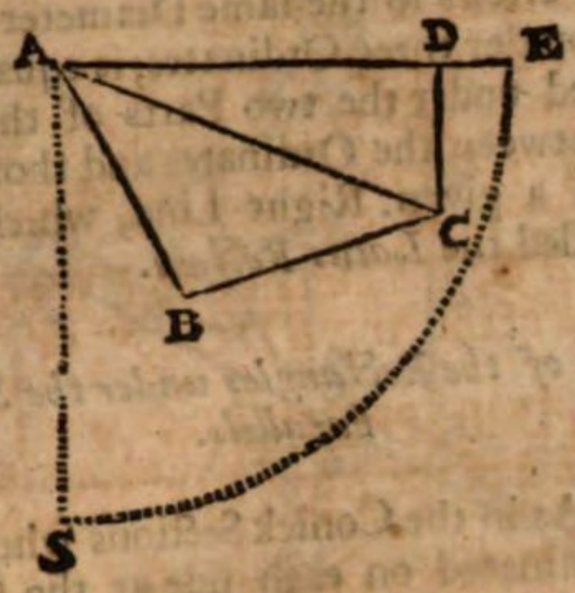
Hence, because she sail'd from a South Latitude } —— Nly
From the Latitude she sail'd from 36°, 30' — Sly
Take the Difference of Lat. made 16⅓' —— Nly
Remains the Lat. the Ship is in 36°, 13⅔' —— Sly

Admit a Ship, from a certain Head-line, in the Latitude of 34°, 00'. North, sails S. E. by S. 24 Miles in 6 Hours, in a Current that sets between the North and the East; and then the Cape is found to bear W. N. W. and the Ship to be in the Lat. of 33°, 45'. North. I demand the Setting and Drift of the Current?

Geome-

*Geometrically.*

1. Set off 3 Points from *S* towards *E*, and draw the Line *A B* equal to 24 Miles.




2. Set off two Points from *E* towards *S*, and draw the Line *A C*.

3. At the Distance of 15 Miles, equal to the Difference of Latitude, draw a parallel to *A E*, till it interfect *AC* as in *C*.

4. From the Interfection *C*, draw *C D* parallel to *A S*; alfo the Line *B C* the Drift and Setting of the Current.

To find which *Arithmetically*.

In the Triangle *A D C*, Right-angled at *D*, are

Given $\left\{\begin{matrix} D\,C\ 15 \\ \angle\, A\ 22^{\circ}, 30' \end{matrix}\right\}$ to find *A C*

Wherefore *S* ∠ *A* : *D C* : : *R* : *A C*; that is,

| | |
|---|---|
| As the Sine of the Angle at *A* 22°, 30' | 9.5828397 |
| To the Difference of Latitude 15 | 1.1760912 |
| So is the Radius | 10.0000000 |
| To the Diftance run 39, 2 | 1.5932515 |

Again, In the Triangle *A B C*, are

Given $\left\{\begin{matrix} A\,B\ 24 \\ \angle\, A\ 33^{\circ}, 45' \\ A\,C\ 39, 2 \end{matrix}\right\}$ to find $\left\{\begin{matrix} \angle\, C \\ B\,C \\ \angle\, B \end{matrix}\right.$

Wherefore,

$$\overline{A\,B + A\,C} : \overline{A\,C - A\,B} :: t\tfrac{1}{2}\,\angle B + \angle C : t\tfrac{1}{2}\,\angle B - \angle C$$

| | |
|---|---|
| As the Sum of the Sum of the Sides *AB* and *AC* 63°, 2' | 1.8007171 |
| To their Difference 15°, 2' | 1.1818436 |
| So is the Tangent of 73°, 07½' | 10.5180608 |
| To the Tangent of 38°, 24½' | 9.8991873 |

Which added to 73°, 07½', gives 111°, 32'. the Angle at *B*. And hence the Current will be found to fet E. by N. 00°; 58' Northerly.

For *B C*, the Drift of the Current, it will be,

*s*, ∠ *B* : *A C* : : *s*, ∠ *A* : *B C*; that is,

| | |
|---|---|
| As the Sine of the Ang. at *B* 111°, 32' | 9.9685783 |
| To *A C* the Diftance run 39°, 2'. | 1.5932515 |
| So is the Sine of the Ang. at *A* 33°, 45' | 9.7447390 |
| To *B C* the Drift of the Current in 6 Hours, 23°, 41'. | 1.3694122 |

And confequently it fets at the Rate of 3°, 9'. Miles an Hour.

Several other Queftions might be propos'd relating to Currents, but thefe being throughly underftood, are fufficient for the Purpofe.

CURSOR, is a Piece or little Ruler or Label of Brafs being divided like a Line of Sines, and fliding in a Groove or Notch along the middle of another Label or Ruler, repreferting the Horizon, and always at Right Angles to it: 'Tis ufed in the *Analemma*, which fee.

CURVATURE *of a Line*, is the peculiar manner of its bending or Flexure, whereby it becomes a Curve of fuch peculiar Properties. Thus the *Curvature* of the Circle is fuch, that all Points of the Periphery are equally diftant from one Point within, call'd the Centre. The Curvatures of different Circles are to one another reciprocally as their Radii.

CURVE, generating the Solid of leaft Refiftance, See *Solid*.

CURVES. *The incomparable Sir* Ifaac Newton *gives this following Enumeration of Geometrical Lines of the Third or Cubick Order; in which you have an admirable account of many Species of* Curves *which exceed the* Conick-Sections, *for they go no higher than the Quadratick or Second Order.*

*The Orders of Geometrick Lines.*

1. GEOMETRICK-LINES, are beft diftinguifh'd into *Claffes*, *Genders* or *Orders*, according to the Number of the Dimenfions of an Equation, expreffing the relation between the *Ordinates* and the *Abfciffæ*; or which is much at one, according by the Number of Points in which they may be cut to a Right Line. Wherefore, a Line of the *Firft Order* will be only a Right Line: Thofe of the *Second* or *Quadratick Order*, will be the *Circle* and the *Conick-Sections*; and thofe of the *Third* or *Cubick Order*, will be the *Cubical* and *Nelian Parabola's*, the *Ciffoid* of the Antients, and the reft as below enumerated. But a *Curve* of the *Firft Gender* (becaufe a Right Line can't be reckoned among the *Curves*) is the fame with a Line of the *Second Order*; and a *Curve* of the *Second Gender*, the fame with a Line of the *Third Order*; and a Line of an *Infinitefimal Order*, is that which a Right Line may cut in infinite Points, as the *Spiral*, *Cycloid*, the *Quadratrix*, and every Line generated by the infinite Revolutions of a *Radius* or *Rota*.

2. The chief Properties of the *Conick-Sections* are every where treated of by Geometers; and of the fame Nature are the Properties of the *Curves* of the *Second Gender*, and of the reft, as from the following Enumeration of their Principal Properties will appear.

3. For if any right and parallel Lines be drawn and terminated on both Sides by one and the fame *Conick Section*; and a Right Line bifecting any two

two of them ſhall biſect all the reſt; and therefore ſuch a Line is called the Diameter of the Figure; and all the Right Lines ſo biſected, are called *Ordinate Applicates* to that Diameter, and the Point of Concourſe to all the Diameters is called the *Centre* of the *Figure*; as the Interſection of the *Curve* and of the Diameter, is called the *Vertex*, and that Diameter the *Axis* to which the Ordinates are *Normally* applied. And ſo in *Curves* of the *Second Gender*, if any two right and parallel Lines are drawn occurring to the Curves in three Points; a right Line which ſhall ſo cut thoſe Parallels, that the Sum of two Parts terminated at the Curve on one Side of the interſecting Line, ſhall be equal to the third Part terminated at the Curve on the other Side; this Line ſhall cut, after the ſame manner, all others parallel to theſe, and occurring to the Curve in three Points; that is, ſhall ſo cut them, that the Sum of the two Parts on one Side of it, ſhall be equal to the third Part on the other.

And therefore theſe three Parts, one of which is thus every where equal to the Sum of the other two, may be called *Ordinate Applicates* alſo: And the interſecting Line to which the Ordinates are applied, may be called the *Diameter*; the Interſection of the Diameter and the Curve, may be called the *Vertex*, and the Point of Concourſe of any two Diameters, the *Centre*.

And if the Diameter be Normal to the Ordinates, it may be called the *Axis*; and that Point where all the Diameters terminate, the *General Centre*.

### *Aſſymptotes and their Properties.*

4. The Hyperbola of the firſt Gender has two *Aſſymptotes*, that of the ſecond, three; that of the third, four; and it can have no more, and ſo of the reſt. And as the Parts of any Right Line lying between the *Conical Hyperbola* and its two Aſſymptotes are every where equal; ſo in the Hyperbola of the Second Gender, if any Right Line be drawn, cutting both the Curve and its three Aſſymptotes in three Points, the Sum of the two Parts of that Right Line being drawn the ſame way from any two Aſſymptotes to two Points of the Curve, will be equal to the third Part drawn a contrary way from the third Aſſymptote, to a third Point of the Curve.

### *Latera Tranſverſa & Recta.*

5. And as in *Non Parabolick Conick Sections*, the Square of the Ordinate Applicate, that is, the Rectangle under the Ordinates, drawn at contrary Sides of the Diameter, is to the Rectangle of the Parts of the Diameter, which are terminated at the Vertex's of the *Ellipſis* or *Hyperbola*, as a certain given Line, which is called the *Latus Rectum*, is to that Part of the Diameter which lies between the Vertex's, and is called the *Latus Tranſverſum*: So in *Non Parabolick Curves* of the ſecond Gender, a Parallelopiped under the three Ordinate Applicates, is to a Parallelopiped, under the Parts of the Diameter terminated at the Ordinates, and the three Vertex's of the Figure in a certain given Ratio; in which Ratio, if you take three Right Lines to the three Parts of a Diameter ſituated between the Vertex's of the Figure, one anſwering to another; then theſe three Right Lines may be called the *Latera Recta* of the Figure, and the Parts of the Diameter between the *Vertices*, the *Latera Tranſverſa*. And as in the Conick Parabola, having to one and the ſame Diameter but one only Vertex, the Rectangle under the Ordinates is equal to that under the Part of the Diameter cut off between the Ordinates and the Vertex, and a certain Line called the *Latus Rectum*: So in the Curves of the ſecond Gender, which have but two Vertex's to the ſame Diameter; the Parallelopiped under three Ordinates, is equal to the Parallelopiped under the two Parts of the Diameter cut off between the Ordinates and thoſe two Vertexes, and a given Right Line, which therefore may be called the *Latus Rectum*.

### *The Ratio of the Rectangles under the Segments of Parallels.*

*Laſtly*, As in the Conick Sections when two Parallels terminated on each ſide at the Curve, are cut by two other Parallels terminated on each ſide by the Curve, the firſt being cut by the third, and the ſecond by the fourth; as here the Rectangle under the Parts of the firſt, is to the Rectangle under the Parts of the third; as the Rectangle under the Parts of the ſecond, is to that under the Parts of the Fourth: So when four ſuch Right Lines occur to a Curve of the ſecond Gender, each one in three Points; then ſhall the Parallelopiped under the Parts of the firſt Right Line, be to that under the Parts of the third; and as the Parallelopiped under the Parts of the ſecond Line, unto that under the Parts of the Fourth.

### *Hyperbolick and Parabolick Legs.*

All the Legs of Curves of the ſecond and higher Genders, as well as of the firſt, infinitely drawn out, will be of the *Hyperbolick* or *Parabolick* Gender; and I call that an *Hyperbolick* Leg, which infinitely approaches to ſome Aſſymptote; and that a *Parabolick* one, which hath no Aſſymptote. And theſe Legs are beſt known from the Tangents: For if the Point of Contact be at an infinite Diſtance, the Tangent of an *Hyperbolick* Leg will coincide with the Aſſymptote, and the Tangent of a *Parabolick* Leg will recede *in infinitum*, will vaniſh and no where be found. Wherefore the Aſſymptote of any Leg is found, by ſeeking the Tangent to that Leg at a Point infinitely diſtant: And the *Courſe*, *Place* or *Way* of an infinite Leg, is found by ſeeking the Poſition of any Right Line, which is parallel to the Tangent where the Point of Contact goes off *in infinitum*: For this Right Line is directed towards the ſame way with the infinite Leg.

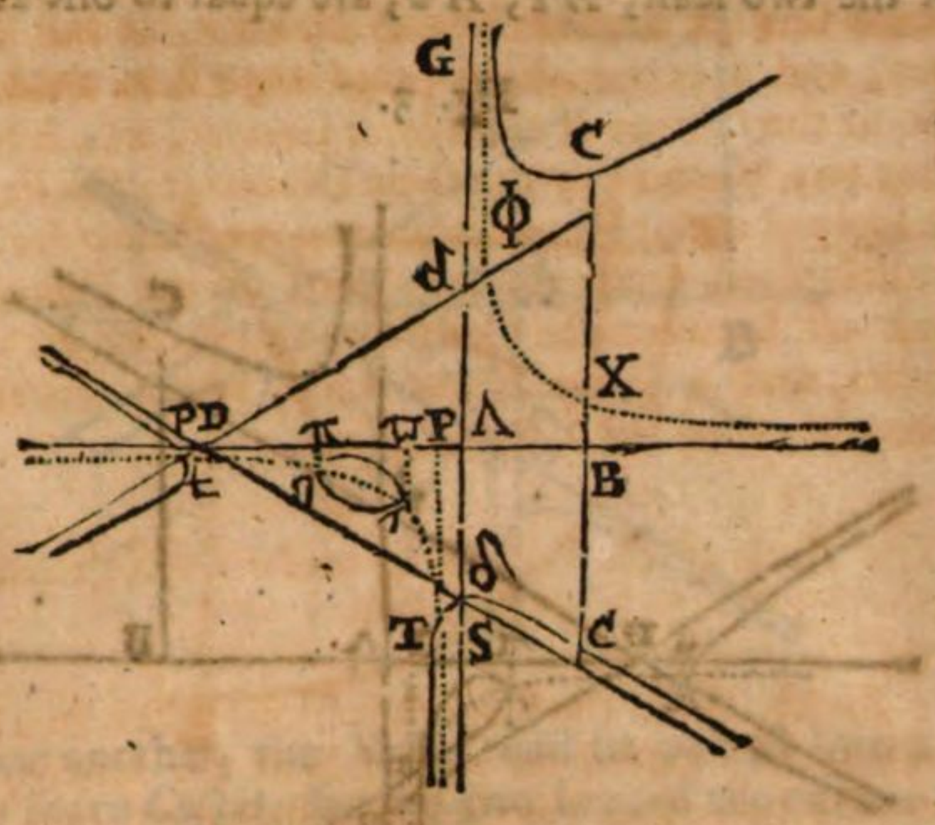
### *The Reduction of all Curves of the ſecond Gender, to four Caſes of Equations.*

### CASE I.

All Lines of the firſt, third, fifth and ſeventh Order, and ſo of any one, proceeding in the Order of the odd Numbers, have at leaſt two Legs or Sides proceeding on *ad infinitum*, and towards contrary ways. And all Lines of the third Order have two ſuch Legs or Sides running out contrary ways, and towards which no other of their infinite Legs (except in the *Carteſian Parabola*) do tend. If the Legs are of the Hyperbolick Gender, let $GAS$ be their Aſſymptote; and to it let the parallel $CBc$ be drawn, terminated (if poſſible) at both Ends at the Curve. Let this parallel be biſected

fected in $X$; and then will the Place of that Point

*Fig.* 1.




$X$ be the *Conical Hyperbola* $X o$, one of whose Asymptotes is $A S$: Let its other Asymptote be $A B$; then the *Equation* by which the Relation between the Ordinate $B C$ and the Abscissa $A B$ is determined, if $A B$ be put $= x$ and $B C = y$, will always be in this Form, $x y y + e y = a x^3 + b x x + c x + d$, where the Terms $e$, $a$, $b$, $c$, and $d$, denote given Quantities, affected with their Signs $+$ and $-$; of which any one may be wanting, so the Figure, through their Defect, don't turn into a Conick Section. And this Conical Hyperbola may coincide with its Asymptotes, that is, the Point $X$ may come to be in the Line $A B$, and then the Term $+ e y$ will be wanting.

## CASE II.

9. But if the Right Line $C B c$ cannot be terminated both ways at the Curve, but will occur to the Curve only in one Point, then draw any Line in a given Position, which shall cut the Asymptote $A S$ in $A$; as also any other Right Line, as $B C$, parallel to the Asymptote, and meeting the Curve in the Point $C$: And then the Equation by which the Relation between the Ordinate $B C$ and the Abscissa $A B$ is determined, will alway put on this Form, $x y = a x^3 + b x x + c x + d$.

## CASE III.

10. But if the opposite Legs are of the Parabolick Gender, draw the Right Line $C B c$, terminated at both Ends, if it's possible, at the Curve; and running according to the Course of the Legs, which bisect in $B$: Then shall the Place of $B$ be a Right Line. Let that Right Line be $A B$, terminated at any given Point, as $A$; and then the Equation by which the Relation between the Ordinate $B C$ and the Abscissa $A B$ is determined, will always be in this Form, $y y = a x^3 + b x x + c x + d$.

## CASE IV.

11. But if the Right Line $C B c$ meet the Curve but in one Point, and therefore can't be terminated at the Curve at both Ends; let the Point where it occurs to the Curve be $C$; and let that Right Line at the Point $B$, fall on any other Right Line given in Position, as $A B$, and terminated at any given Point, as $A$: Then will the Equation, by which the Relation between the Ordinate $B C$ and the Abscissa $A \beta$ is determined, always be in this Form, $y y = a x^3 + b x x + c x + d$.

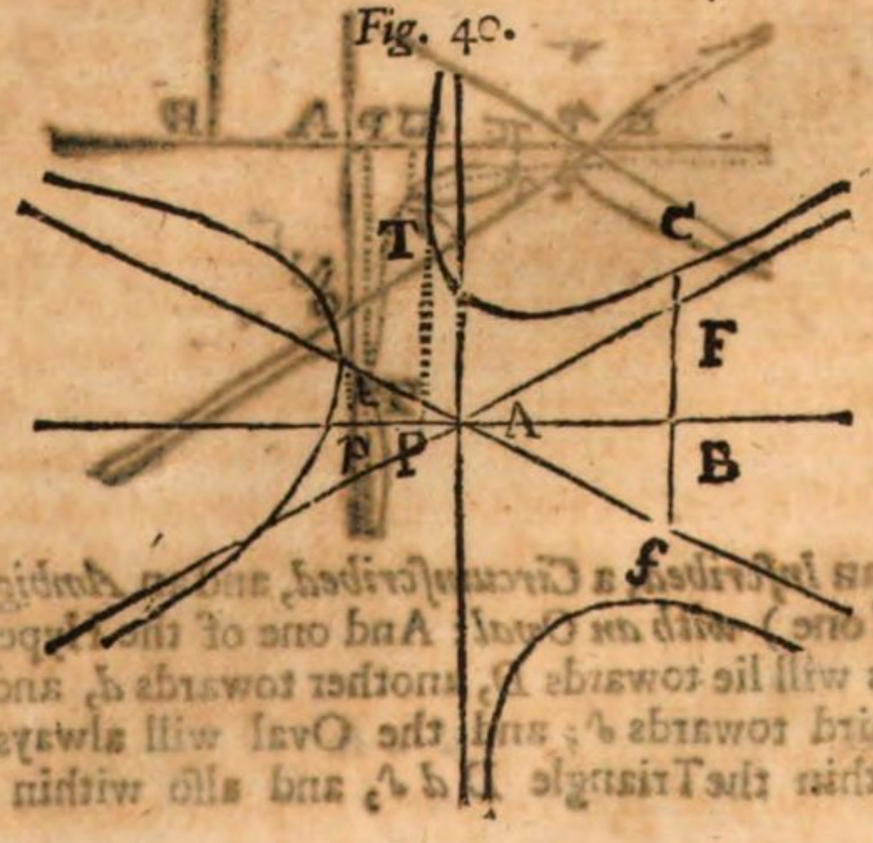
### *The Names of the Forms.*

12. In the Enumeration of Curves of these Cases, we call that an *Inscribed Hyperbola*, which lies entirely within the Angle of the Asymptotes, like the *Conical Hyperbola*; and that a *Circumscribed* one, which cuts the Asymptotes, and contains the Parts cut off within its own proper Space; and that an *Ambigenial* one, which hath one of its infinite Legs inscribing it, and the other circumscribing it. I call that a *Converging* one, whose concave Legs bend inwards towards one another, and turn both the same way; but that I call a *Diverging* one, whose Legs turn their Convexities towards each other, and tend towards quite contrary ways. I call that *Hyperbola contrary leg'd*, whose Legs are Convex towards contrary Parts, and run infinitely on towards contrary ways; and that a *Conchoidal one*, which is applied to its Asymptote with its Concave Vertex and diverging Legs; and that an *Anguineal or Eel-like* one, which cuts its Asymptote with contrary Flexions, and is produced both ways into contrary Legs. I call that a *Cruciform or Cross-like one*, which cuts its Conjugate crosswise; and that *Nodate*, which by returning round into, decussates it self. I call that *Cuspidate*, whose two Parts meet and terminate in the Angle of Contact; and that *Punctate*, whose Oval *Conjugate* is infinitely small, or a Point: And that Hyperbola I call *Pure*, which, by the Impossibility of its two Roots, is without any Oval Node, Spike or Conjugate Point. And in the same Sense I denominate a Parabola also, to be *Converging*, *Diverging*, *contrary leg'd*, *Cruciform*, *Nodate*, *Cuspidate*, *Punctate* and *Pure*.

### *Of the redundant Hyperbola and its Asymptotes.*

13. In the first Case, if the Term $a x^3$ be Affirmative, then the Figure will be a tripple Hyperbola with six Hyperbolical Legs, which will run on infinitely by the three Asymptotes, of which none are parallel, two Legs towards each Asymptote, and towards contrary Parts; and these Asymptotes, if the Term $b x x$ be not wanting in the Equation, will mutually intersect each other in three Points, forming thereby the Triangle $D d \delta$. But if the Term $b x x$ (see *Fig.* 1.) be wanting, they will all converge to the same Point. In the former Case take $A D = \frac{-b}{2a}$, and $A d = A \delta = \frac{b}{2\sqrt{d}}$, and

*Fig.* 40.



join $D\,d$, $D\,\delta$; ſo ſhall $A\,D$, $D\,d$, and $D\,\delta$, be the three Aſſymptotes. In the latter Caſe, draw any Ordinate, as $B\,C$, in which, both ways produced, take, on each Side, $B\,F$ and $B\,f$ equal to one another, and in the ſame Ratio with $A\,B$ that $\sqrt{a}$ hath to $l$; and then joining $A\,F$, $A\,f$; $A\,B$, $A\,F$, and $A\,F$, ſhall be three Aſſymptotes. And this kind of *Hyperbola* I call *redundant*, becauſe it exceeds the Conick Sections in the Number of its Hyperbolick Legs.

*Of the Diameter of this Hyperbola, and the Poſition of its infinite Legs.*

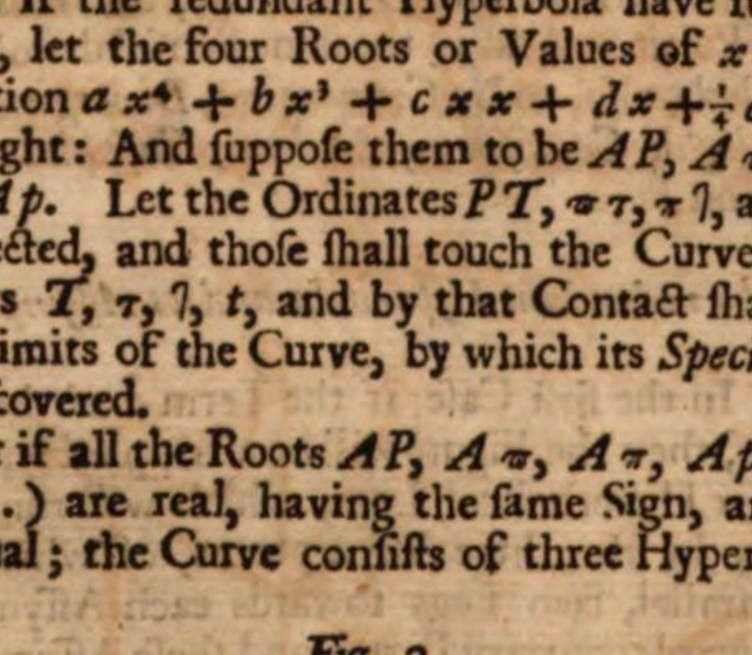
14. In every redundant Hyperbola, if neither the Term $e\,y$ be wanting, nor $b\,b - 4\,a\,c$ equal to $+ a\,e\,\sqrt{:}\,a$, the Curve will have no Diameter; but if either of thoſe happen, it will have *one only Diameter*, and *three* if they both happen. And the Diameter will always paſs through the Interſection of two of the Aſſymptotes, and biſect all Right Lines which are terminated each way by thoſe Aſſymptotes, and which are parallel to the third Aſſymptote: And the *Abſciſſa A B* will be the Diameter of the Figure, as often as the Term $e\,y$ is wanting. I take the Word *Diameter* here, and in the following Pages, *Abſolutely*; and in the common Acceptation of it, *viz.* for an *Abſciſſa* which hath every where two equal Ordinates, one on each Side, inſiſting at the ſame Point.

*Nine redundant Hyperbola's, having no Diameter, but three Aſſymptotes, which form a Triangle.*

15. If the redundant Hyperbola have no Diameter, let the four Roots or Values of $x$ in this Equation $a\,x^4 + b\,x^3 + c\,x\,x + d\,x + \frac{1}{4}\,e\,e = 0$, be ſought: And ſuppoſe them to be $A\,P$, $A\,\varpi$, $A\,\pi$, and $A\,p$. Let the Ordinates $P\,T$, $\varpi\,\tau$, $\pi\,\gamma$, and $p\,t$, be erected, and thoſe ſhall touch the Curve in the Points $T$, $\tau$, $\gamma$, $t$, and by that Contact ſhall give the Limits of the Curve, by which its *Species* will be diſcovered.

For if all the Roots $A\,P$, $A\,\varpi$, $A\,\pi$, $A\,p$, (ſee *Fig.* 1.) are real, having the ſame Sign, and are unequal; the Curve conſiſts of three Hyperbola's,

*Fig.* 2.




(an *Inſcribed*, a *Circumſcribed*, and an *Ambigenial* one) *with an Oval*: And one of the Hyperbola's will lie towards $D$, another towards $d$, and the third towards $\delta$; and the Oval will always lie within the Triangle $D\,d\,\delta$, and alſo within the middle Limits $\gamma$ and $\tau$, where it will be touch'd by the Ordinates $\pi\,\gamma$ and $\varpi\,\tau$. And this is the *Firſt Species*.

But if either the two greateſt Roots, $A\,\pi$, $A\,p$; or the two leaſt, $A\,P$, $A\,\varpi$, are equal to one another, and have the ſame Sign with the other two; then the *Oval* and *Circumſcribed Hyperbola* will join with one another, the Points of Contact $\gamma$ and $t$, or $T$ and $\tau$, co-inciding; and the Legs of the Hyperbola decuſſating one another, will be continued in the *Oval*, and make the *Nodate* Figure. The *Second Species*;

*Fig.* 3.

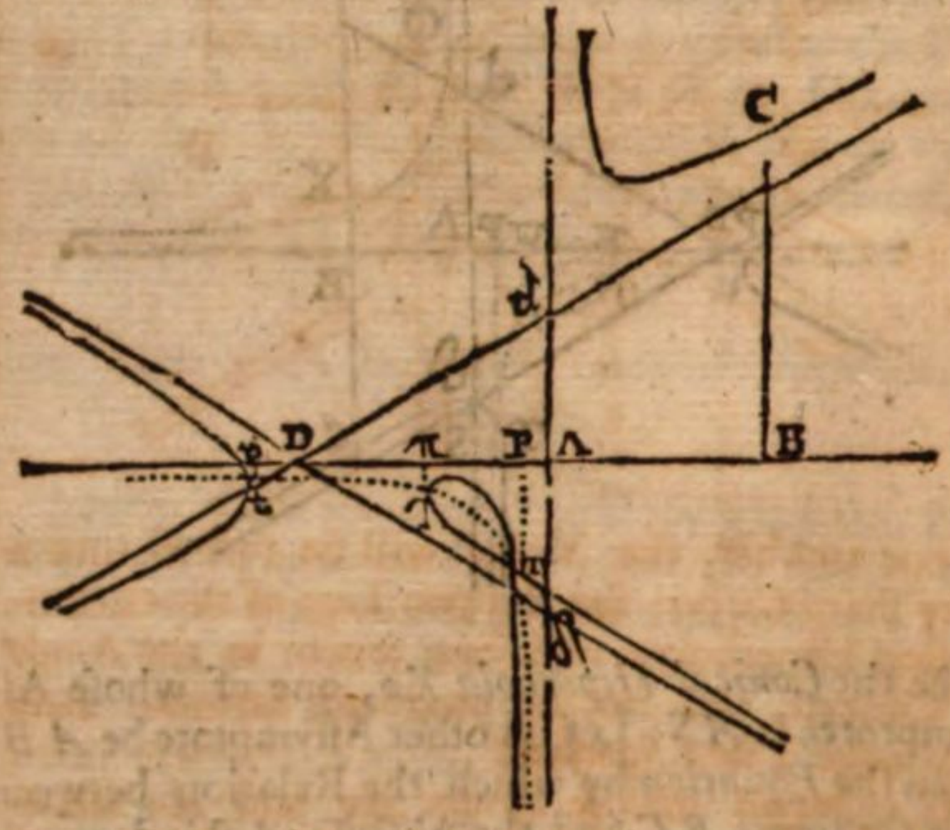
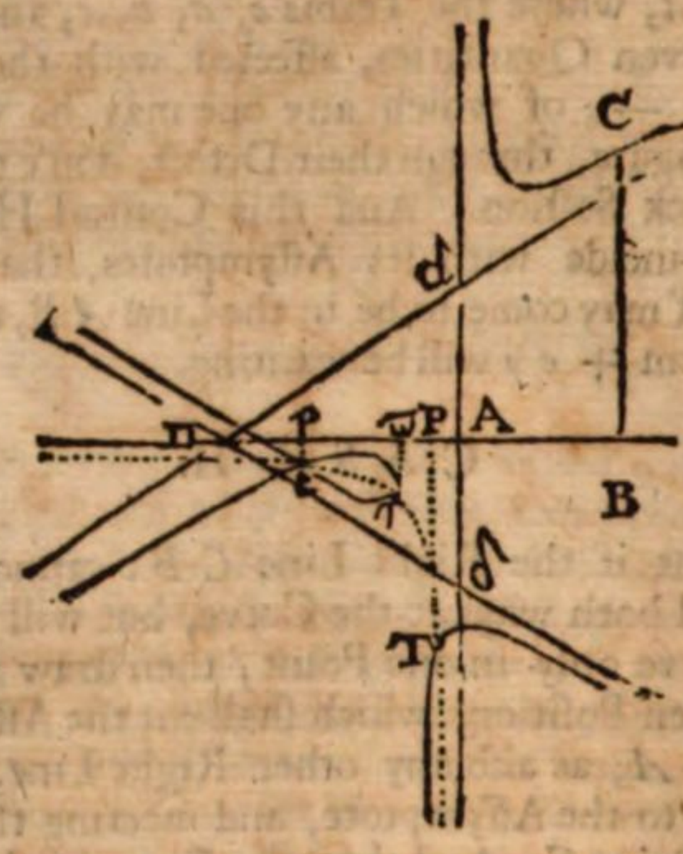



*Fig.* 4.




If the three greateſt of the Roots, $A\,p$, $A\,\pi$, $A\,\varpi$; or the three leaſt, $A\,\pi$, $A\,\varpi$, $A\,P$, are equal

*Fig.* 5.

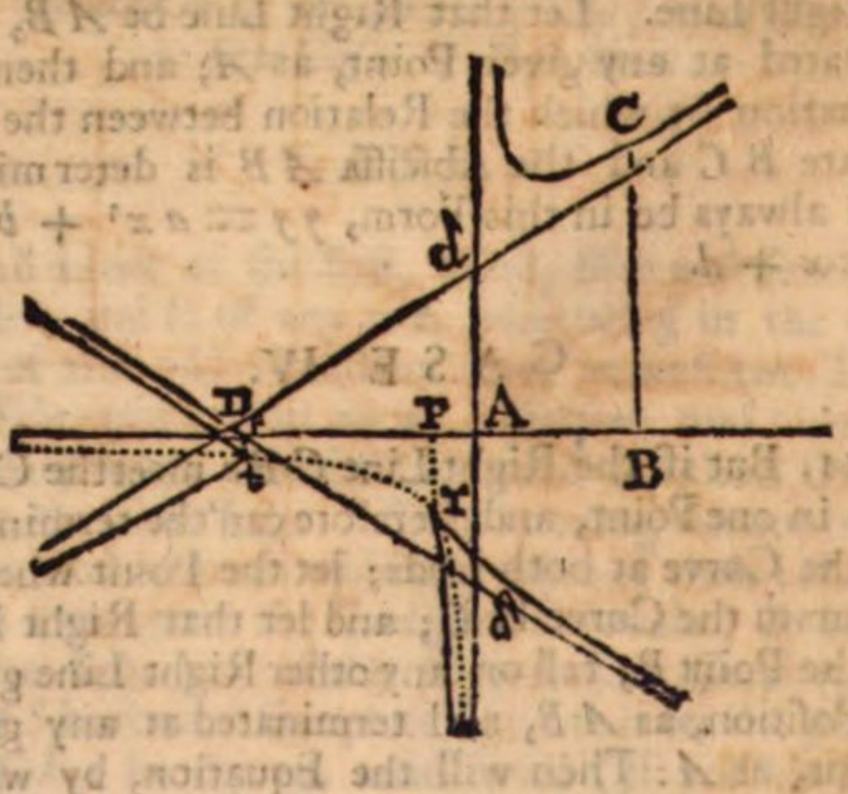
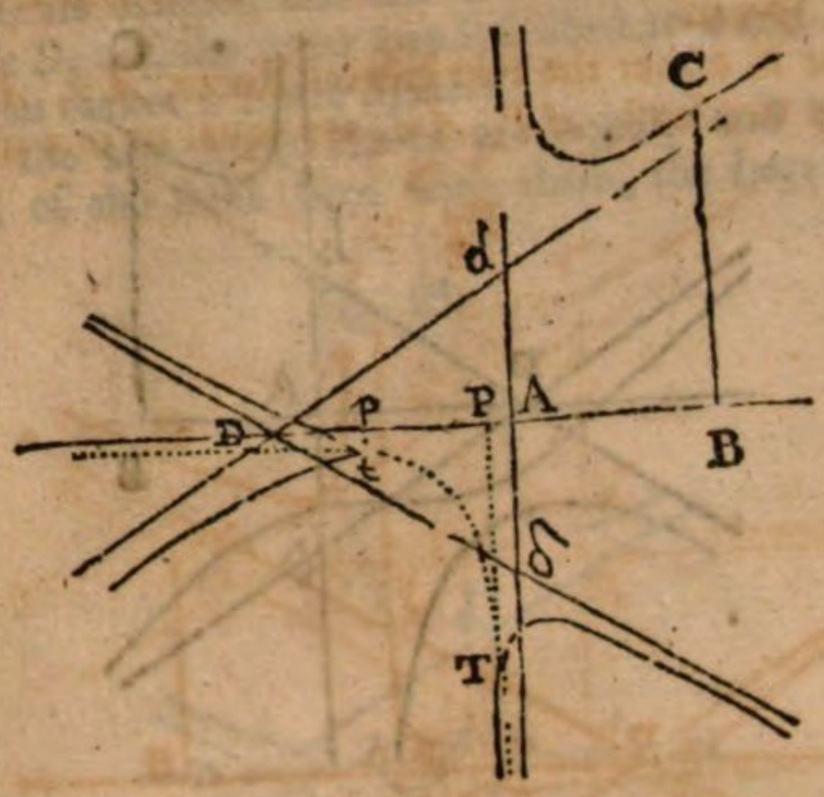



*Fig.*

Fig. 6.




to one another, the *Nodus* will be turned into a very ſharp *Cuſpis*; for the two Legs of the circumſcribed Hyperbola's will then concur in the Angle of Contact, and not be produced further. And this is the *Third Species*.

If the two middle Roots $A\varpi$ and $A\pi$ are equal, the Points of Contact $\tau$ and $\gamma$ will be coin-

Fig. 7.




cident; wherefore the *Oval* will vaniſh into a Point, and the Figure will conſiſt of three Hyperbola's, an *Inſcribed*, a *Circumſcribed*, and an *Ambigenial* one, with a Conjugate *Point*: Which makes a *Fourth Species*.

If two of the Roots are impoſſible, and the other two unequal, and of the ſame Sign, (for they (*See Fig.* 7.)

Fig. 8.

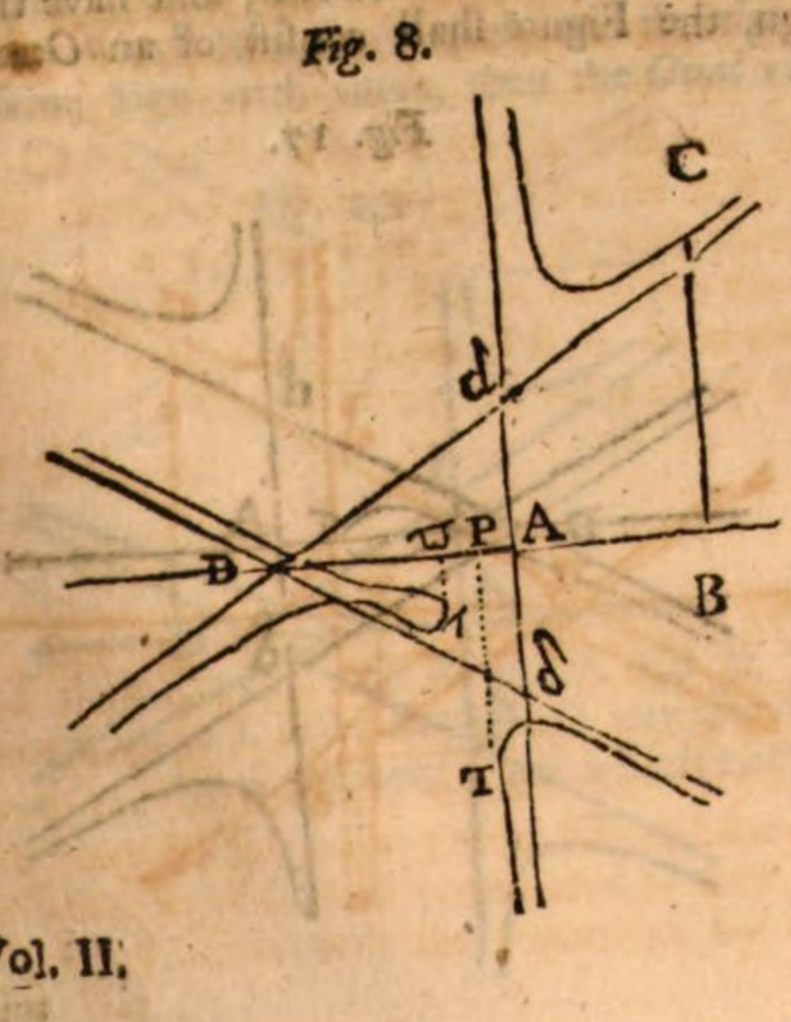



Fig. 13.

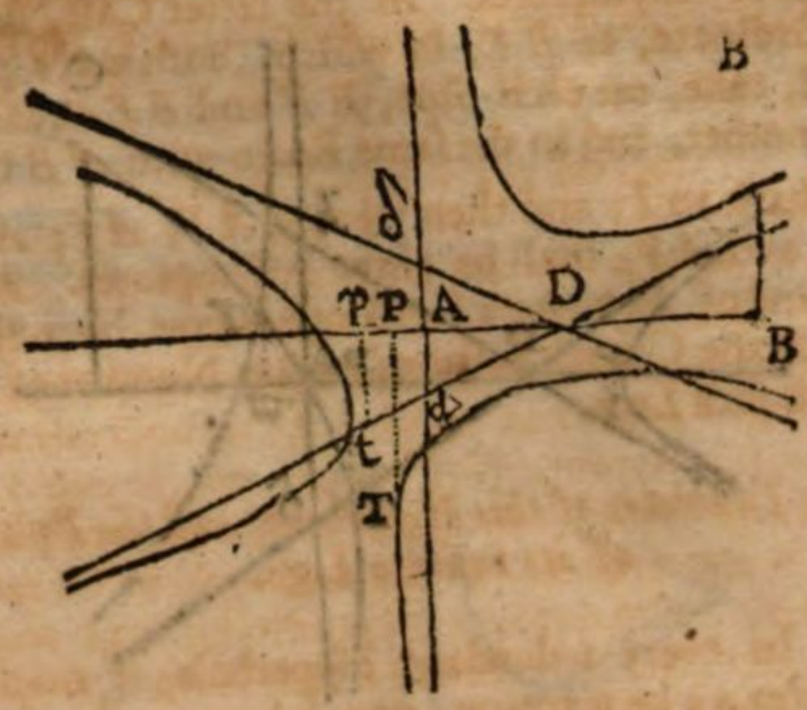
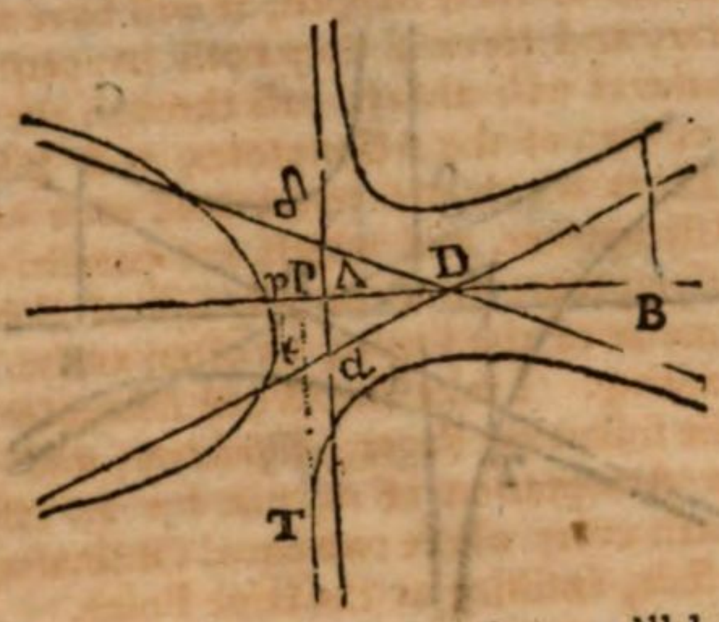



Fig. 14.




can't have contrary Signs); there will be three pure Hyperbola's, without any *Oval*, *Node*, *Cuſp*, or *Point Conjugate*; and theſe Hyperbola's will either lie at the Sides or the Angles of the Triangle made by the Aſſymptotes: Which makes a *Fifth* or *Sixth Species*.

If two of the Roots are equal, and the other two either impoſſible or real, with Signs contra-

Fig. 9.

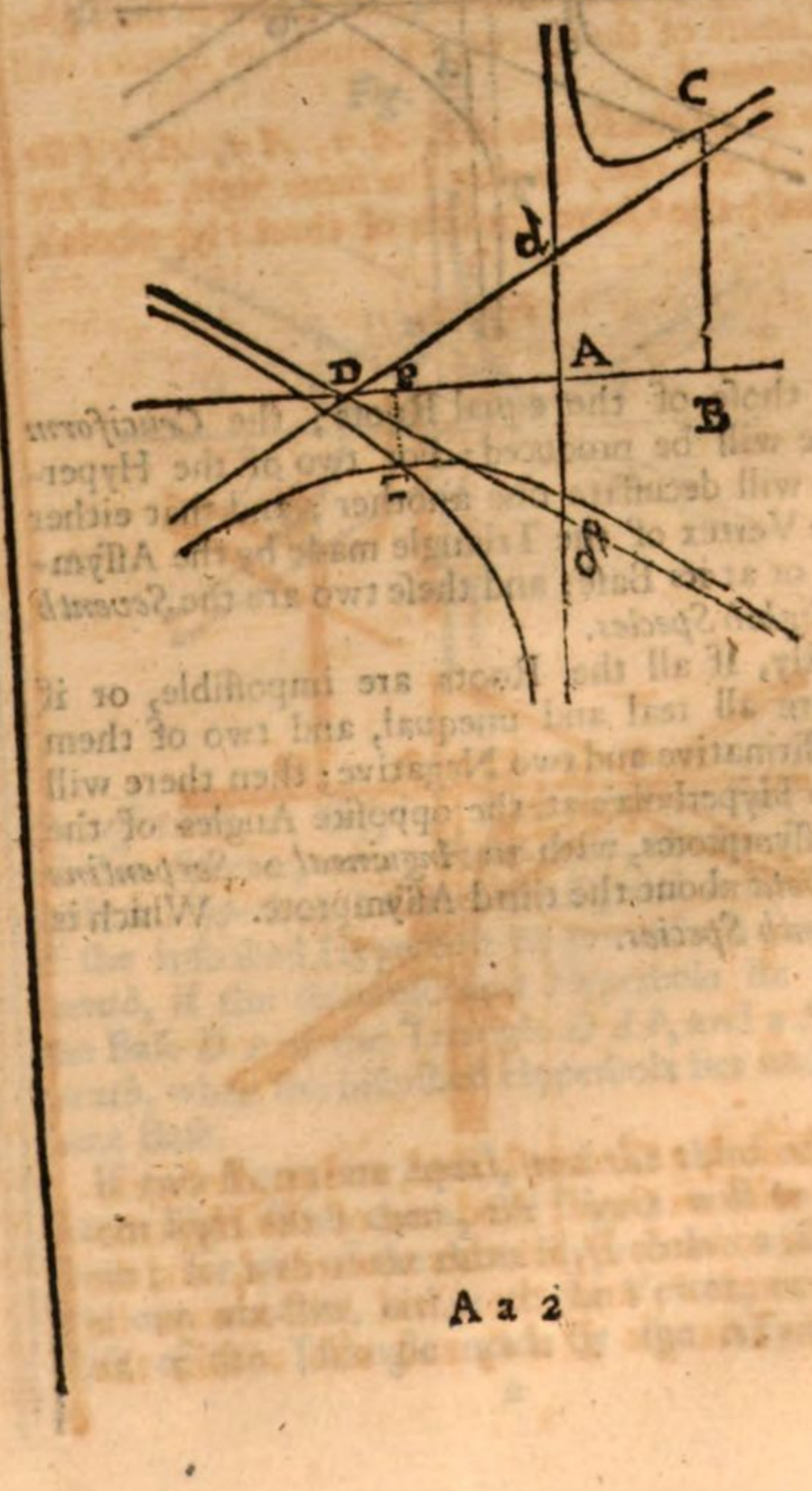


*Fig.* 10.

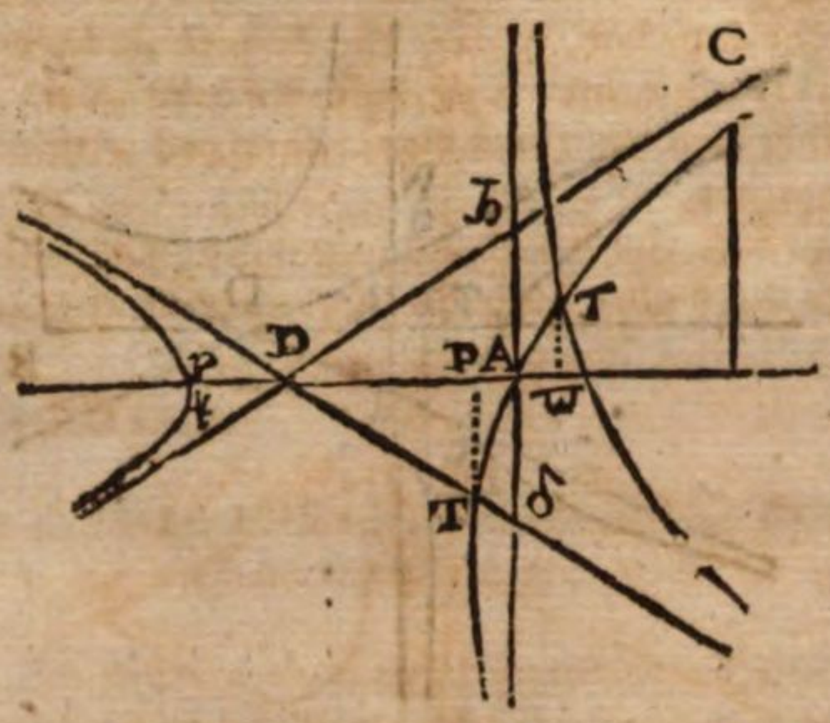



*Fig.* 15.

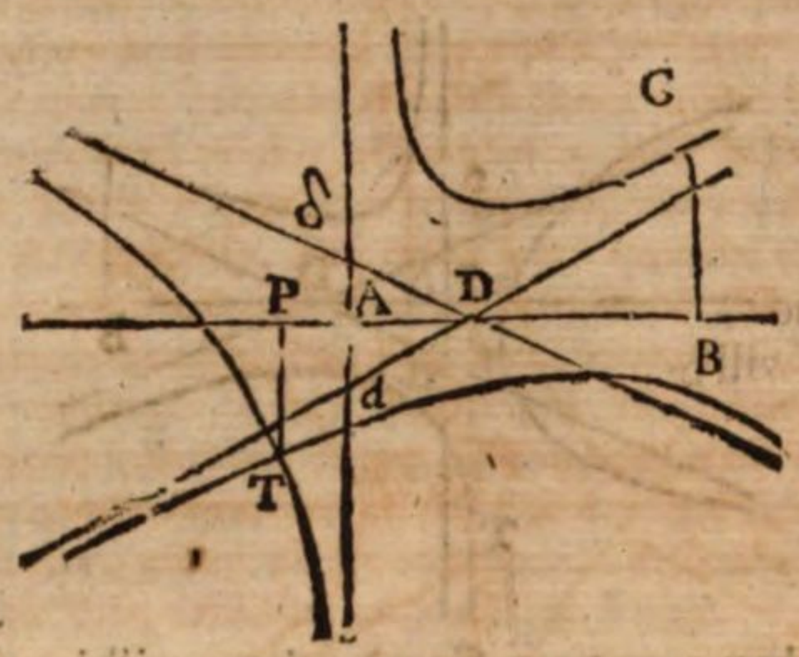
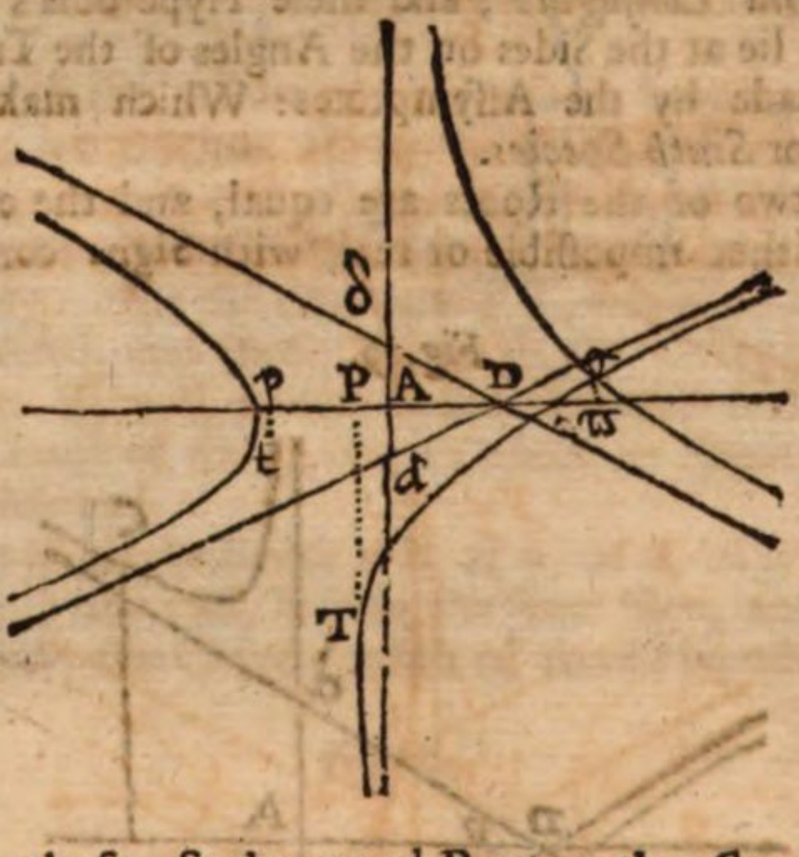



*Fig.* 16.




ry to those of the equal Roots; the *Cruciform* Figure will be produced: For two of the Hyperboal's will decussate one another; and that either at the Vertex of the Triangle made by the Assymtotes, or at its Base; and these two are the *Seventh* and *Eighth Species*.

Lastly, If all the Roots are impossible, or if they are all real and unequal, and two of them are Affirmative and two Negative; then there will be two Hyperbola's at the opposite Angles of the two Assymptotes, with an *Anguineal* or *Serpentine Hyperbola* about the third Assymptote. Which is the *Ninth Species*.

*Fig.* 11.

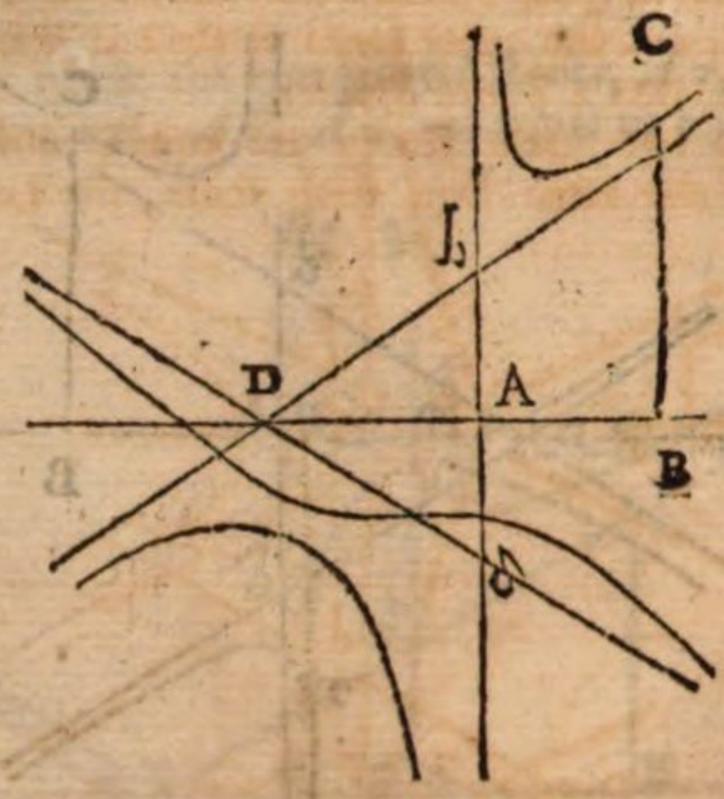
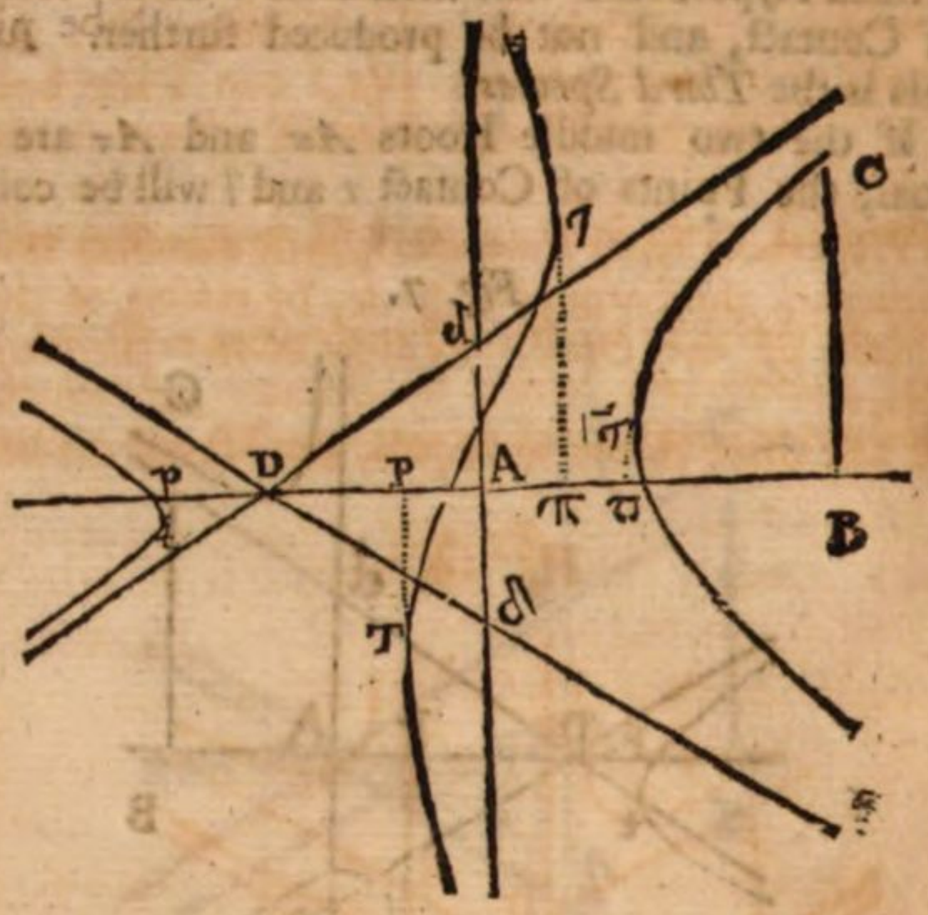



*Fig.* 12.



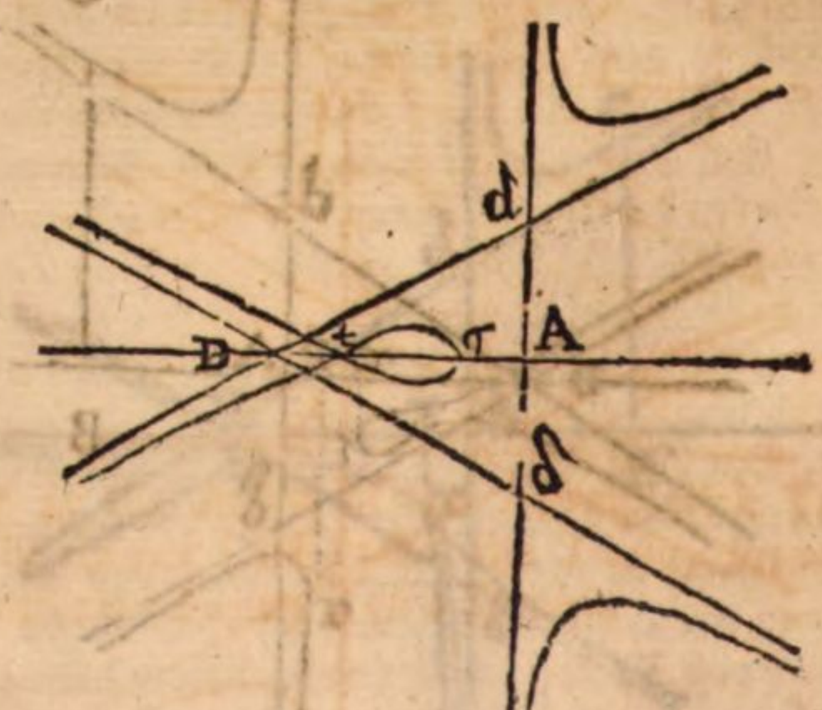

And these are all the possible Cases of the Roots; for if any two Roots are equal to one another, and the other two are equal also, the Figure will become a *Conick Section* with a Right Line.

*Twelve redundant Hyperbola's with one only Diameter.*

16. If the redundant Hyperbola have one only Diameter, let it be the Abscissa $AB$; and in the Equation $ax^3 + bxx + cx + d = 0$, seek the three Values of $x$, or the three Roots. Then,

If those Roots are all real, and have the same Sign, the Figure shall consist of an *Oval* lying

*Fig.* 17.

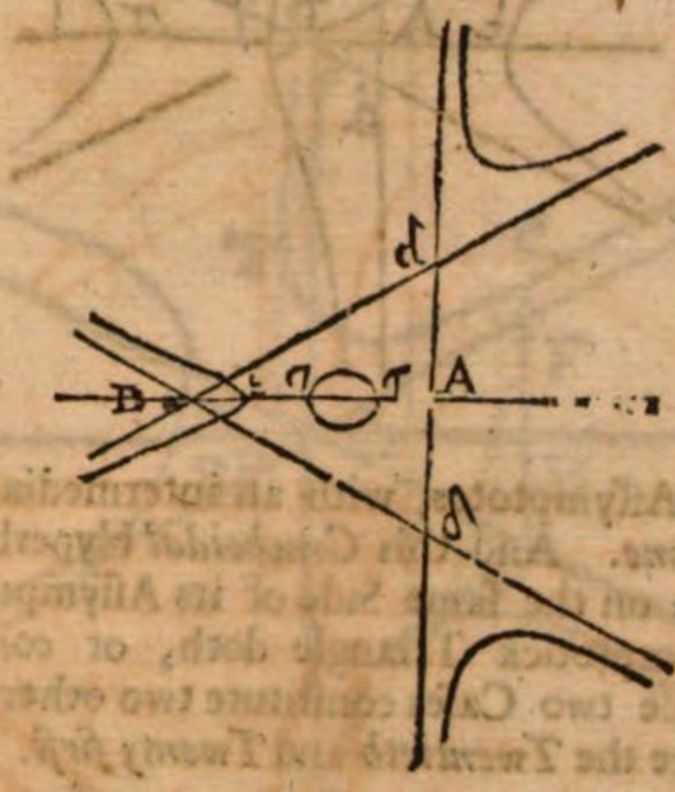



within

within the Triangle $D\,d\,\delta$, and of three Hyperbola's as its Angles, *viz.* one circumſcribed at the Angle $D$, and the other two inſcribed at $d$ and $\delta$; and this makes a *Tenth Species*.

If the two great Roots are equal, and the third of the ſame Sign with them, the Legs of

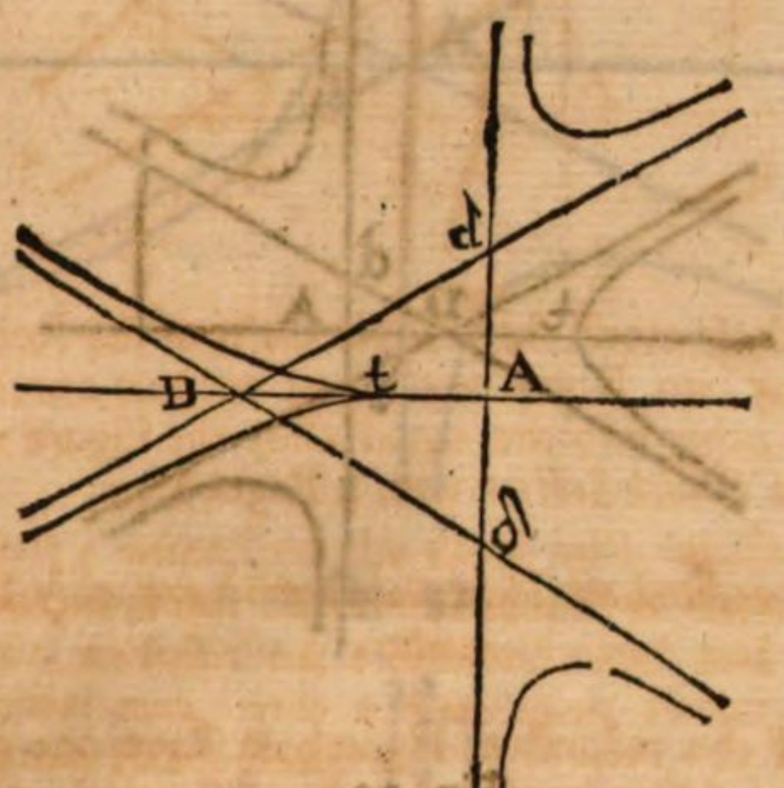
*Fig.* 18.




the Hyperbola lying towards $D$, will decuſſate one another in the Form of a *Node*, by reaſon of the Contact of the *Oval*. Which is the *Eleventh Species*.

If the three Roots are equal, the Hyperbola be-

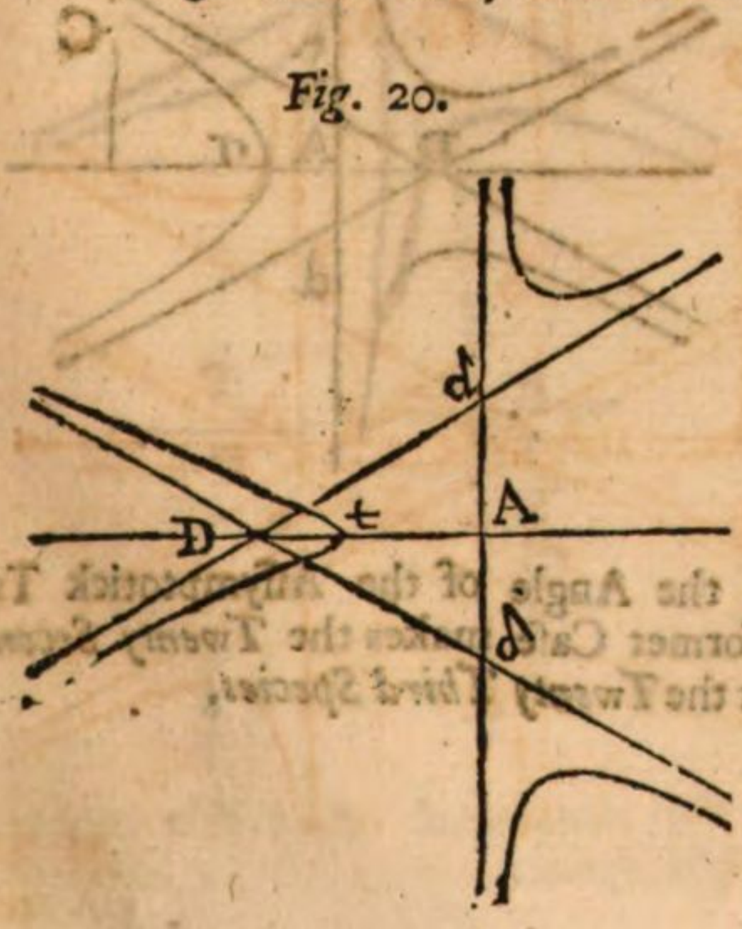
*Fig.* 19.




comes *Cuſpidate*, without any *Oval*. Which is the *Twelfth Species*.

If the two leaſt Roots are equal, and the third of the ſame Sign with them, then the *Oval* va-

*Fig.* 20.




nishes into a Point. Which makes a *Thirteenth Species*.

In the four laſt *Species*, the Hyperbola lying towards $D$ contains its Aſſymptote within it; but the other two are themſelves contained within the Aſſymptotes.

If two of the Roots are impoſſible, then there will be three pure Hyperbola's, without any *Oval*,

(See *Fig.* 20.)

*Fig.* 21.

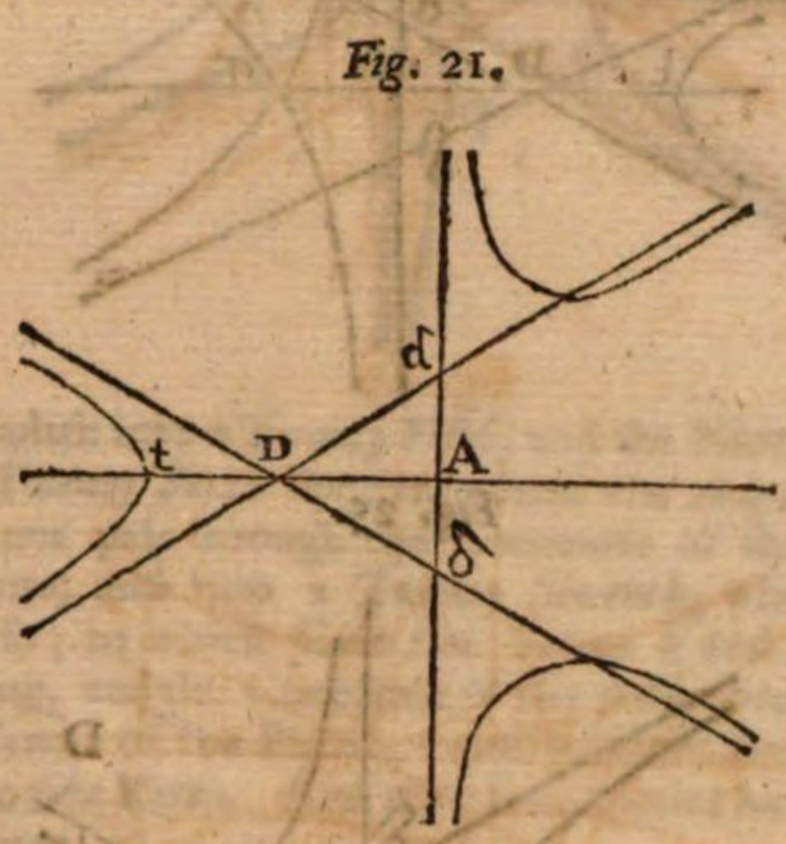



*Fig.* 22.

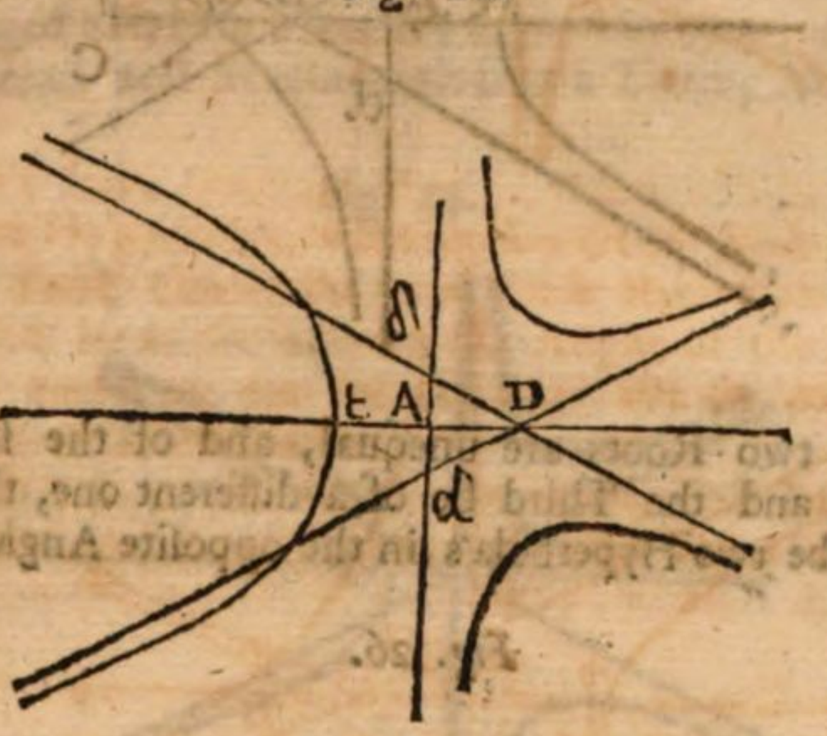
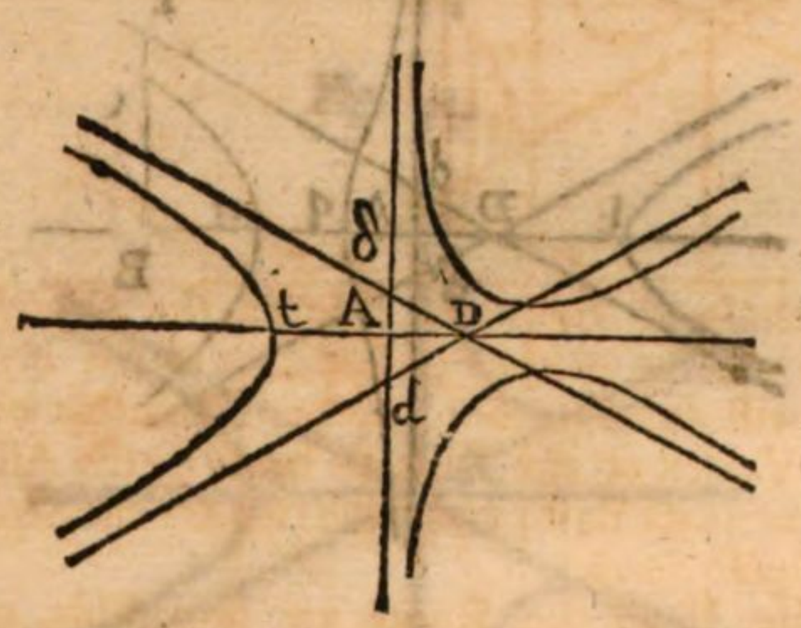



*Fig.* 23.




*Deciſſation*, or *Cuſpis*. And there are four Caſes of this *Species*, *viz.* a *Fourteenth*, if the circumſcribed Hyperbola lie towards $D$, and a *Fifteenth*, if the inſcribed Hyperbola lie towards $D$, a *Sixteenth*, if the circumſcribed Hyperbola lie under the Baſe $D\,\delta$ of the Triangle $D\,d\,\delta$, and a *Seventeenth*, when the inſcribed Hyperbola lies under the ſame Baſe.

If two Roots are equal, and the third of a diſferent Sign from them, the Figure will be *Cruciform*; for two of the three Hyperbola's will decuſſate one another, either at the Vertex, or at the Baſe of the Triangle made by the Aſſymptotes.

Which two *Species* are the *Eighteenth* and *Nineteenth.*

*Fig.* 24.

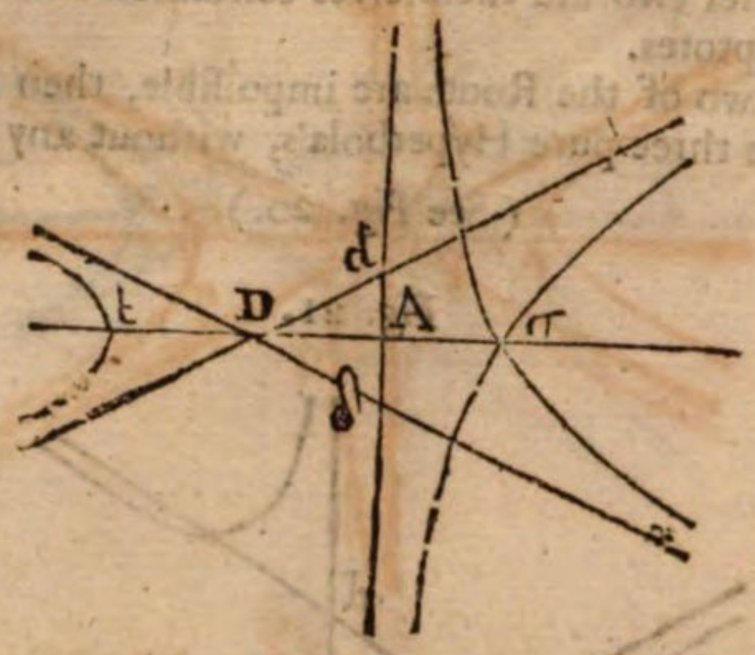
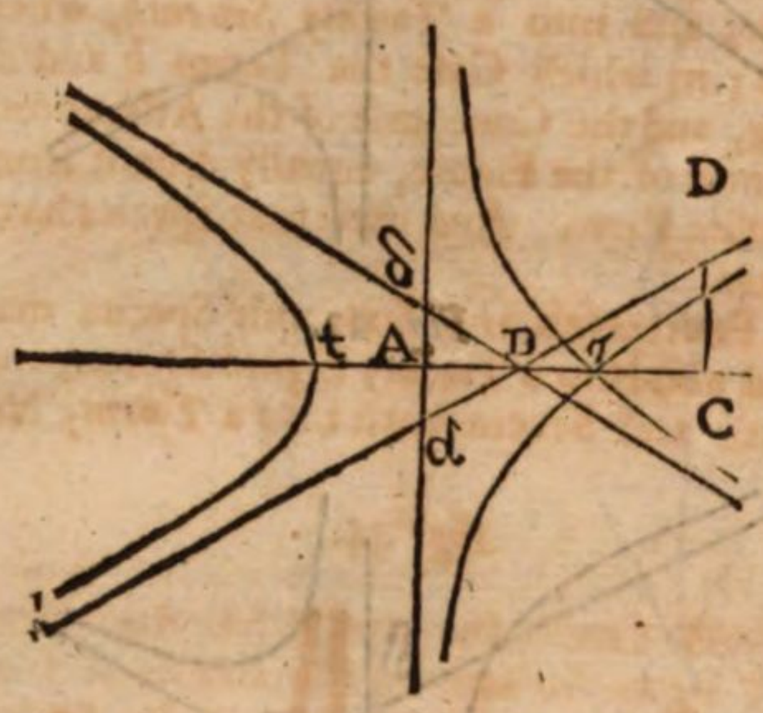



*Fig.* 25.




If two Roots are unequal, and of the ſame Sign, and the Third be of a different one, there will be two Hyperbola's in the oppoſite Angles of

*Fig.* 26.

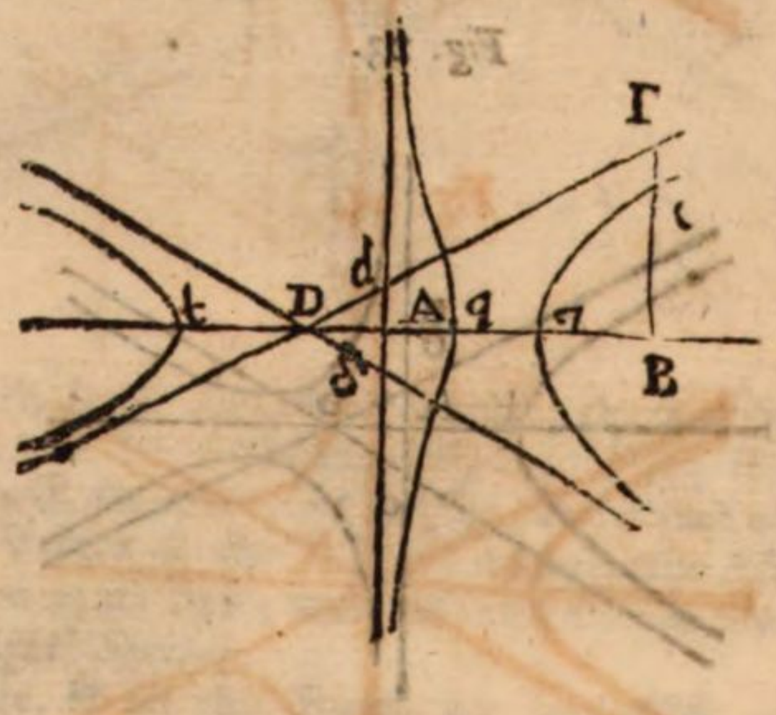



*Fig.* 27.

the two Aſſymptotes, with an intermediate *Conchoidal one.* And this *Conchoidal* Hyperbola will either lie on the ſame Side of its Aſſymptote that the Aſſymptotick Triangle doth, or contrarily: And theſe two Caſes conſtitute two other *Species*, which are the *Twentieth* and *Twenty firſt.*

*Two redundant Hyperbola's with three Diameters.*

17. The redundant Hyperbola which hath three Diameters, conſiſts of three Hyperbola's lying within the Aſſymptotes, and that either at the Sides,

*Fig.* 28.

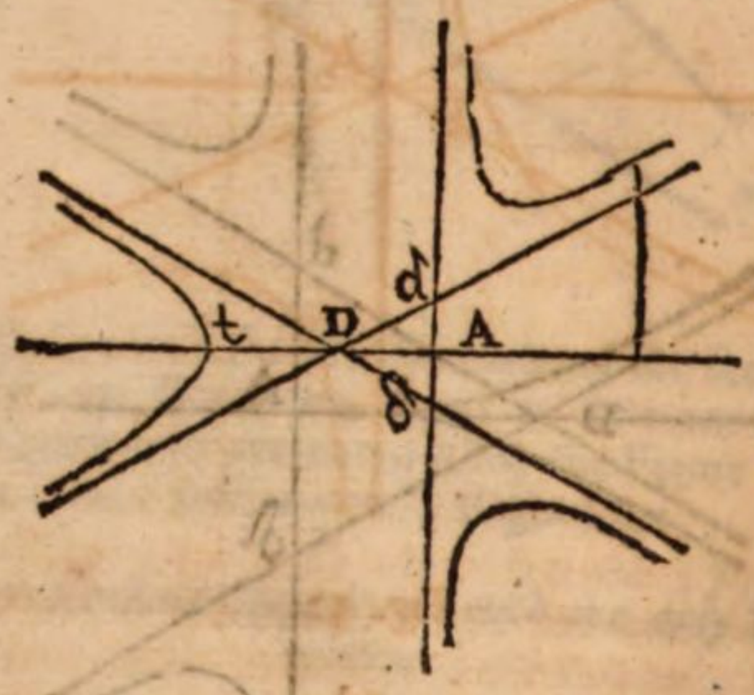
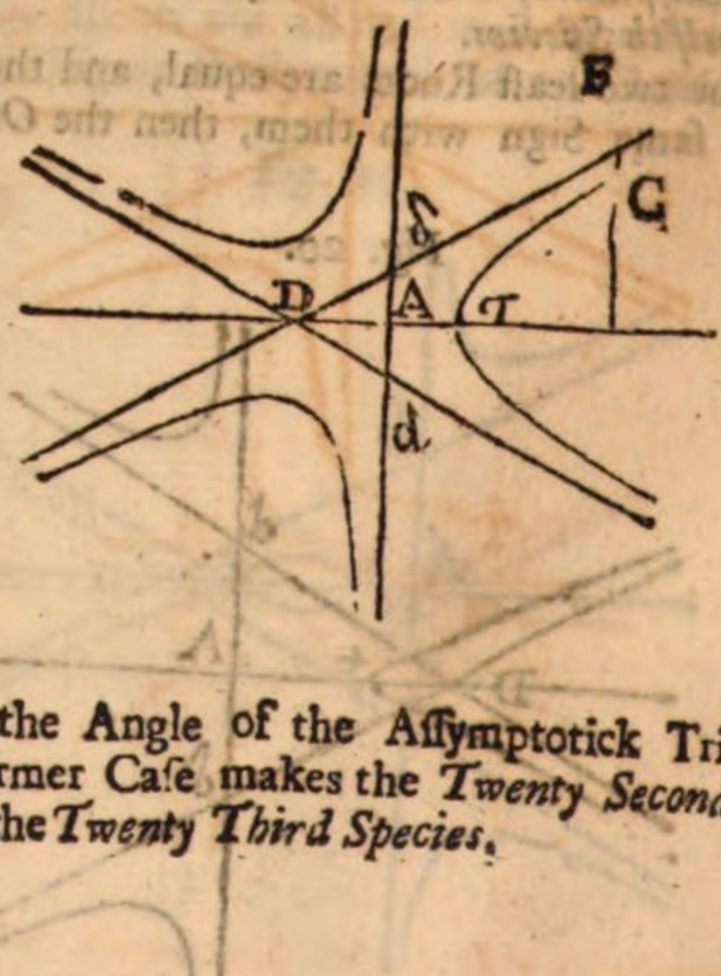



*Fig.* 29.




or at the Angle of the Aſſymptotick Triangle. The former Caſe makes the *Twenty Second*, this Latter the *Twenty Third Species.*

*Nine redundant Hyperbola's with three Assymptotes, converging towards one common Point.*

18. If the three Assymptotes do interfect one another in one common Point, the 5th and 6th Species will be changed into a *Twenty Fourth*, the Seventh

*Fig.* 30.

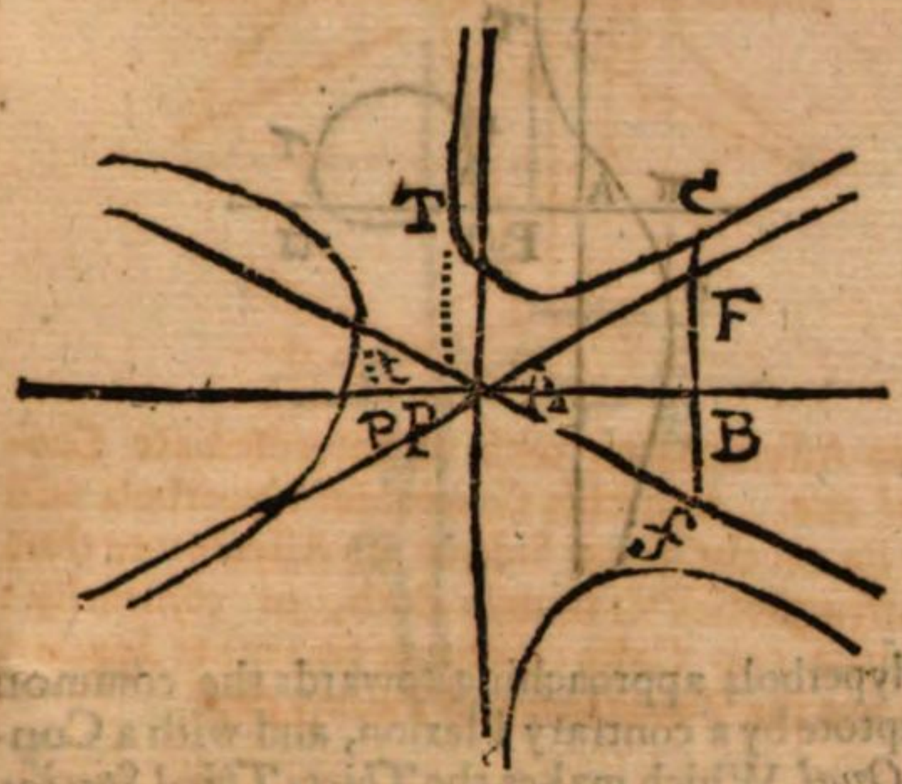



*Fig.* 31.

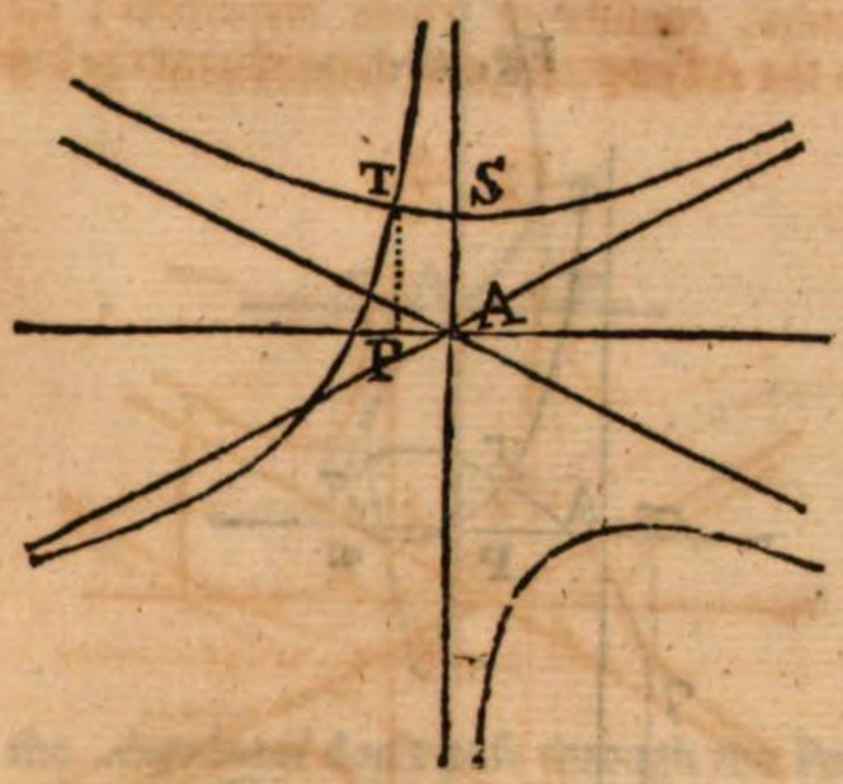



*Fig.* 32.

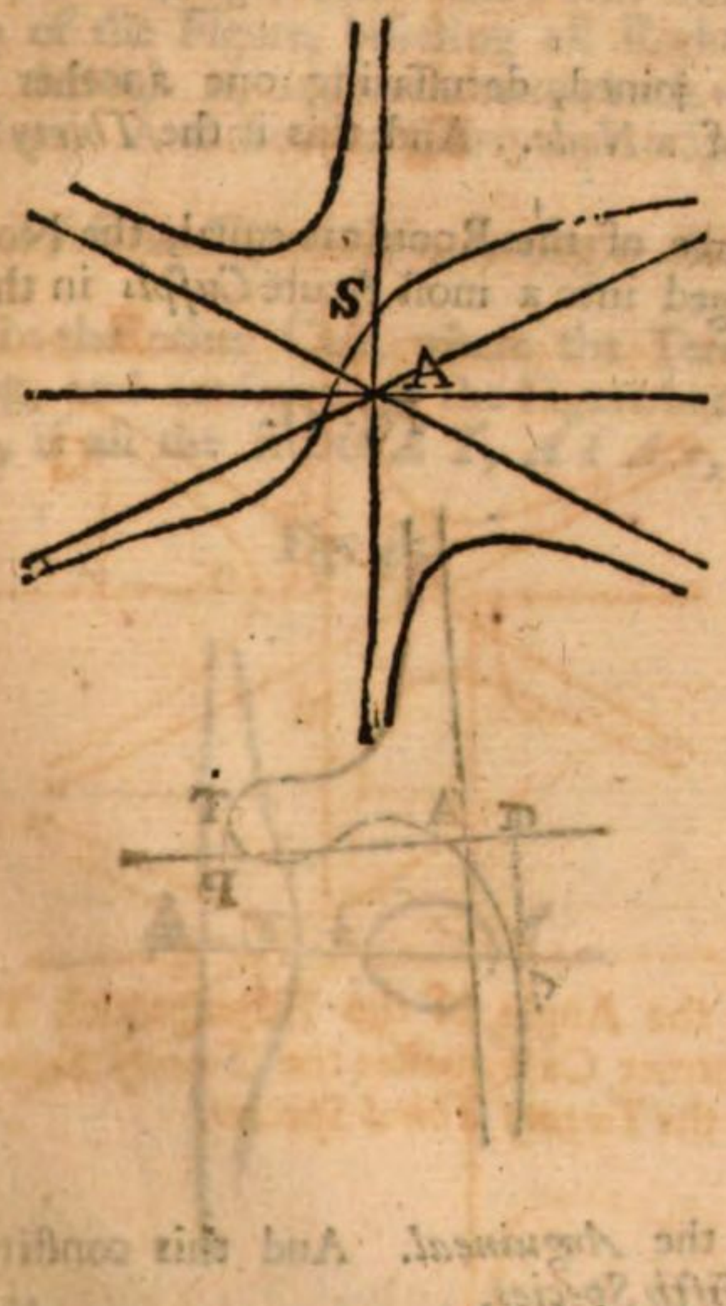
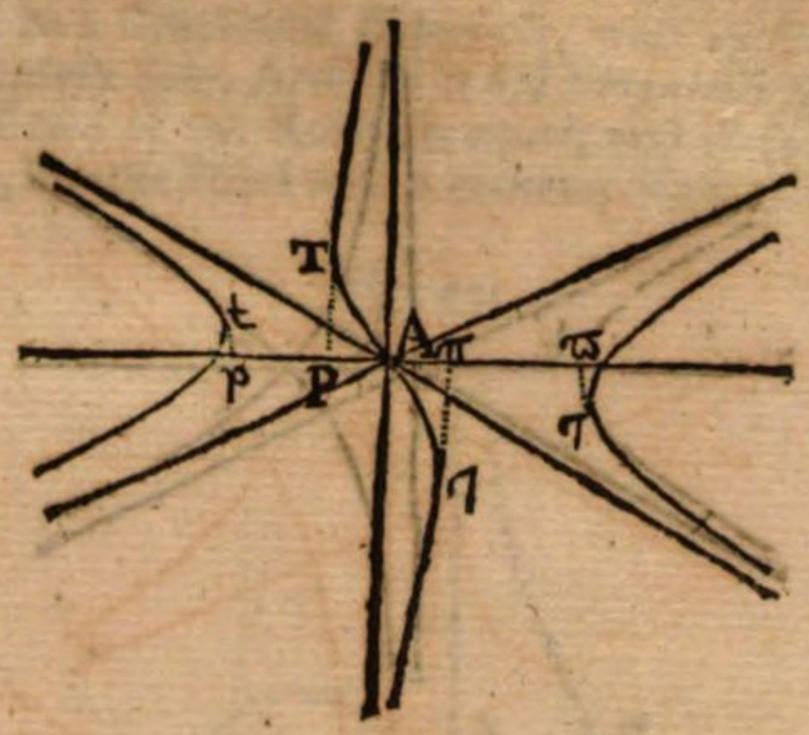



*Fig.* 33.




and Eighth into a *Twenty Fifth*, and the Ninth into a *Tweuty Sixth* Species, where the *Anguineal* doth not pass through the Concourse of the Assymptote, and into a *Twenty Seventh*, where it doth so; in which Case the Terms *b* and *d* are wanting, and the Concourse of the Assymptotes is the Centre of the Figure, equally distant from all its opposite Parts. And these four Species have no Diameter.

The Fourteenth and Sixteenth Species may be changed also into a *Twenty Eighth Species*, and the Fifteenth and Seventeenth into a *Twenty Ninth*.

*Fig.* 34.

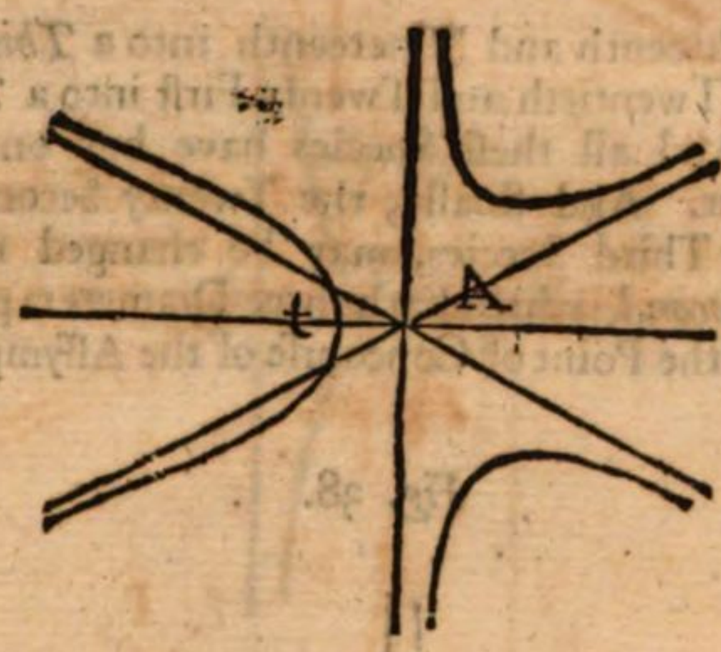



*Fig.* 35.

*Fig.*

Fig. 36.

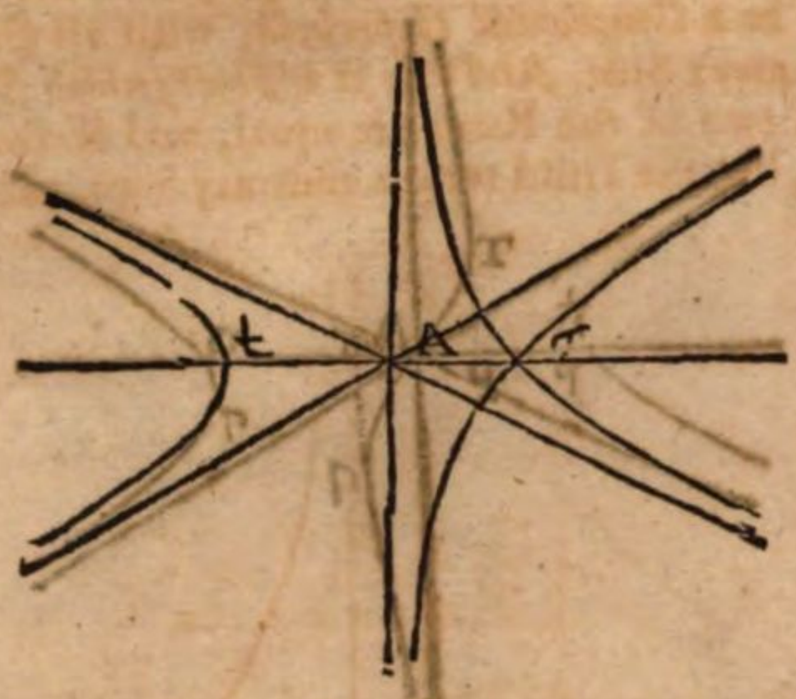
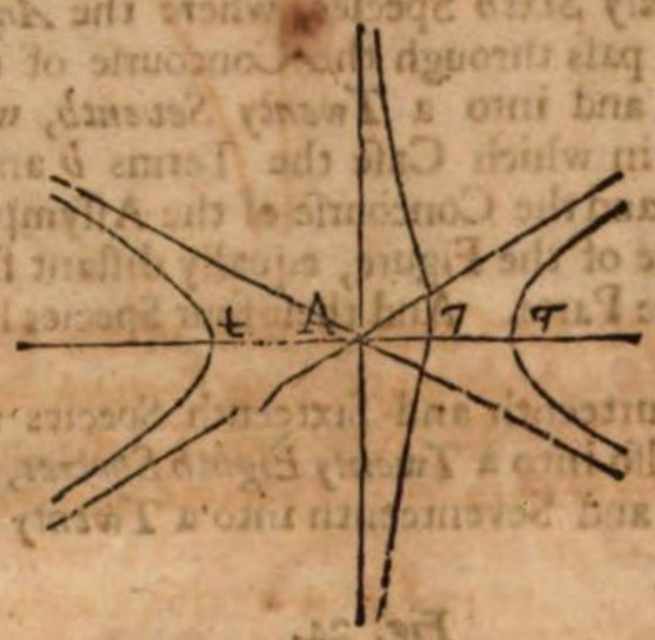
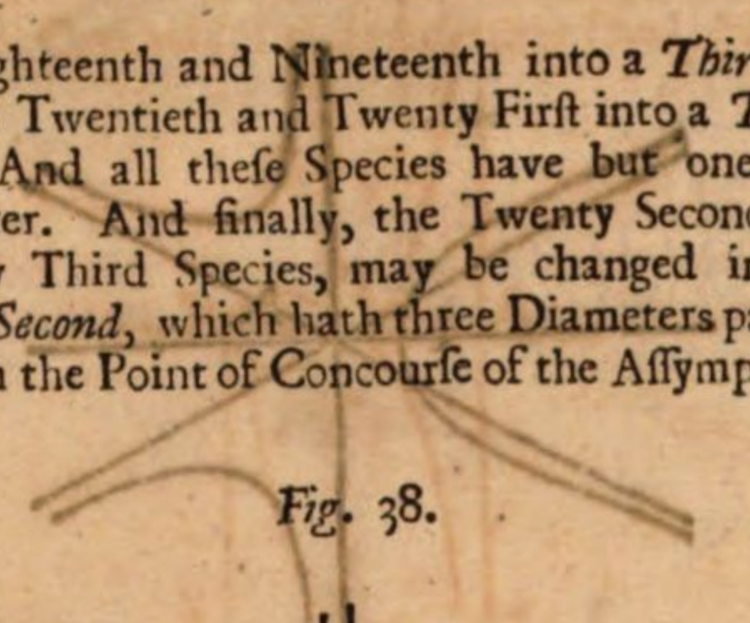



Fig. 37.




The Eighteenth and Nineteenth into a *Thirtieth*, and the Twentieth and Twenty Firſt into a *Thirty Firſt*. And all theſe Species have but one only Diameter. And finally, the Twenty Second and Twenty Third Species, may be changed into a *Thirty Second*, which hath three Diameters paſſing through the Point of Concourſe of the Aſſymptotes.

Fig. 38.



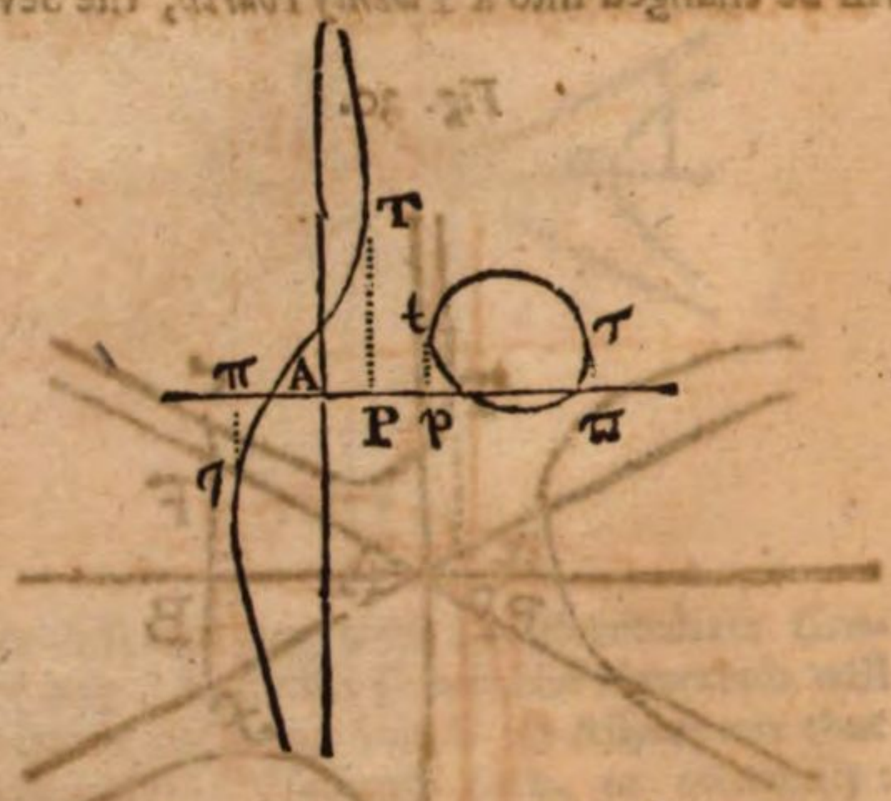

All which Changes will be eaſily underſtood, if you ſuppoſe the Aſſymptotick Triangle to be diminiſhed till it vaniſh into a Point.

*Six deficient Hyperbola's, having no Diameter.*

19. If, in the firſt Caſe of the Equations, the Term $a x^3$ be Negative, the Figure will be a deficient Hyperbola, having one only Aſſymptote, and only two Hyperbolick Legs running out infinitely towards the Side of the Aſſymptote, but quite contrary ways; and this Aſſymptote is the firſt and principal Ordinate $AG$. If the Term $ey$ be not wanting, the Figure will have no Diameter; but if it be wanting, it will have but one: In the former Caſe the Species are thus enumerated:

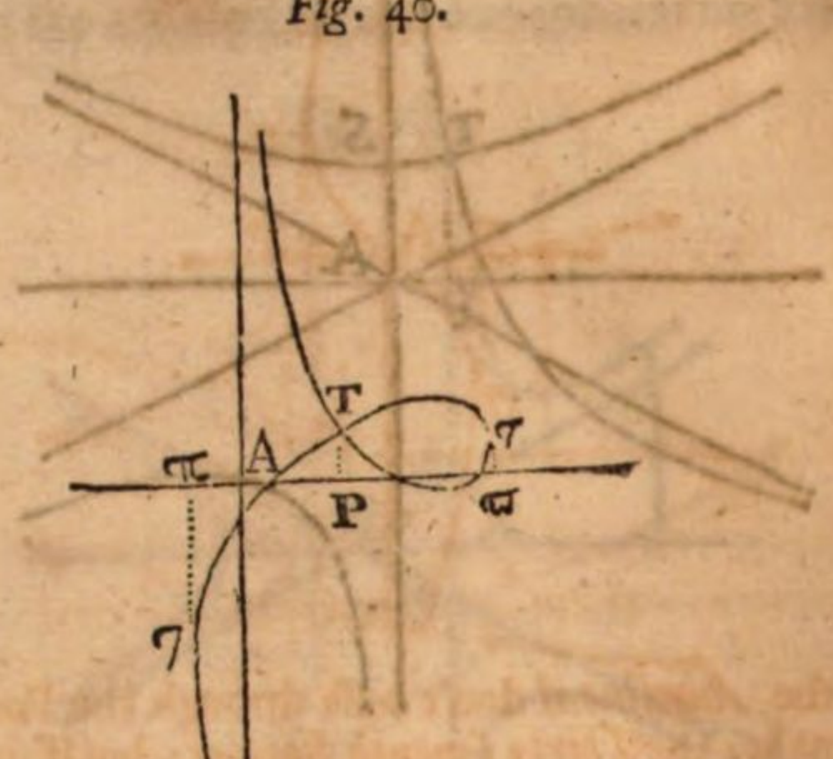
If all the Roots $A\pi$, $AP$, $Ap$, $A\varpi$, of this Equation $a x^4 = b x^3 + c x x + d x + \frac{1}{4} e e$, be real and unequal, the Figure will be an *Anguineal* Hyperbola approaching towards the common Aſſymptote by a contrary Flexion, and with a Conjugate *Oval*. Which makes the *Thirty Third Species*.

Fig. 39.



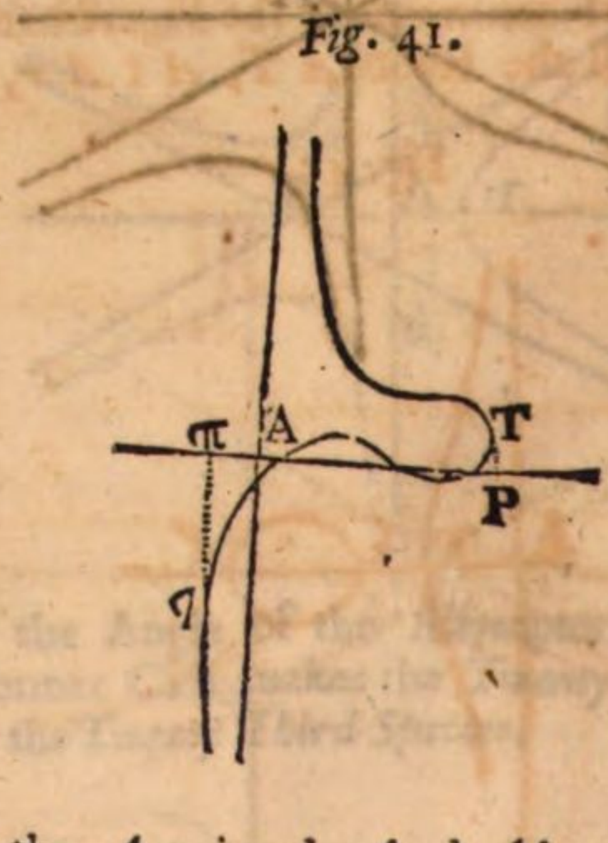

If the two middle Roots $AP$ and $Ap$ be equal one to another, then the *Oval* and the *Anguineal* will be joined, decuſſating one another in the Form of a *Node*. And this is the *Thirty Fourth Species*.

Fig. 40.




If three of the Roots are equal, the Node will be changed into a moſt Acute *Cuſpis* in the Vertex of the *Anguineal*. And this conſtitutes a *Thirty Fifth Species*.

Fig. 41.



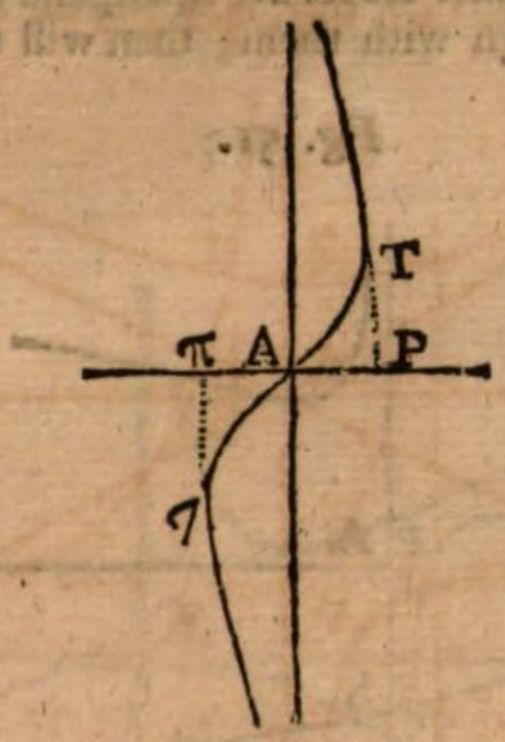

If

If of the three Roots, having the same Sign, the two greatest, $Ap$ and $A\pi$, are equal to one another; then the *Oval* vanishes into a Point. Which makes a *Thirty sixth Species*. (See *Fig.* 43.)

If any two Roots are imaginary, there will remain the *Anguineal* alone, and this *Pure*, without any *Oval*, *Decussation*, *Cuspis*, or *Conjugate Point*.

*Fig.* 42.

*Fig.* 43.

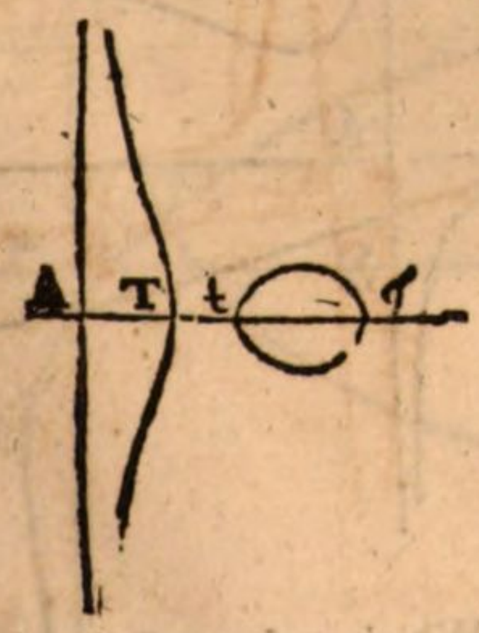



If the *Anguineal* don't pass through the Point *A*, it makes the *Thirty seventh Species*; but if it doth pass through *A*, (as it will do when the Terms *b* and *d* are wanting) then that Point will be the Centre of the Figure, bisecting all Right Lines drawn through it, and terminated both ways by the Curve. And this is a *Thirty eighth Species*.

*Seven defective Hyperbola's, having a Diameter.*

20. In the other Case, where the Term $ey$ is wanting, and consequently the Figure hath a Diameter, if all the Roots $AT$, $At$ $A\tau$, of the

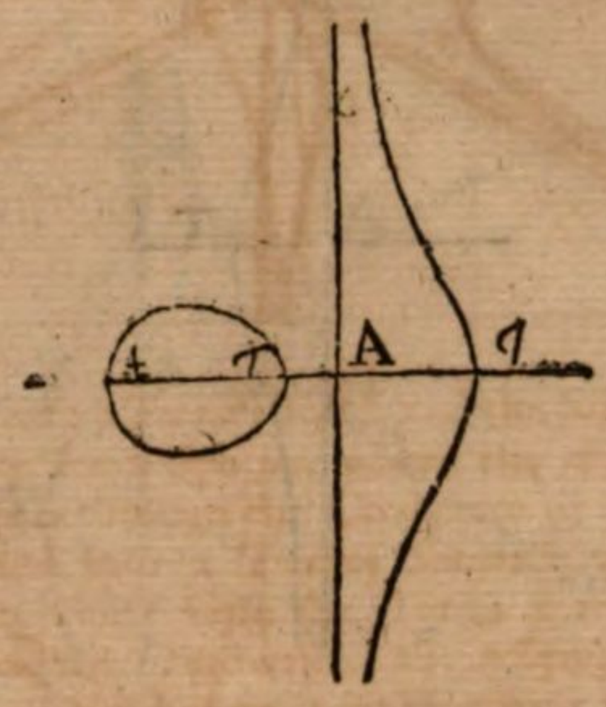
*Fig.* 45.




Equation $ax^3 + bxx + cx + d$, are real, unequal, and of the same Sign; then the Figure will be a *Conchoidal Hyperbola*, with an *Oval* on its convex Side. And this is a *Thirty ninth Species*.

If two of the Roots are equal, and of the same Sign, but the Third with a contrary Sign, the *Oval*

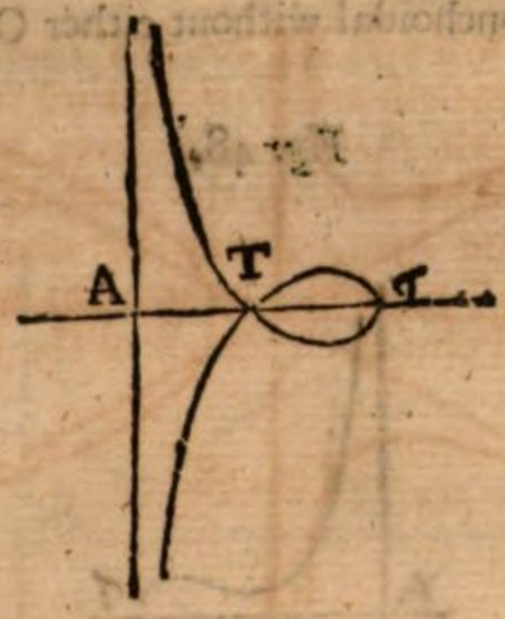
*Fig.* 44.




will lie on the Concave Side of the *Conchoidal Hyperbola*. And this makes a *Fortieth Species*.

If the two lesser Roots $AT$, $At$, are equal, and the third $A\tau$, be of the same Sign with them,

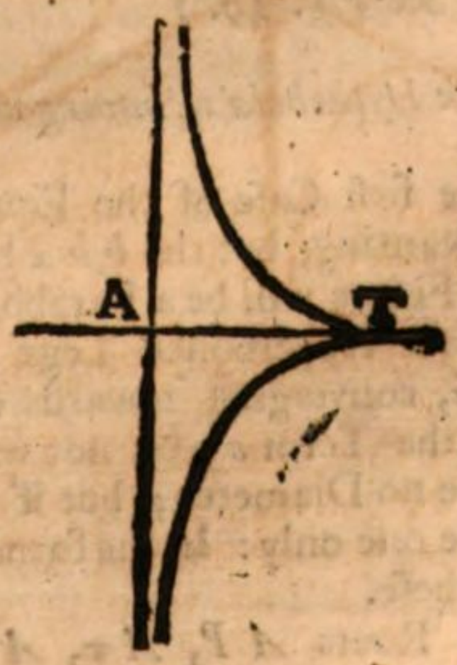
*Fig.* 46.




then the *Oval* and the *Conchoidal* will be joined, decussating one another like a *Node*. Which is a *Forty first Species*.

If the three Roots are equal, the *Nodus* will be changed into a *Cuspis*, and the Figure will be the

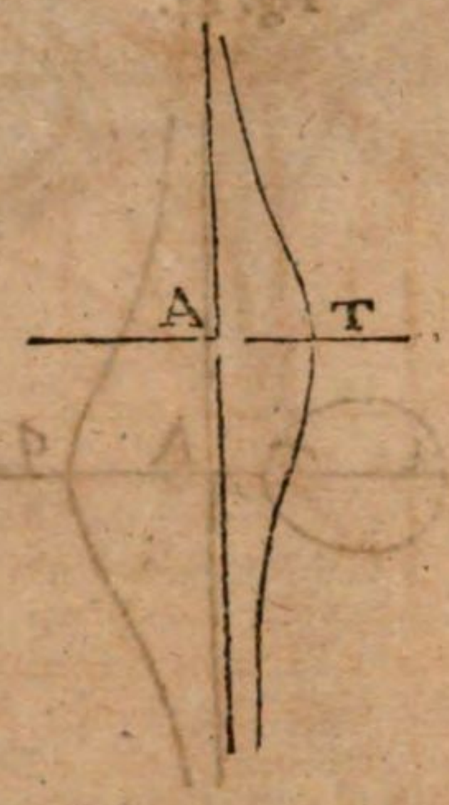
*Fig.* 47.



*Ciſſord* of the Ancients. And this makes a *Forty ſecond Species.*

If the two greater Roots are equal, and the Third of the ſame Sign with them, then the Con-

*Fig.* 49.

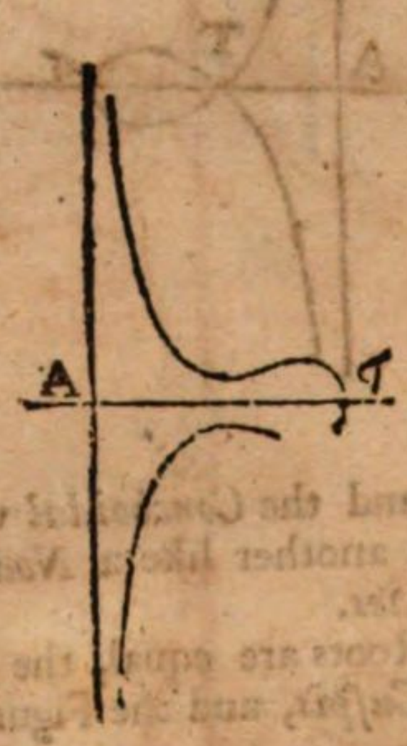



choidal Hyperbola, will have a Conjugate *Point* at its Convexity. Which is a *Forty third Species.*

If two of the Roots are equal, and the Third have a contrary Sign; the Conchoidal Hyperbola will then have a *Conjugate Point* at its Concavity. Which makes a *Forty fourth Species.*

If two of the Roots are impoſſible, there will be a pure Conchoidal without either Oval, Node,

*Fig.* 48.




Cuſp, or Conjugate Point. And this is a *Forty fifth Species.* (See *Fig.* 49.)

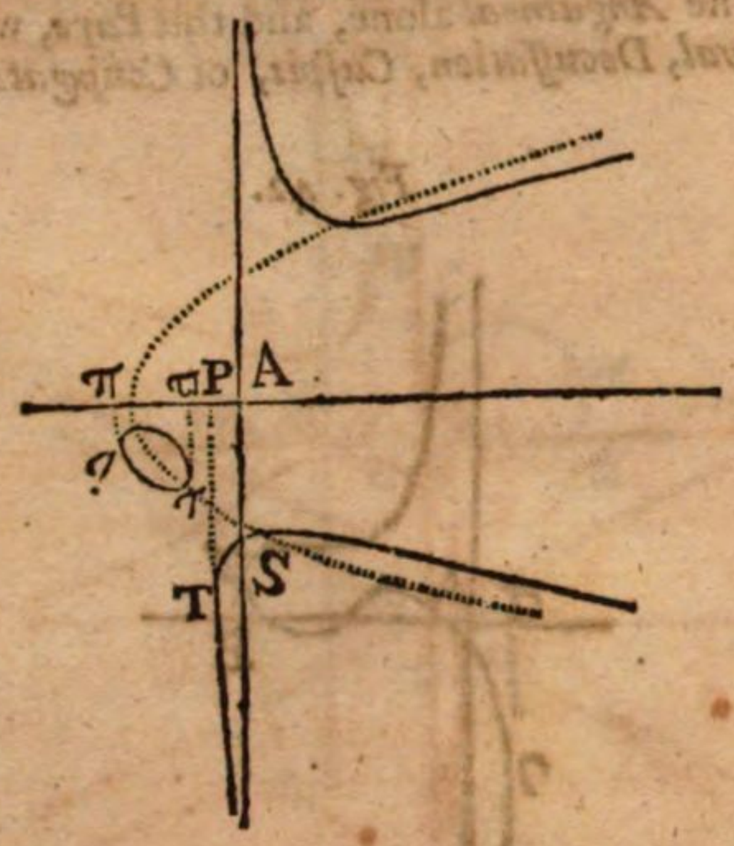
*Seven Parabolick Hyperbola's, having no Diameter.*

21. If in the firſt Caſe of the Equations, the Term $a\,x^3$ be wanting, but the $b\,b\,x$ be not wanting; then the Figure will be a Parabolick Hyperbola, having two Hyperbolick Legs to one Aſſymptote $S\,A\,G$, converging towards one and the ſame Sign. If the Term $e\,y$ be not wanting, the Figure will have no Diameter; but if it be wanting, it will have one only: In the former Caſe the *Species* will be theſe.

If the three Roots $A\,P$, $A\,\pi$, $A\,\pi$, of this Equation $b\,x^3 + c\,x^2 + d\,x + \frac{e\,e}{4} = 0$, be unequal, and have the ſame Sign, the Figure will conſiſt of an Oval, and of two other Curves, which

are partly Hyperbolical, and partly Parabolical; that is, the Parabolick Legs, by being continually

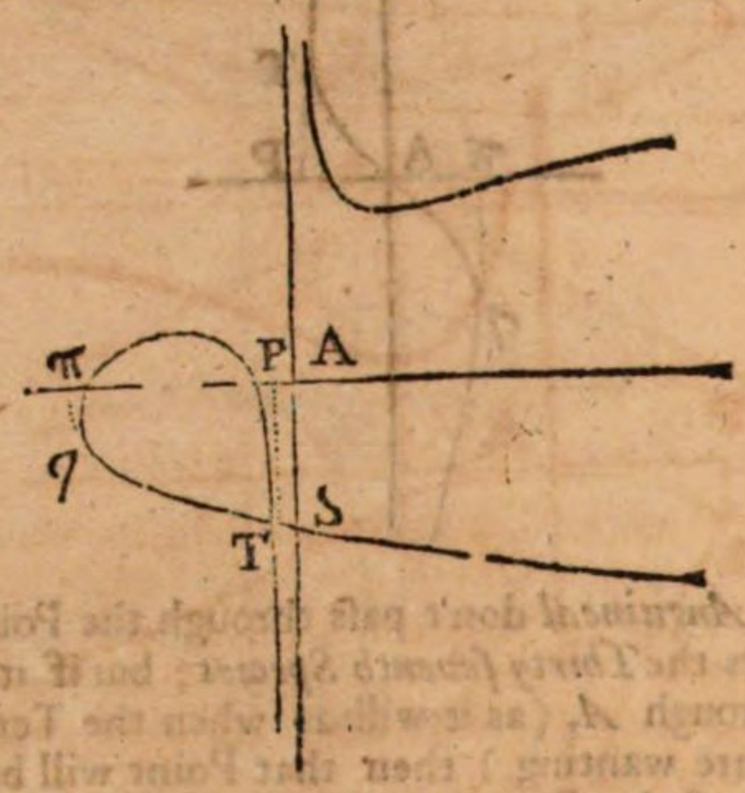
*Fig.* 50.




drawn out, are joined with the Hyperbolical Legs which are next to them. And this is the *Forty ſixth Species.*

If the two leſſer Roots are equal, and the Third of the ſame Sign with them; then will the Oval,

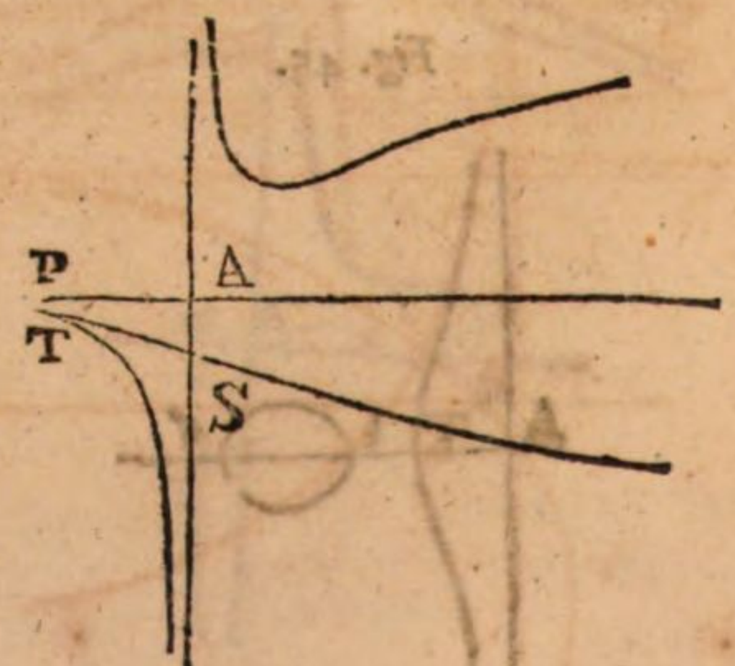
*Fig.* 51.




and one of thoſe Hyperbola Parabolick Curves be joined, and interſect one another in the Form of a Node. Which is the *Forty ſeventh Species.*

If the three Roots are equal, the Node will turn

*Fig.* 52.

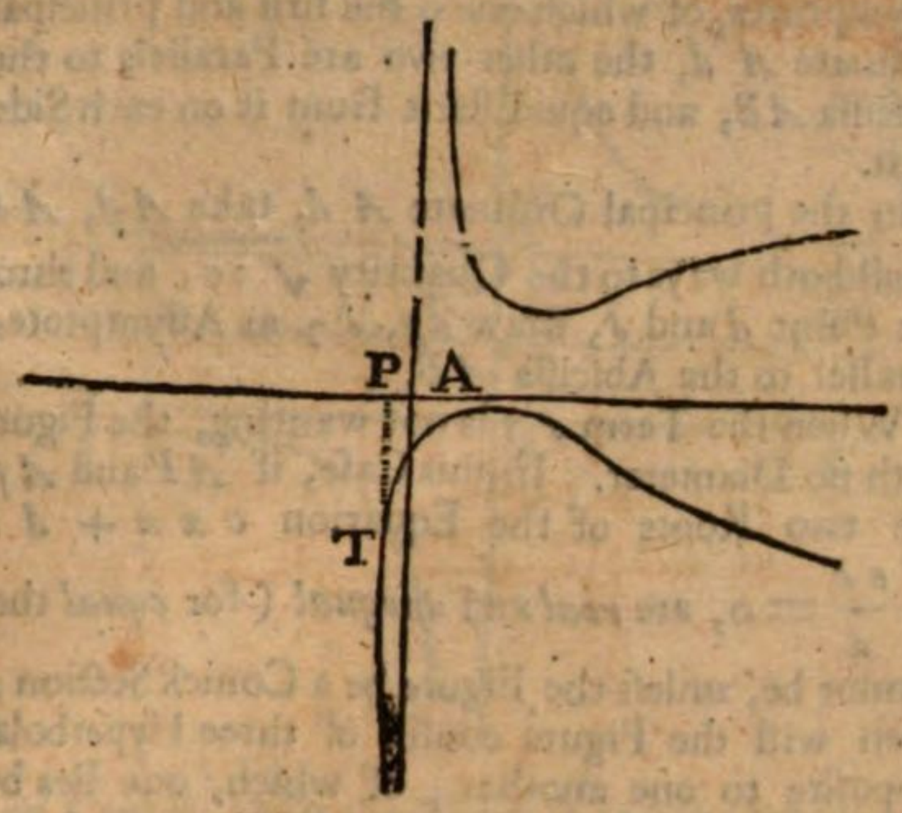



into a Cuſp. Which makes a *Forty eighth Species.*

If

If the two greateſt Roots are equal, and the Third hath the ſame Sign with them, the *Oval*

*Fig.* 53.




will vaniſh into a *Conjugate Point*. Which is the *Forty ninth Species*.

If two of the Roots are impoſſible, the two Hyperbola Parabolick Curves will remain pure, (See *Fig.* 53.)

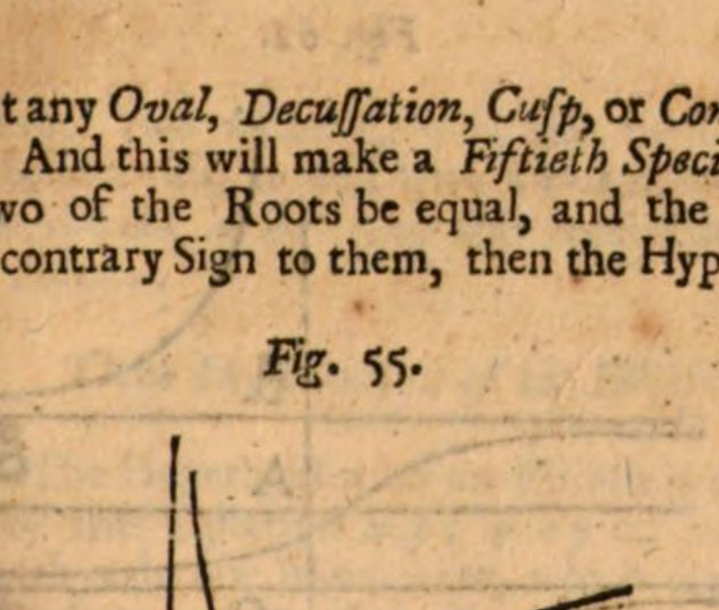
*Fig.* 54.




without any *Oval*, *Decuſſation*, *Cuſp*, or *Conjugate Point*. And this will make a *Fiftieth Species*.

If two of the Roots be equal, and the Third have a contrary Sign to them, then the Hyperbola

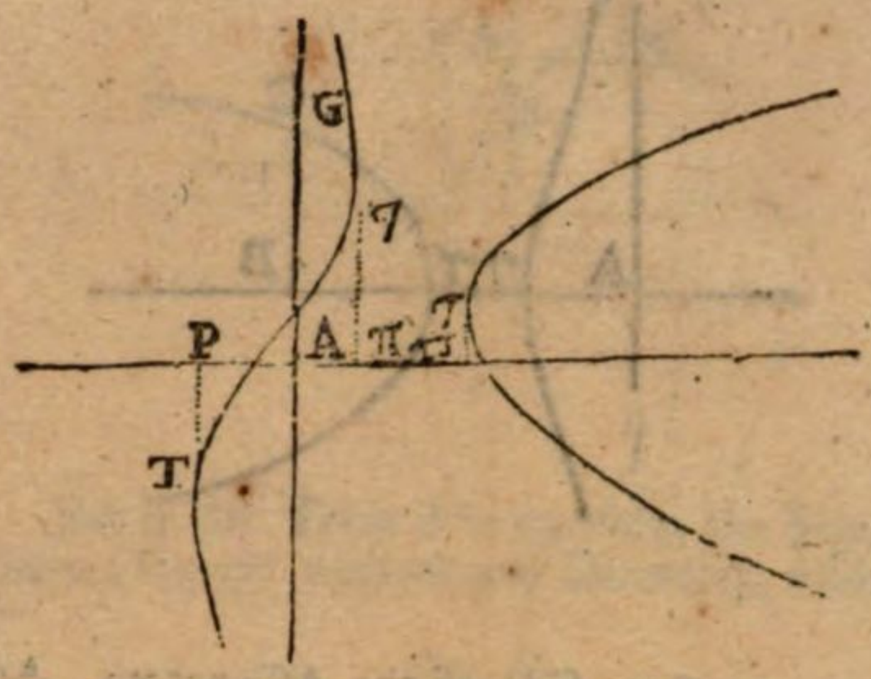
*Fig.* 55.




Parabolick Curves will be joined, decuſſating one another in the Form of a Croſs. And this is the *Fifty firſt Species*.

If the two Roots are unequal, and of the ſame Sign, and the Third have a contrary Sign, the Figure will become an Angineal Hyperbola about the

*Fig.* 56.

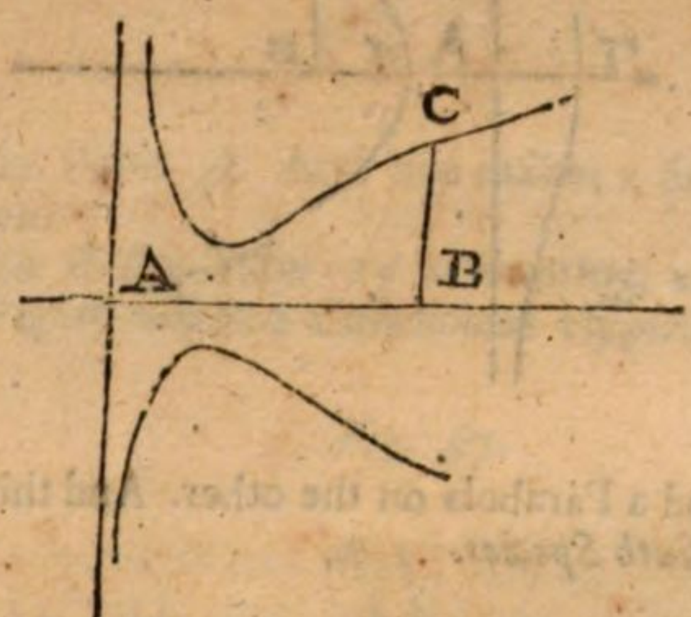



Aſſymptote *A G*, together with a *Conjugate Parabola*. And this will be a *Fifty ſecond Speciees*.

*Four Parabolick Hyperbola's which have a Diameter.*

22. In the other Caſe, where the Term $ey$ is wanting, and the Figure hath a Diameter, if the two Roots of this Equation $bxx + cx + d = o$

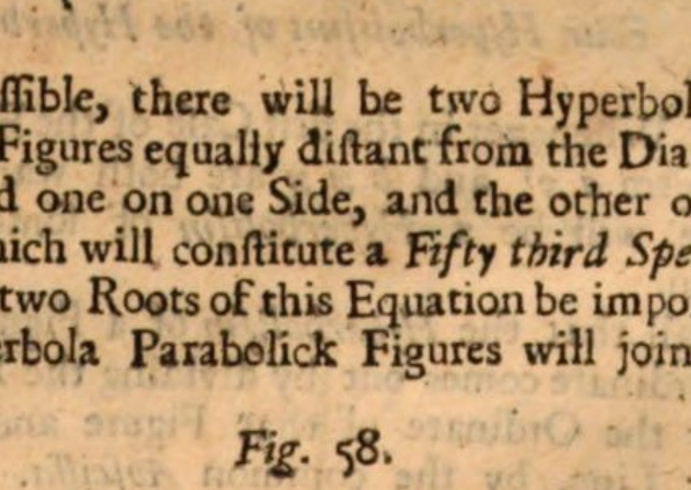
*Fig.* 57.




are impoſſible, there will be two Hyperbola Parabolick Figures equally diſtant from the Diameter *A B*, and one on one Side, and the other on the other, which will conſtitute a *Fifty third Species*.

If the two Roots of this Equation be impoſſible, the Hyperbola Parabolick Figures will join, and

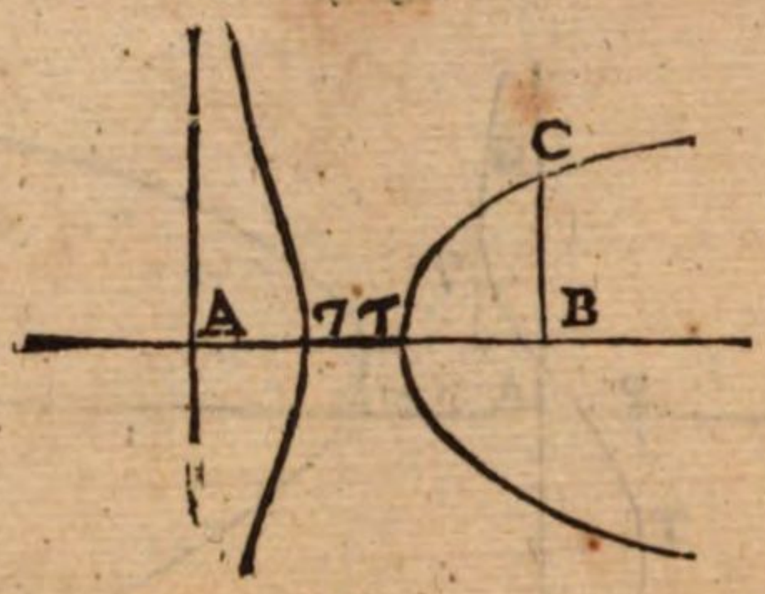
*Fig.* 58.



interſect one another in the Form of a Croſs. And this will be a *Fifty fourth Species*.

If the Roots are equal, and have the ſame Sign, there will be a Conchoidal Hyperbola with a Para-

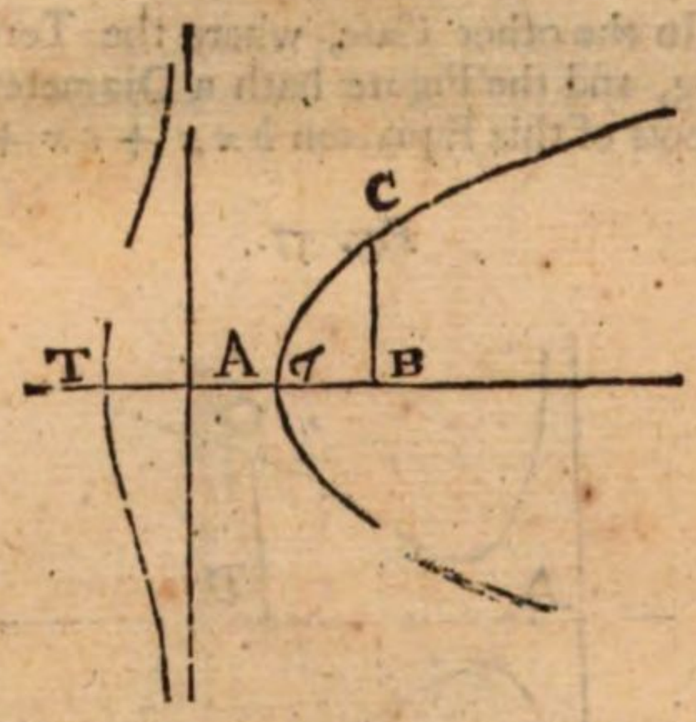
*Fig.* 59.




bola on the ſame Side of the Aſſymptote. And this makes a *Fifty fifth Species*.

If the Roots have contrary Signs, there will be a Conchoidal Hyperbola on one Side of the Aſſymp-

*Fig.* 60.




tote, and a Parabola on the other. And this makes a *Fifty ſixth Species*.

### *Four Hyperboliſms of the Hyperbola.*

23. Whenever in the firſt Caſe of the Equations, the Term $a x^3$ and $b x x$ are both wanting, the Figure will be a *Hyperboliſm* of ſome Conick Section.

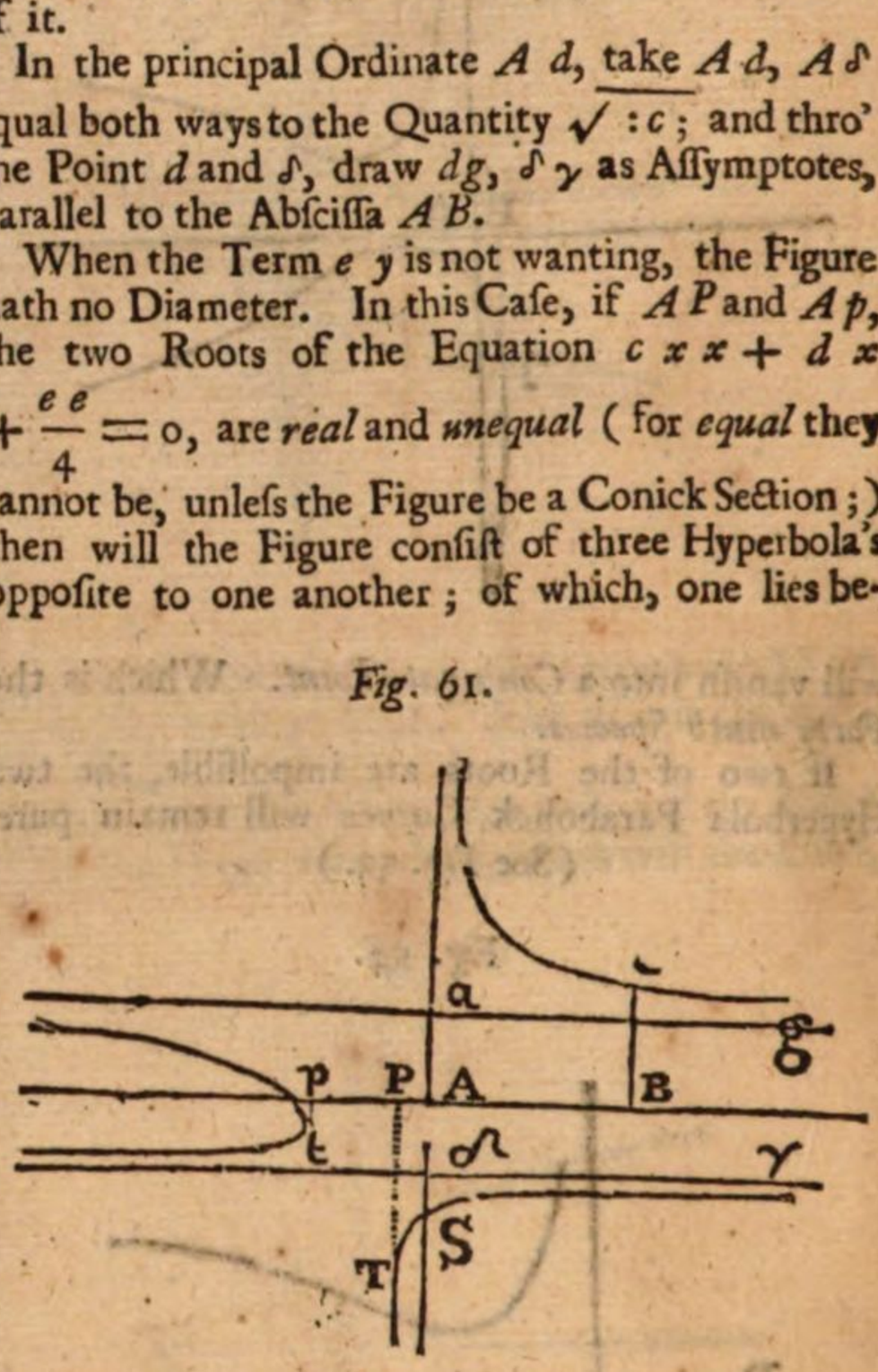
I call that the *Hyperboliſm* of a Figure, when the Ordinate comes out by dividing the Rectangle under the Ordinate of that Figure and a given Right Line, by the common *Abſciſſa*. By this means a Right Line is changed into a Conick Section, and every Conick Section into ſome one of thoſe Figures which I here call the Hyperboliſms of the Conick Sections. For the Equation for the Figure, of which we now ſpeak, *viz.* $x y y + e y = c x + d$, gives the Ordinate $y = \frac{e \pm \sqrt{e e + 4 d x + 4 c x x}}{2 x}$; which is generated by dividing the Rectangle under the Ord. of the Conick Section, $\frac{e \times \sqrt{e e + d x + 4 c x x}}{2 m}$ and a given Right Line $m$, by the common Abſciſſa $x$. Whence it is plain, that the Figure produced will be the Hyperboliſm of an Hyperbola, Ellipſis or Parabola, according as the Term $c x$ is Affirmative or Negative, or quite wanting.

The Hyperboliſm of an Hyperbola hath three Aſſymptotes, of which one is the firſt and principal Ordinate $A d$, the other two are Parallels to the Abſciſſa $AB$, and equidiſtant from it on each Side of it.

In the principal Ordinate $A d$, take $A d$, $A \delta$ equal both ways to the Quantity $\sqrt{\ } : c$; and thro' the Point $d$ and $\delta$, draw $dg$, $\delta \gamma$ as Aſſymptotes, parallel to the Abſciſſa $AB$.

When the Term $e y$ is not wanting, the Figure hath no Diameter. In this Caſe, if $AP$ and $Ap$, the two Roots of the Equation $c x x + d x + \frac{e e}{4} = 0$, are *real* and *unequal* (for *equal* they cannot be, unleſs the Figure be a Conick Section;) then will the Figure conſiſt of three Hyperbola's oppoſite to one another; of which, one lies be-

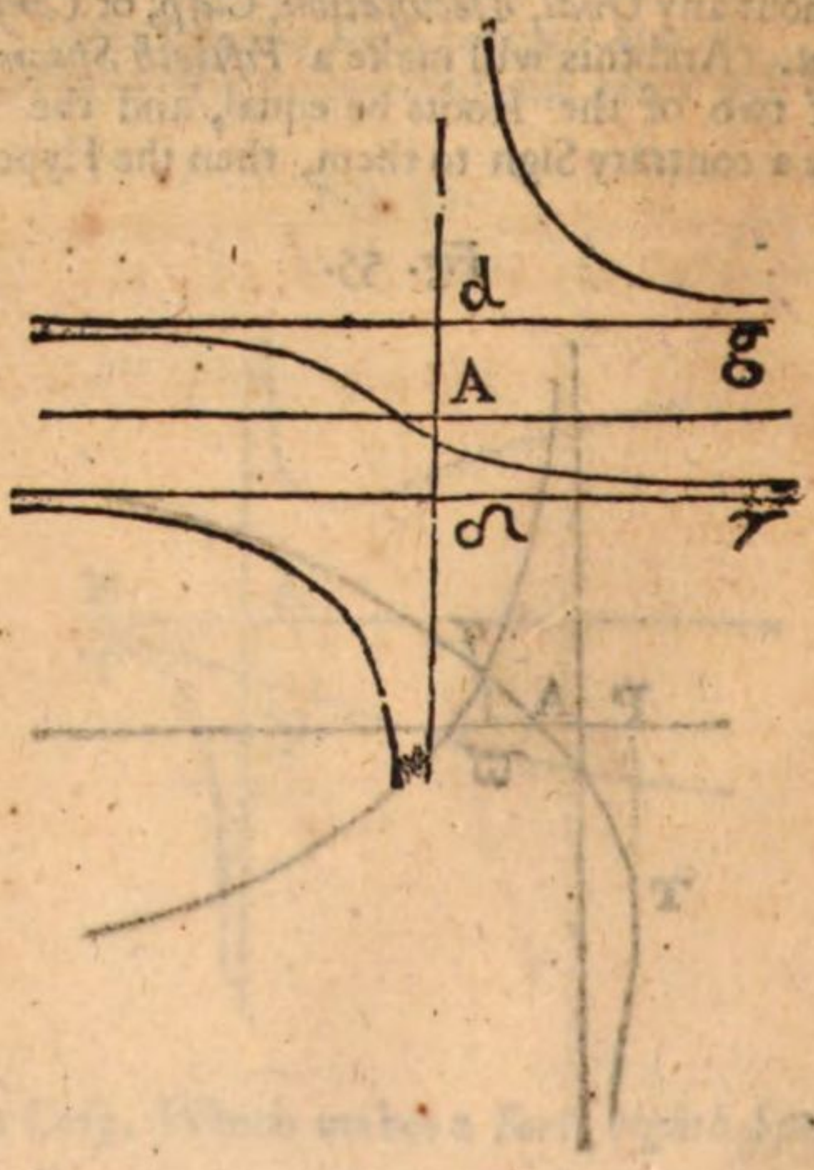
*Fig.* 61.




tween the parallel Aſſymptotes, and the other two without them. And this is a *Fifty ſeventh Species*.

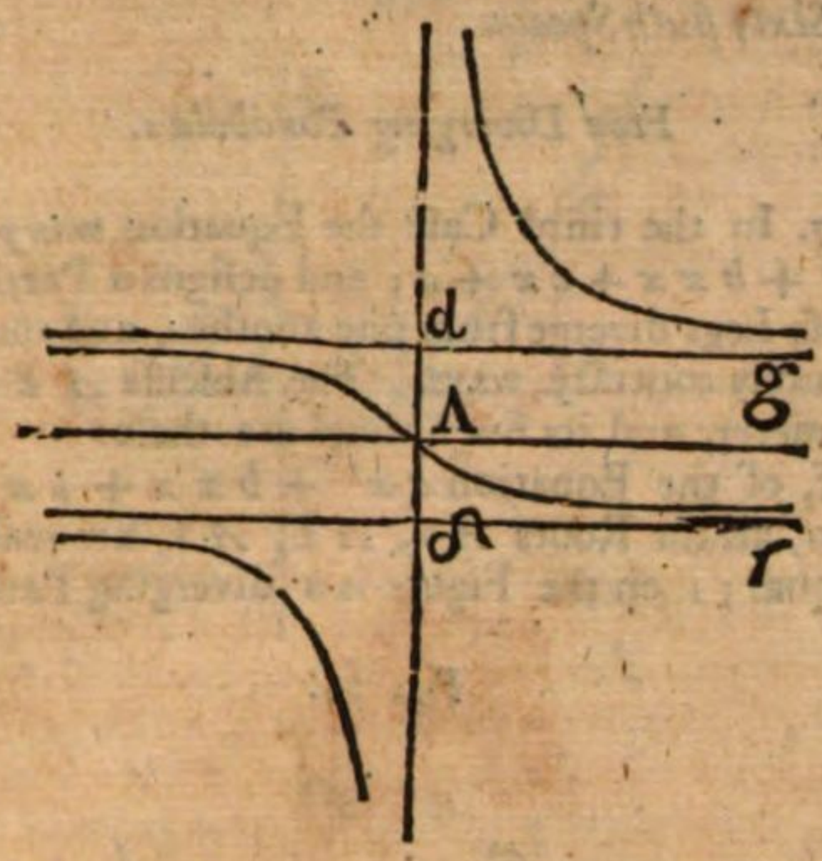
If the two Roots are impoſſible, there will be two oppoſite Hyperbola's without the parallel Aſſymptotes, and an Hyperbolical Anguineal within them. This Figure is of two Species; for it hath

*Fig.* 62.




no

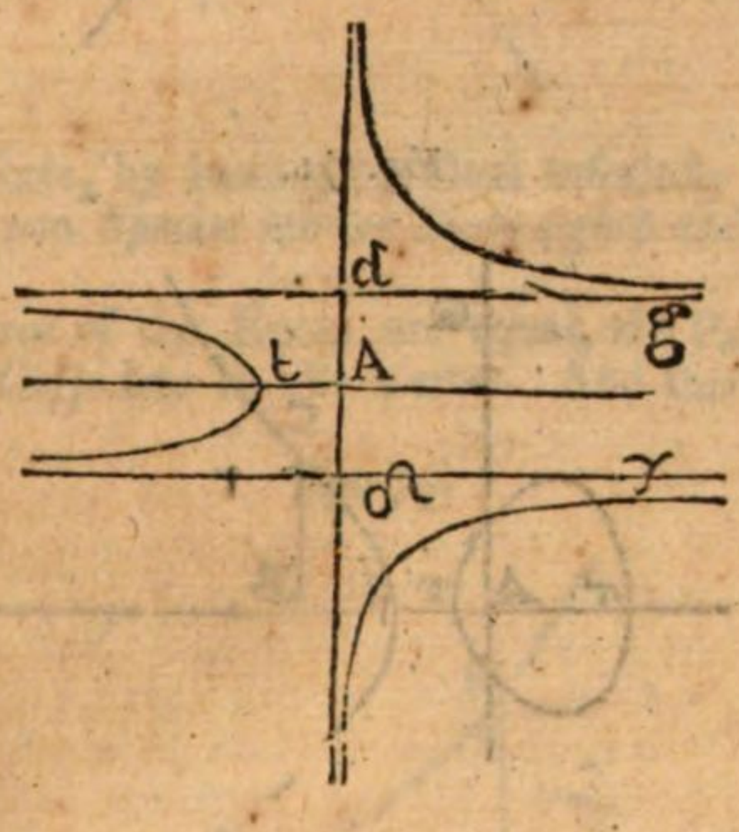
*Fig.* 63.




no Centre when the Term *d* is not wanting, but if *d* be wanting, the Point *A* is its Centre. The former of these makes a *Fifty eighth*, the latter a *Fifty ninth Species.*

But if the Term *e y* is wanting, the Figure will consist of three opposite Hyperbola's, of which one will lie between the parallel Assymptotes, and

*Fig.* 64.

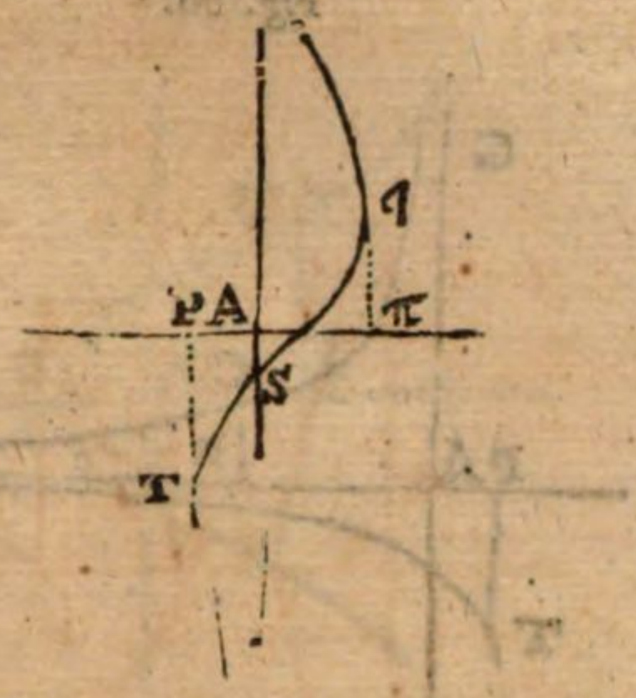



the other two without, as in the 54th Species: And besides this, it will have a Diameter, which is the Abscissa *A B.* And this constitutes a *Sixtieth Species.*

*Three Hyperbolisms of the Ellipse.*

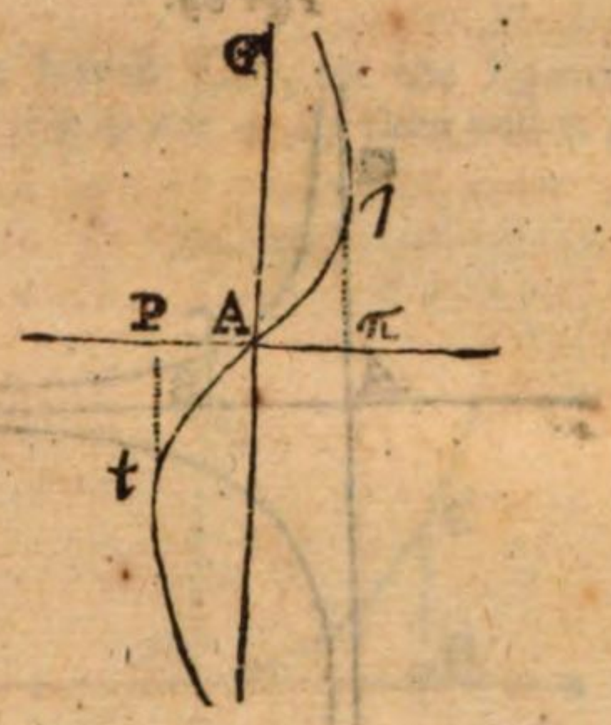
24. The Hyperbolism of an Ellipsis is determined by this Equation $x\,yy + e\,y = c\,x + d$; and hath only one Assymptote, which is the principal Ordinate *A d.* If the Term *e y* be not wanting, the Figure will be an Anguineal Hyperbola without any Diameter, and even without any Centre, if the Term *d* be not wanting. Which makes the *Sixty first Species.*

*Fig.* 65.




But if the Term *d* be wanting, the Figure will have a Centre without any Diameter, which will

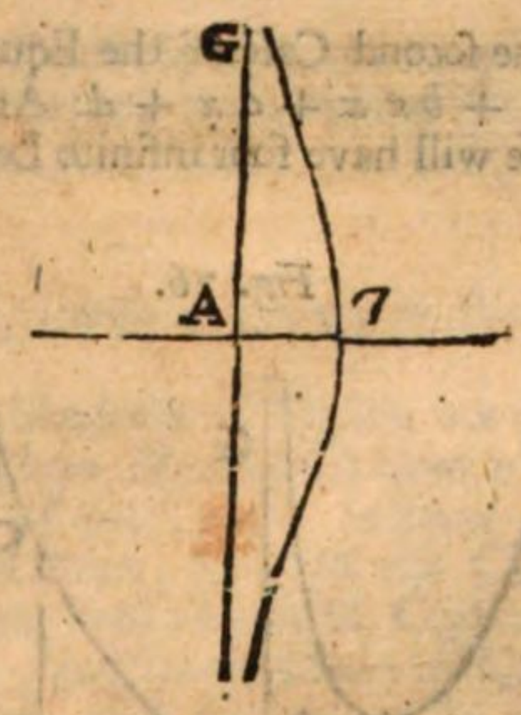
*Fig.* 66.




be the Point *A.* And this makes a *Sixty second Species.*

And if the Term *e y* be wanting, and not *d*, the Figure will be a Conchoidal Hyperbola to the

*Fig.* 67.




Assymptote *A G*, and will have a Diameter without any Centre, that is, the Abscissa *A B.* Which makes a *Sixty third Species.*

*Two Hyperbolisms of the Parabola.*

25. The Hyperbolism of a Parabola is determined by this Equation $x\,yy + e\,y = d$; and hath two Assymptotes, the Abscissa *A B*, and the first and principal Ordinate *A G.* But the Hyperbola's in this Figure are two, not lying in the opposite An-

gles

gles of the Aſſymptote, but in the contiguous or adjoining ones, aud that on each Side the Abſciſſa

*Fig.* 68.

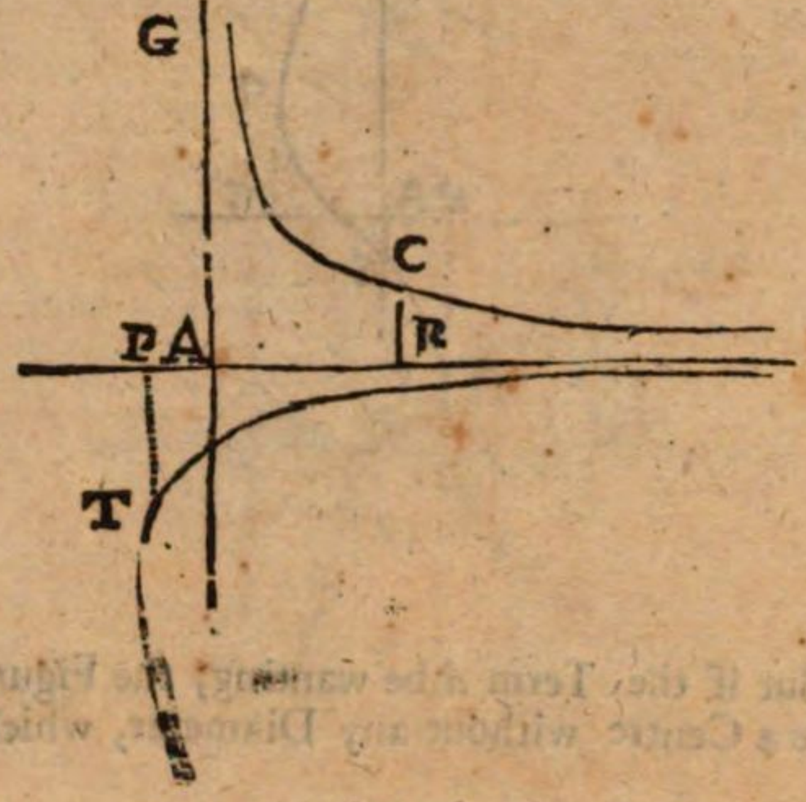
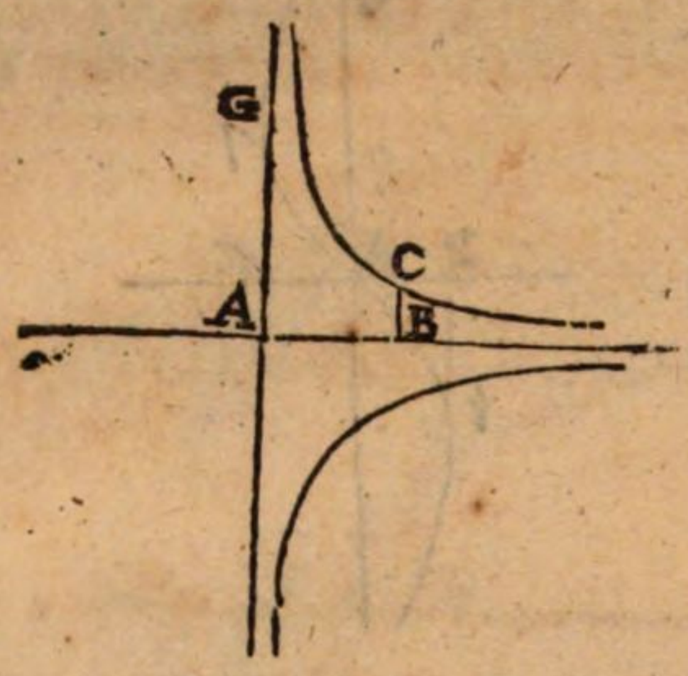



*Fig.* 69.

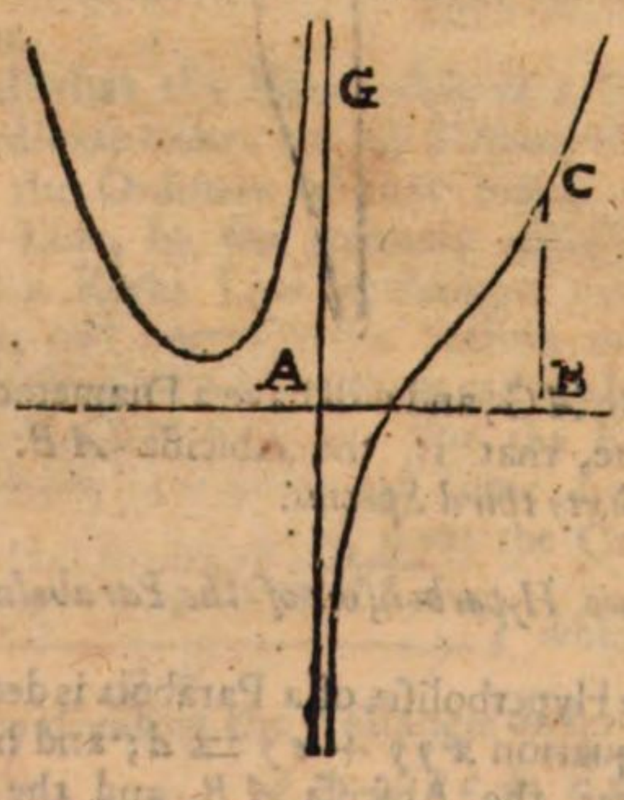



*A B*; and even without any Diameter, if the Term *e y* be there, but with one if that be wanting. Which two *Species* are the *Sixty fourth* and *Sixty fifth.*

### *A Trident.*

26 In the ſecond Caſe of the Equation there is $xy = ax^3 + bxx + cx + d$: And the Figure in this Caſe will have four infinite Legs, of which

*Fig.* 76.




two are Hyperbola's about the Aſſymptote *A G* tending towards contrary Parts, and two converging Parabola's, and, with the former, making as it were the Figure of a *Trident*. And this Figure is that Parabola by which *Des Cartes* conſtructed Equations of ſix Dimenſions. This therefore is the *Sixty ſixth Species.*

### *Five Diverging Parabola's.*

27. In the third Caſe the Equation was $yy = ax^3 + bxx + cx + d$; and deſigns a Parabola, whoſe Legs diverge from one anothe:, aud run out infinitely contrary ways. The Abſciſſa *A B* is its Diameter, and its five Species are theſe:

If, of the Equation $ax^3 + bxx + cx + d = 0$, all the Roots *A τ*, *A T*, *A t*, are real and unequal; ; en the Figure is a diverging Parabola

*Fig.* 70.

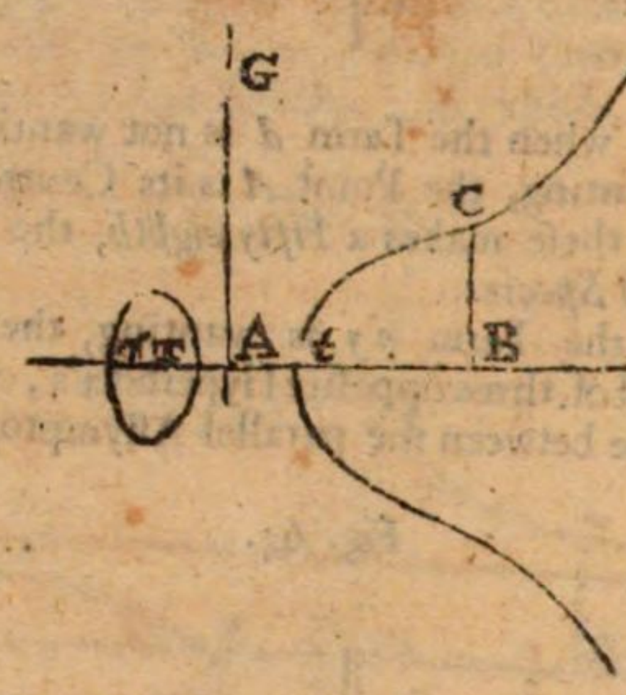
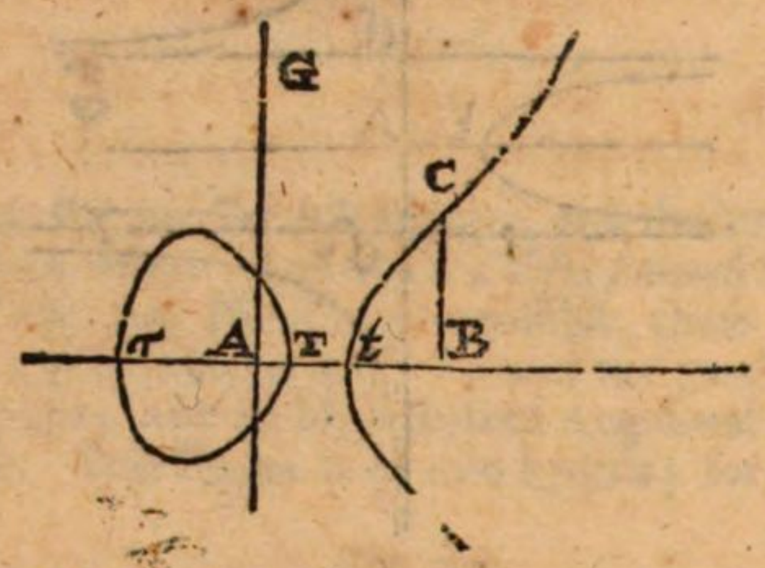



*Fig.* 71.




of the Form of a Bell, with an Oval as its Vertex. And this makes a *Sixty ſeventh Species.*

If two of the Roots are equal, a Parabola will be formed, either *Nodated* by touching an Oval,

*Fig.* 72.

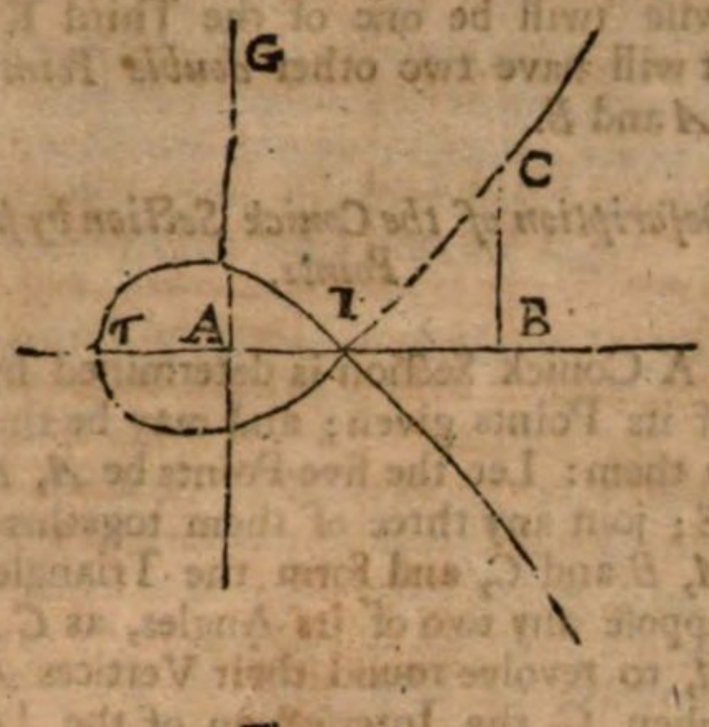
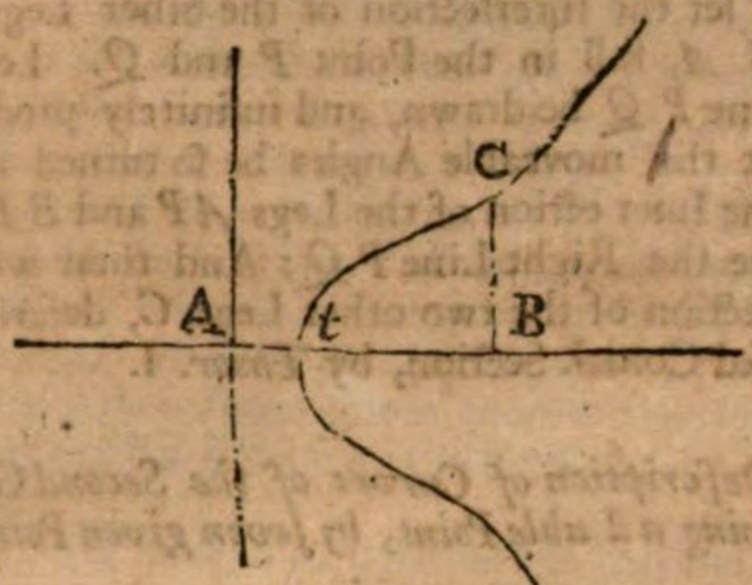


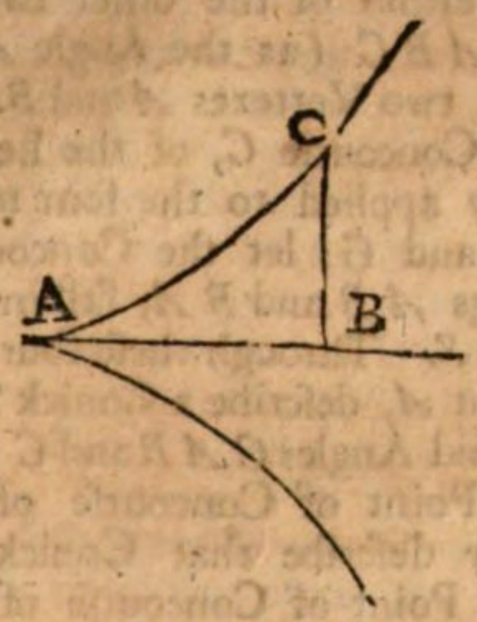

*Fig.* 73.




or *Punctate*, by having the Oval infinitely small. Which two *Species* are the *Sixty eighth* and *Sixty ninth*.

If three of the Roots are equal, the Parabola will be *Cuspidate* at the Vertex. And this is the

*Fig.* 75.

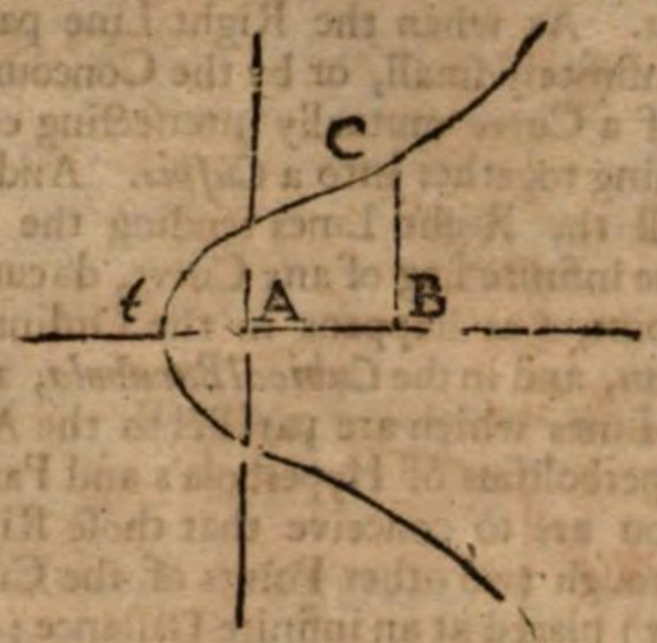



*Neilian* Parabola, commonly called Semi-cubical. Which makes the *Seventieth Species*.

If two of the Roots are impossible, there will

(See *Fig.* 73.)

*Fig.* 76.

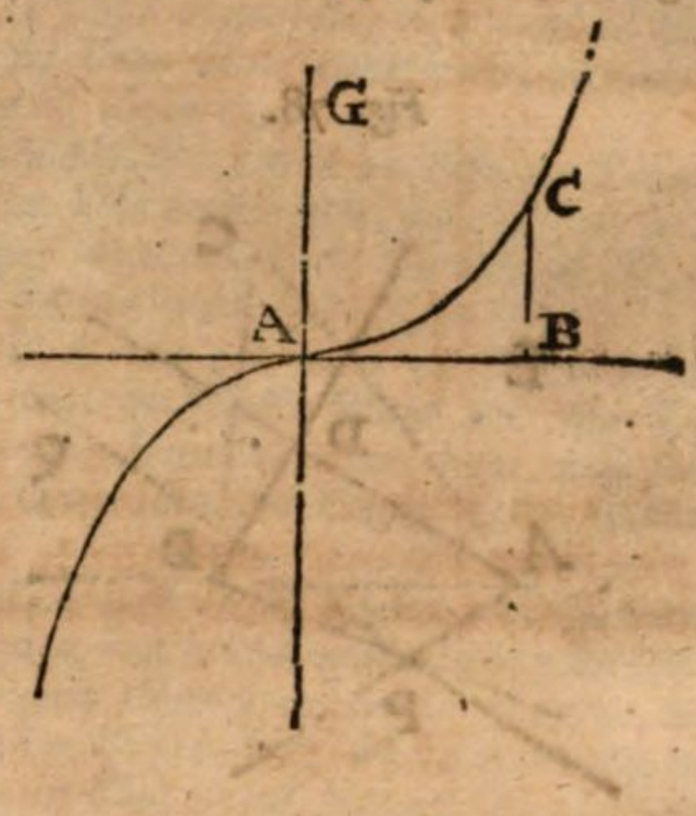



be a pure Parabola of a Bell-like Form. And this makes the *Seventy first Species*.

### *The Cubical Parabola.*

28. In the fourth Case, let the Equation be $y = ax + bxx + cx + d$; then will it denote

*Fig.* 77.




the *Cubical Parabola* with contrary turn'd Legs. And this makes up, or compleats the Number of the Species of these Curves, to be in all *Seventy two*.

### *Of the Genesis of Curves by Shadows.*

29. If the Shadows of Figures are projected on an infinite Plane illuminated from a lucid Point, the Shadows of the Conick Sections will always be Conick Sections; those of the Curves of the Second Gender, will always be Curves of the Second Gender; and the Shadows of Curves of the Third Gender, will themselves be of the same Gender, and so on *in infinitum*. And as a Circle, by the Projection of its Shade, generates all the Conick Sections; so will the five diverging Parabola's spoken of in *ch.* 28. by their Shadows generate and exhibit all Curves of the Second Gender; and so some more simple Curves of other Genders may be found, which, by the Projection of their Shadows from a lucid Point upon a Plane, shall form all other Curves of the same Kinds.

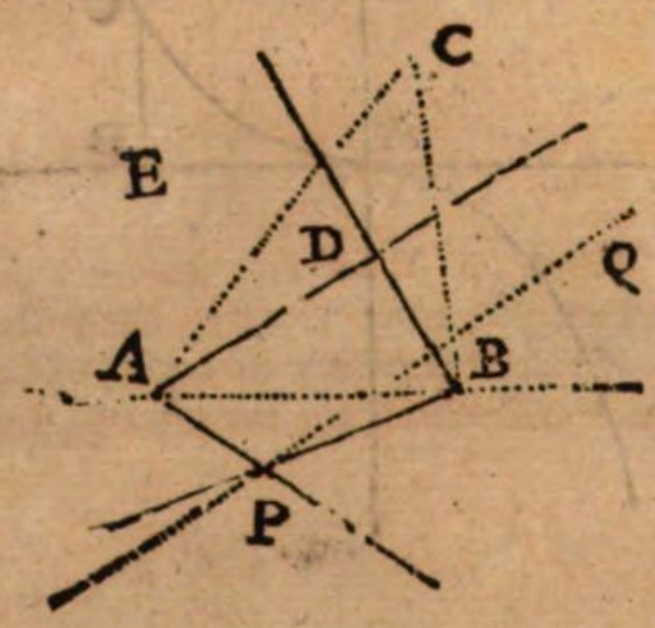
*Of the double Points of Curves.*

30. I ſaid above, that Curves of the Second Gender might be cut by a Right Line in three Points; but two of thoſe Points are ſometimes co-incident. As when the Right Line paſſes by an Oval infinitely ſmall, or by the Concourſe of two Parts of a Curve mutually interſecting each other, or running together into a *Cuſpis*. And if at any time all the Right Lines tending the ſame way with the infinite Leg of any Curve, do cut it in one only Point, (as happens in the Ordinate of the *Carteſian*, and in the *Cubical Parabola*, and in the Right Lines which are parallel to the Abſciſſa of the Hyperboliſms of Hyperbola's and Parabola's;) then you are to conceive that thoſe Right Lines paſs through two other Points of the Curve (as I may ſay) placed at an infinite Diſtance; and theſe two co-incident Interſections, whether they be at a finite or an infinite Diſtance, I call the *double Point*. And ſuch Curves as have this *double Point*, may be deſcribed by the following Theorems.

*Theorems for the Organical Deſcription of Curves.*

31. *Theor.* I. If two Angles, as $PAD$ and $PBD$, whoſe Magnitude is given, be turned round the Poles $A$ and $B$, given alſo in Poſition; and their Legs $AP$, $BP$, by their Point of Concourſe

*Fig.* 78.




$P$, deſcribe a Conick Section paſſing thro' their Poles $A$ and $B$; except when that Right Line happens to paſs through either of the Poles $A$ or $B$; or when the Angles $BAD$ and $ABD$ vaniſh together into nothing; for in ſuch Caſes the Point will deſcribe a Right Line.

II. If the firſt Legs $AP$, $BP$, by their Point of Concourſe $P$, do deſcribe a Conick Section paſſing through the Pole $A$; then will the two other Legs $AD$, $BD$, by their Point of Concourſe $D$, deſcribe a Curve of the Second Gender, paſſing through the other Pole $B$, and having a *double Point* in the firſt Pole $A$, through which the Conick Sections, except when the Angles $BAD$, $ABD$, vaniſh both away together; for then the Point $D$ will deſcribe another Conick Section paſſing through the Pole $A$.

III. But if the Conick Section which the Point $P$ deſcribes, paſs through neither the Pole $A$, nor $B$; then the Point $D$ will deſcribe a Curve of the Second or Third Gender, having a *double Point*; and that *double Point* will be in the Concourſe of the deſcribent Legs $AD$ and $BD$, when the Angles $BAP$, $ABP$ vaniſh together: And the Curve deſcribed, will be one of the Second Gender, if the Angles $BAD$, $ABD$ vaniſh together, otherwiſe 'twill be one of the Third Kind, and then it will have two other *double Points* in the Poles $A$ and $B$.

*The Deſcription of the Conick Section by five given Points.*

32. A Conick Section is determined by having five of its Points given; and may be thus deſcribed by them: Let the five Points be $A$, $B$, $C$, $D$, and $E$; join any three of them together, as ſuppoſe $A$, $B$ and $C$, and form the Triangle $ABC$, and ſuppoſe any two of its Angles, as $CAB$ and $CBA$, to revolve round their Vertices $A$ and $B$; and when $C$, the Interſection of the Legs $AC$, $BC$, is ſucceſſively applied to the other two Points $D$, $E$, let the Interſection of the other Legs $AB$ and $BA$, fall in the Point $P$ and $Q$. Let alſo the Line $PQ$ be drawn, and infinitely produced; and let the moveable Angles be ſo turned round, that the Interſection of the Legs $AP$ and $BP$, may deſcribe the Right Line $PQ$: And then will the Interſection of the two other Legs, $C$, deſcribe the propoſed Conick Section, by *Theor.* I.

*The Deſcription of Curves of the Second Gender having a double Point, by ſeven given Points.*

33. All Curves of the Second Gender which have a *double Point*, are determined from their ſeven given Points, of which one is that *double Point*. And by means of thoſe Points they may be thus deſcribed: Let there be given any ſeven Points of the Curve to be deſcribed, as $A$, $B$, $C$, $D$, $E$, $F$, and $G$; of which $A$ is the *double Point*. Join $A$ with any two other Points, as ſuppoſe $B$ and $C$; and then let both the Angles $CAB$, and alſo either of the other two Angles of the Triangle $ABC$ (as the Angle $ABC$) revolve round the two Vertexes $A$ and $B$. And when the Point of Concourſe $C$, of the Legs $AC$, $BC$, is ſucceſſively applied to the four remaining Points $D$, $E$, $F$, and $G$; let the Concourſe of the two other Legs $AB$ and $BA$, fall in the four Points $P$, $Q$, $R$, $S$. Through theſe four Points, and the fifth Point $A$, deſcribe a Conick Section; and let the aforeſaid Angles $CAB$ and $CBA$, ſo revolve, that the Point of Concourſe of the Legs $AP$, $PB$, may deſcribe that Conick Section: Then ſhall the Point of Concourſe of the other Legs $AC$, $BC$, deſcribe the Curve propoſed, by *Theor.* the *Second.*

If inſtead of the Point $C$, the Right Line $BC$ be given in Poſition, and which ſhall touch the Curve to be deſcribed in $B$; then the Lines $AD$, $AP$, will be coincident; and inſtead of the Angle $DAP$, there will be a Right Line revolving round the Pole $A$.

If the *donble Point* $A$ be infinitely diſtant, the Right Line will perpetually tend with a Direction towards that Point, and will be carried with a parallel Motion, while the Angle $ABC$ revolves about the Pole $B$.

Theſe Curves may alſo be deſcribed after another manner, by the Third Theorem; but 'tis enough to ſhew you the moſt ſimple way of their Deſcription.

After

After the same Method may Curves of the Third, Fourth, and yet higher Genders, be deſcrib'd; not at all indeed, but ſuch as by ſome commodious Ratio may be deſcrib'd by local Motion: For how commodiouſly, to deſcribe ſome Curves of the Second or higher Genders, when they have no *Common Point*, is a Problem that muſt be reckoned amongſt the more difficult ones.

*The Conſtruction of Equations by the Deſcription of Curves.*

*The Uſe of Curves in Geometry is, that by their Interſections Problems may be ſolved.* Let an Equation be propoſed to be conſtructed having Nine Dimenſions, as $x^9 * + b\,x^7 + c\,x^6 + d\,x^5 + e\,x^4 + f\,x^3 + g\,x\,x + h\,x + k = 0$; where $b$, $c$, $+ m$ $d$, &c. ſignify any given or known Co-efficients, adfected with the Signs + and —. Let an Equation to a Cubical Parabola $x^3 = y$ be aſſumed: Then will the former Equation, putting $y$ for $x^3$, ſtand thus, $y^3 + b\,x\,y\,y + c\,y\,y + d\,x\,x\,y + e\,x\,y + m\,y + f\,x^3 + g\,x\,x + h\,x + k = 0$, be an Equation to another Curve of the Second Gender, where $m$ or $f$ may either be wanting or aſſum'd at pleaſure. And by the Deſcriptions of theſe Curves and their Interſections, there will be found the Roots of the Equation at firſt given to be conſtructed.

*Note*, 'Tis enough to deſcribe the Cubical Parabola once.

If the Equation to be conſtructed, by reaſon of the two laſt Terms $h\,x$ and $k$ being wanting, is depreſſed to ſeven Dimenſions; the other Curve, by expunging $m$, will have a *Double Point* in the Beginning of the Abſciſſa, and therefore may eaſily be deſcrib'd as above.

If the Equation to be conſtructed hath the three laſt Terms $g\,x\,x + h\,x + k$ wanting, and therefore is but of ſix Dimenſions, the other Curve, expunging $f$, will become a Conick-Section.

And if the ſix laſt Terms being wanting, the Curve be reduced to three Dimenſions, its Conſtruction will fall in with Dr. *Wallis*'s, by the Cubical Parabola and a Right Line.

*Equations may alſo be conſtructed by the Hyperboliſm of a Parabola with a Diameter.* Suppoſe this Equation of nine Dimenſions, and wanting its laſt Term ſave one, were to be conſtructed, $a + c\,x\,x + d\,x^3 + e\,x^4 + f\,x^5 + g\,x^6 + h\,x^7 + k\,x^8 + l\,x^9 = 0$. Let there be an Equation aſſumed to that Hyperboliſm; thus, $x\,x\,y = 1$; and ſubſtituting $y$ for $\frac{1}{x\,x}$, the Equation to be conſtructed will be changed into this Form, $a\,y^3 + c\,y\,y + d\,x\,y\,y + e\,y + f\,x\,y + m\,x\,x\,y + g + h\,x + k\,x\,x + l\,x^3 = 0$, which denotes a Curve of the ſecond Gender, by whoſe Deſcription on the Problem may be ſolved, and of the Quantities $m$ and $g$, either may be wanting or aſſumed at pleaſure.

By the Cubical Parabola and Curves of the Third Genders, all Equations may be conſtructed not exceeding twelve Dimenſions; and by the ſame Parabola, and a Curve of the Fourth Gender, all Equations not exceeding fifteen Dimenſions, and ſo on infinitely. And theſe Curves of the third, fourth, and ſuperior Genders, may always be deſcrib'd by finding their Points by plain Geometry.

As if this Equation were to be conſtructed, $x^{12} * + a\,x^{10} + b\,x^9 + c\,x^8 + d\,x^7 + e\,x^6 + f\,x^5 + g\,x^4 + h\,x^3 + i\,x\,x + k\,x + l = 0$. and the Cubical Parabola be ſuppoſed to be deſcribed; let the Equation for that Cubical Parabola be $x = y^3$: Wherefore ſubſtituting $y$ for $x^3$, the Equation will put on this Form,

$$y^4 + a\,y\,y^3 + c\,x\,x\,y + f\,x\,x\,y + i\,x\,x = 0$$
$$+ b \quad + d\,x \quad + g\,x \quad + k\,x$$
$$+ e \quad + b \quad + l$$

Which is an Equation to a Curve of the Third Gender, by whoſe Deſcription the Problem may be ſolved. And this Curve may be deſcrib'd by finding its Points by plain Geometry, becauſe the indeterminate Quantities relate not to above Two Dimenſions.

In the Memoires of the *French* Academy of Sciences for the Year 1699, there is a Method for finding the Curves, which Bodies riſing towards, or aſcending from the Horizon, will deſcribe, let the Ratio of the Time of the Deſcent or the Aſcent, and the Acceleration or Retardation be what it will. Communicated by Mr. *Varignon*.

CUSPIDATED *Hyperbola*, is a kind of Hyperbola whoſe Two Parts concur and terminate in the Angle of Contact.

CUSTUMARIUS, was an inferior Tenant in Soccage or Villenage, who, by *Cuſtom*, is obliged to pay ſuch and ſuch Service of Work and Labour for his Lord. Dr. *Kennet*.

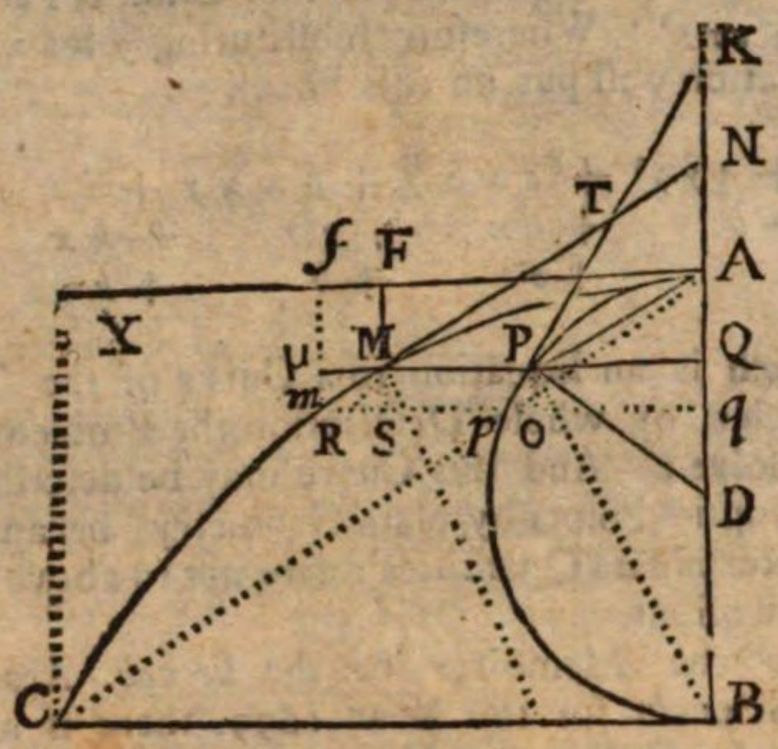
CUTTER *of the Tallies*, is an Officer in the Exchequer, that provideth Wood for the Tallies, and cuts the Sum paid upon them, and then caſteth the ſame into the Court to be written upon.

CYCLOID. Beſides the Segment of the Semicycloidal Space, firſt found quadrable by Sir *Chriſtopher Wren*, and afterwards by Mr. *Huygens*, and alſo the Trilinear Part of it, which is plainly ſo; Dr. *Wallis*, in *Phil. Tranſ. N.* 217. *P.* 111. produces, from his Tracts *de Cycloide* and *de Motu*, ſome other Portions of the Cycloid which are capable of being ſquared. And the ſame Excellent Author, in *N.* 229. *P.* 561. ſhews, That this Figure of the Cycloid was conſidered long before the Time of *Merſennus* and *Gallileo*, tho' not throughly underſtood 'till this preſent Age: For in the *Math. Works* of *Bovillus*, publiſh'd at ſeveral times between 1501. and 1510. the Curve which we now call the *Cycloid*, was then conſider'd; and yet not firſt by *Bovillus* neither, for Cardinal *Cuſanus*, as appears by an Antient Manuſcript of his Works, tranſlated by *J. Scoblant* in the Year 1451. had taken it into Conſideration before. Indeed the Figure, both in the Manuſcript, and in the *Baſil* Edition of his Works, is ill drawn; but being corrected by the Cardinal's own Words, it plainly repreſents the Modern Cycloid.

In *Philoſ. Tranſ. N.* 94. you have a Demonſtration of the Synchroniſm of the Vibrations made in a Cycloid; that is, of a Pendulum of a due Length, vibrating between Two Cycloids: For ſuch a Pendulum will move in a Cycloid, and conſequently its Vibrations will be Synchronal.

*To inveſtigate the Area's of Cycloidal Spaces.*

Let *A M C* be a Vulgar Semi-cycloid, and the Generating Circle *A P B* from any Point in the Ordinate, *v. g.* Q. Draw Q *M* parallel to the Baſe *B C*, cutting the Periphery of the Circle in




*P*; make the Parallelogram *A F M* Q, and draw *f m* infinitely near *F M*, cutting Q *M* produc'd in *μ*, and the Curve in *m*. Put *A B* = 2 *r*, *A* Q = *F M* = *x*, *μ m* = $\dot{x}$, Q *P* = *y*; then (by the Property of the Circle) $2rx - xx = yy$.

Whence $r\dot{x} - x\dot{x} = y\dot{y}$, and $\dot{y} = \frac{r\dot{x} - x\dot{x}}{y}$:

And becauſe the Triangles *D P* Q, *p P O* are ſimilar, therefore *P* Q $(y) : D\,p\,(r) :: P\,O\,(\dot{x})$

$P\,p = \frac{r\dot{x}}{y}$. Now it is the Nature of the Vulgar Cycloid, that the Arch *A P* + the Right Sine of that Arch *P* Q, are equal to Q *M*: Therefore it is manifeſt, that the Fluxion of the Ordinate of the Cycloid Q *M*, *viz.* *M S*, is equal to the Aggregate of the Fluxions of the Arch *A P*, and the Right Sine *P* Q; that is, $\dot{m}S = P\,\dot{p} + p\,\dot{o} = \frac{r\dot{x} - x\dot{x}}{y} + \frac{r\dot{x}}{y} = \frac{2r\dot{x} - x\dot{x}}{\sqrt{2rx - x}}$, and conſequently the Rectangle $F\mu$ is equal to $FM \times \frac{2r\dot{x} - x\dot{x}}{\sqrt{2rx - xx}} = \frac{2rx\dot{x} - xx\dot{x}}{\sqrt{2rx - xx}} = \dot{x}\sqrt{2rx - xx}$ = to the Fluxion of the Area *A M F*. But the Fluxion of the Portion of the Circle $APQ = \dot{x}\sqrt{2rx - xx}$; therefore the Area *A M F* and the correſponding Portion of the Circle *A P* Q are always equal.

## *CONSECTARY* I.

The Parallelogram *AC* is equal to the Semi-periphery *A P B* × *A B* = Four times the Semi-circle *A P B A*, and the Complement of the Cycloidal Space *A M C B* to the Parallelogram, *viz.* *A M C X* is equal to the Semi-circle *A P B A*; therefore the Area of the Semi-cycloidal Space *A M C B*, is equal to three times the Area of the Semi-circle *A P B A*.

## *CONSECTARY* II.

The Cycloidal Space *A M C B*, is to the Circumſcrib'd Parallelogram *A C*, as 3 is to 4.

## *CONSECTARY* III.

The Space comprehended between the Chord *A C*, and the Curve *A M C*, is equal to the Area of the Semi-circle *A P B*. For *A M C B* is equal to $\frac{3}{4}$ Parallelogram *A C*, and the Triangle *A C B* is equal to $\frac{2}{4}$ Parallelogram *A C*; therefore the Space *A M C A* is equal to $\frac{1}{4}$ Parallelogram *A C*, which is equal to the Area of the Semi-circle *A P B*, and the Space *A M C A* is equal to the Space *A M C X* = $\frac{1}{2}$ the inſcrib'd Triangle *A C B*.

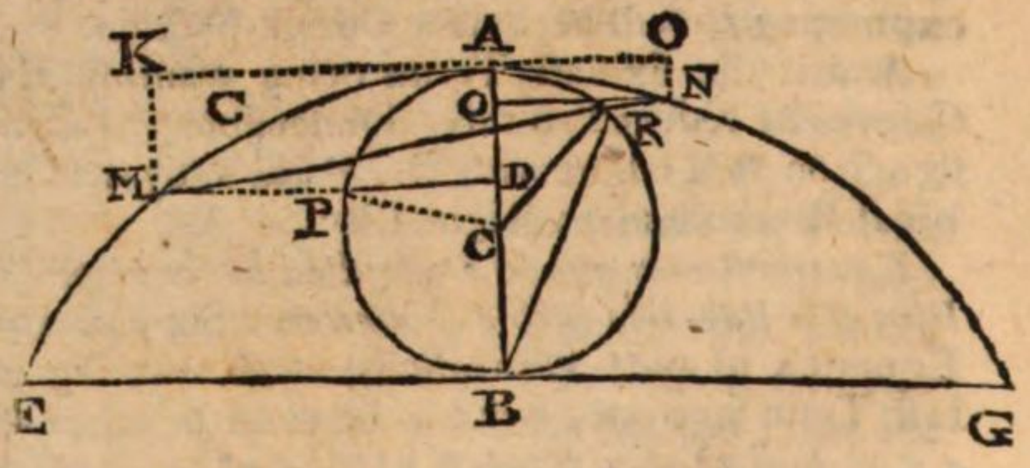
## *CONSECTARY* IV.

Though the Quadrature of the whole Cycloidal Space, or any indefinite Portion thereof, depends on the Quadrature of the Circle; yet an infinite Number of Segments of the Vulgar Cycloid, may be ſquar'd without ſuppoſing the ſame.

Let *E A G* be a Vulgar Cycloid, the Baſe *E G*, and *A B* the Axis, and the generating Circle *A P B*. I ſay, if the Point Q be taken at pleaſure in the Axis *A B*, and if *C D* be taken equal to *A* Q and the Ordinates *D M*, Q *N*, and the Line *M N* connecting their Extremities be drawn, the Segment of the Cycloid *M E N M* = Rectangle Triangle *P B D* ± Rectangle Triangle *R B* Q.

Draw *O A X* parallel to the Baſe, and *N O*, *M K* parallel to the Axis *A B*, and draw the Radij *C P*, *C R*.

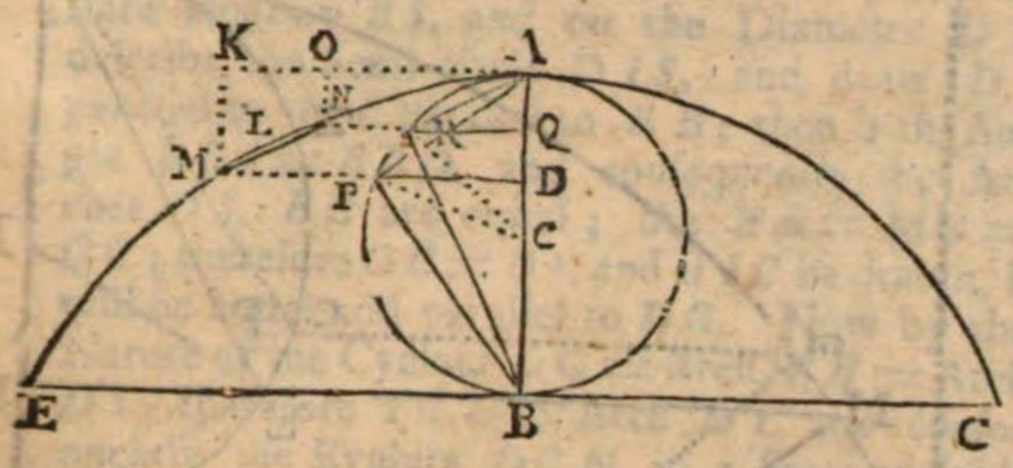
Firſt, If the Ordinates *D M* Q *N* be on the contrary Sides of the Axis *A B*, then the Segment *M e M N* is equal to the Trapezium *M K O N* — Trilineal Figures *A K M* and *A O N*. Now




the Trapezium *M K O N* is = $\frac{1}{2}MK + \frac{1}{2}NO \times KO$ = (becauſe *N O* is = *A* Q = *C D*, and *K M* = *A D*) $\frac{1}{2}CA \times KO = \frac{1}{2}CA \times AK + \frac{1}{2}CA \times AO$. And by the Property of the Cycloid, $\frac{1}{2}AC \times AK$ is = $\frac{1}{2}CA \times$ Arch $\overline{AP + PD}$ = Sector *A C P* + Triangle *B C P* = Sector *A B P*. In like manner it may be demonſtrated, that $\frac{1}{2}CA \times AO$ is = Sector *A B R*; therefore the Trapezium *M K O N* is equal to Two Sectors *P B A* = *R B A*. But, by the known Property of the Cycloid, the Trilineal Figure *A K M* is equal to the Segment of the Circle *A D P*, and the Trilineal Figure *A O N* is equal to the Segment *A* Q *R*; therefore if from the Trapezium *M K O N* the Trilineal Figures *A K M*, *A O N* be ſubtracted, and if from the Sectors *P B A*, *R B A*, the Segments *A D P*, *A* Q *R* be ſubtracted, there will remain the Segment of the Cycloid *M e N M* equal to the Triangles *P D B* + *B* Q *R*.

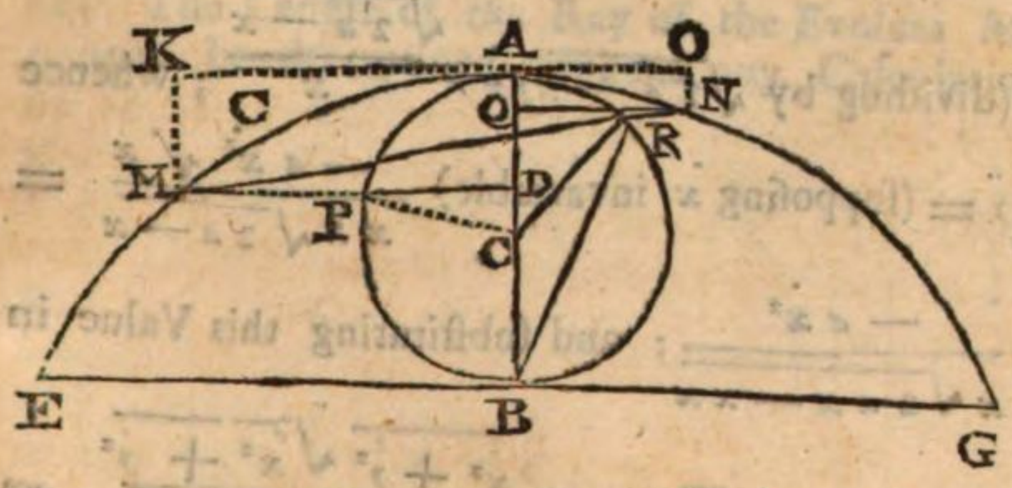
Secondly,

Secondly, But if the Ordinates $QN$, $DM$ be on the ſame Side of the Axis $AB$, then the Segment of the Cycloid $Me\ NM$ = Trapezium $MKON$ + Trilineal Figure $AON$ − Trilineal Figure $AKM$. Now the Trapezium $MKON$ $= \frac{1}{2}\overline{MK + ON} \times OK = \frac{1}{2}CA \times AK - \frac{1}{2}CA \times AO$ = Sector $PBA$ — Sector $RBA$




therefore if we ſubſtitute the Circular Segments $ADP$, $AQR$ in the place of the Trilineal Spaces $AKM$, $AON$, we ſhall have the Cycloidal Segment $Me\ NM$ = Sector $PBA$ — Sector $RBA$ + Segment $AQR$ — Segment $ADP$ = Rectangle Triangle $PDB$ — Rectangle Triangle $RBQ$.

5. If the Points $D$ and $Q$ coincide, then it is manifeſt that $BD$ or $BQ = \frac{1}{2}BC$, and the Chord $MN$ is perpendicular to the Axis $AB$, and the Segment $MeANM$ will be equal to



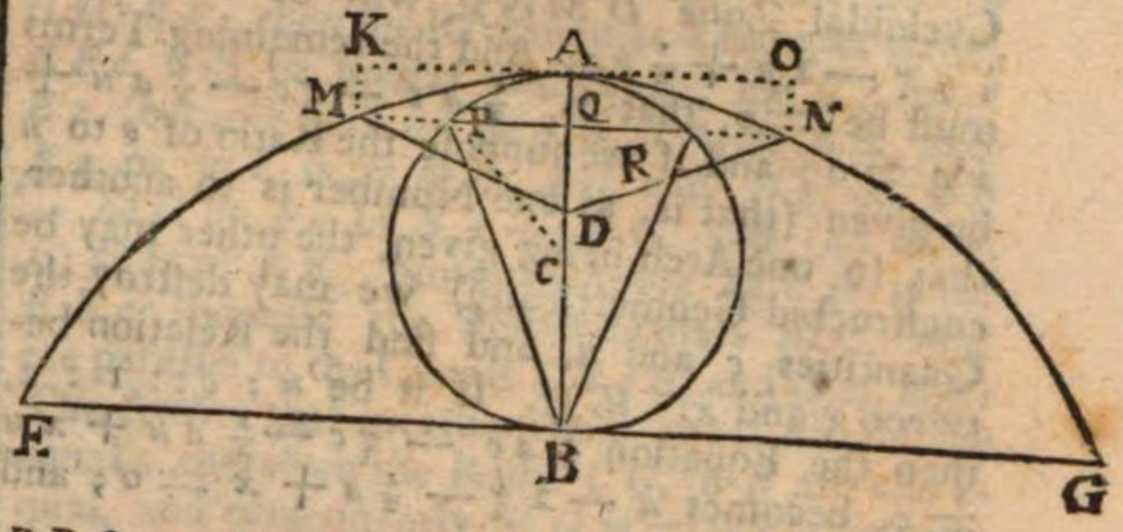

an Equilateral Triangle inſcrib'd in the Generating Circle, and Space $MPBAM$ will be equal to three times the Area of the Triangle $CPB$. Which was firſt diſcover'd by the Excellent Mr. *Hugens*.

6. But if the Point $D$ fall in the Center, then $Q$ will be in $A$, and the Segment $MeNM$ will degenerate into that which the Celebrated Mr. *Leibnitz* firſt ſquar'd, without having Recourſe to the Area of the Circle. And the ſaid Segment $MeNM$ will be equal to the Rectangular Triangle $PBD = \frac{1}{2}$ the Square of the Radius.

7. And to ſquare an infinite Number of Sectors of the Cycloid: Aſſume any Point, $Q$, in the Axis $AB$; and draw the Ordinate $MQN$, and take $CD = AQ$; and draw the Lines $DM$, $DN$: Then, I ſay, the Sector of the Cycloid $DMAND$ is equal to the Iſoſceles Triangle $PBR$. For the Sector of the Cycloid $DMAD$ is equal to the Trapezium $DMKAD$ — Trilineal Figure $AKM$. But the Trapezium $DMKA$ is $= \frac{1}{2}\overline{DQ + AQ} \times AK = \frac{1}{2}AC \times AK = \frac{1}{2}AC \times$ Arch $AP + PQ =$ to the Sector $PBA$, and the Trilineal Figure $AKM$ is equal to the

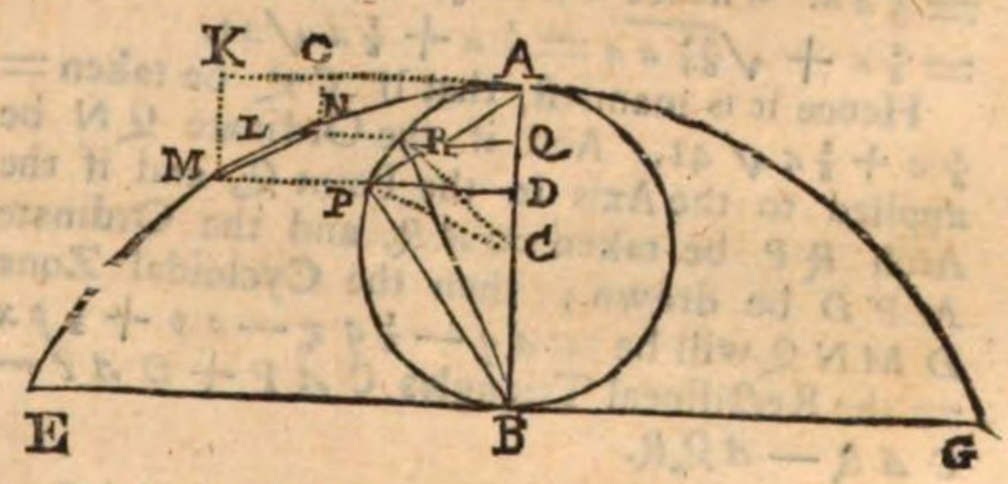


Segment $APQ$; therefore the Sector of the Cycloid $DMAD$ is equal to the Triangle




$PBQ$; and conſequently the Sector of the Cycloid $DMAND$ is equal to the Iſoſceles Triangle $BPR$.

8. And as we have thus ſquar'd an infinite Number of Cycloidal Segments and Sectors, ſo an infinite Number of Cycloidal Zones, (*viz.* Spaces comprehended between the Portion of the Curve $MN$, the Portion of the Axis $QD$, and the Ordinates $QN$, $DM$) may be ſquar'd from the ſame Principles: For if we conſider that the External Space $AKM$ is equal to the Segment of the Circle $APD$, and that $AP = MP$, we may find the Value of any Cycloidal Space in Rectilineal Figures and Circular Segments; and therefore if it be requir'd that the ſaid Cycloidal Space ſhou'd be ſquarable, it is plain that thoſe Terms which conſiſt of circular Segments, muſt deſtroy one another, and conſequently be put $= o$; from which Suppoſition the Quantities which were aſſum'd at firſt may eaſily be determin'd. *Ex. gr.* Let it be requir'd to determine the Right Lines $CQ$, $CD$ in the Axis $AC$, ſo that the Cycloidal Zone $DMNQ$ be ſquarable. Suppoſe $AC = a$, $CQ = x$, $CD = z$, $QR = p$, $DP = q$, $AR$ or $NR = u$, $AP$ or $MP = e$; then the Sector $ACR = \frac{1}{2}au$, and the Sector $ACP$




$= \frac{1}{2}ac$, and conſequently the Segment $AQR$, or the Figure $AON$, is $= ACR - CQR = \frac{1}{2}au - \frac{1}{2}px$; and the Segment $ADP$, or the Figure $AKM$, is $= ACP - CPD = \frac{1}{2}ac - \frac{1}{2}qz$. But the Cycloidal Segment $AQN$ is $= \overline{QO - AON} = QO - AQR = A\,Q \times \overline{QR + RN} - AQR = AQ \times \overline{QR + AR} - AQR = a - x \times p + u - \frac{1}{2}au + \frac{1}{2}px = ap - \frac{1}{2}px + \frac{1}{2}au - xu$.

And in like manner the other Segment $ADM$ is $= aq - \frac{1}{2}qz + \frac{1}{2}ac - zc$.

And conſequently the Zone $DMNQ = ADM - AQN$ is $= aq - \frac{1}{2}qz - ap + \frac{1}{2}px + \frac{1}{2}ac - zc - \frac{1}{2}au + xu$.

Whence it appears, that the Four firſt Members conſiſt of Rectilineal Figures only, and that the other Terms affected with $u$ and $c$, hinder the

Zone from being ſquarable. Whence it is evident, that if we ſuppoſe the Terms affected with $u$ and $c$ mutually to deſtroy one another, then the Cycloidal Zone $D\,M\,N\,Q$ will be $= a\,q - \frac{1}{2}\,q\,z - a\,p + \frac{1}{2}\,p\,x$. And the remaining Terms muſt be $= o$, that is, $\frac{1}{2}\,a\,c - z\,c - \frac{1}{2}\,a\,u + x\,u = o$; and if we ſuppoſe the Ratio of $c$ to $u$ be given (that is, as one Number is to another, that ſo one Arch being given, the other may be conſtructed Geometrically) we may deſtroy the Quantities $c$ and $u$, and find the Relation between $z$ and $x$. *V. gr.* If it be $u : c :: 1 : 2$, then the Equation $\frac{1}{2}\,a\,c - z\,c - \frac{1}{2}\,a\,u + x\,u = o$, becomes $a - 2\,z - \frac{1}{2}\,a + x = o$; and conſequently $z = \frac{a + 2\,x}{4}$. And if $u : c :: 1 : 3$, then $z = \frac{2\,a + 2\,x}{6}$; or if it be $u : c :: 1 : 4$, then $z = \frac{3\,a + 2\,x}{8}$, &c. in the ſame Progreſſion.

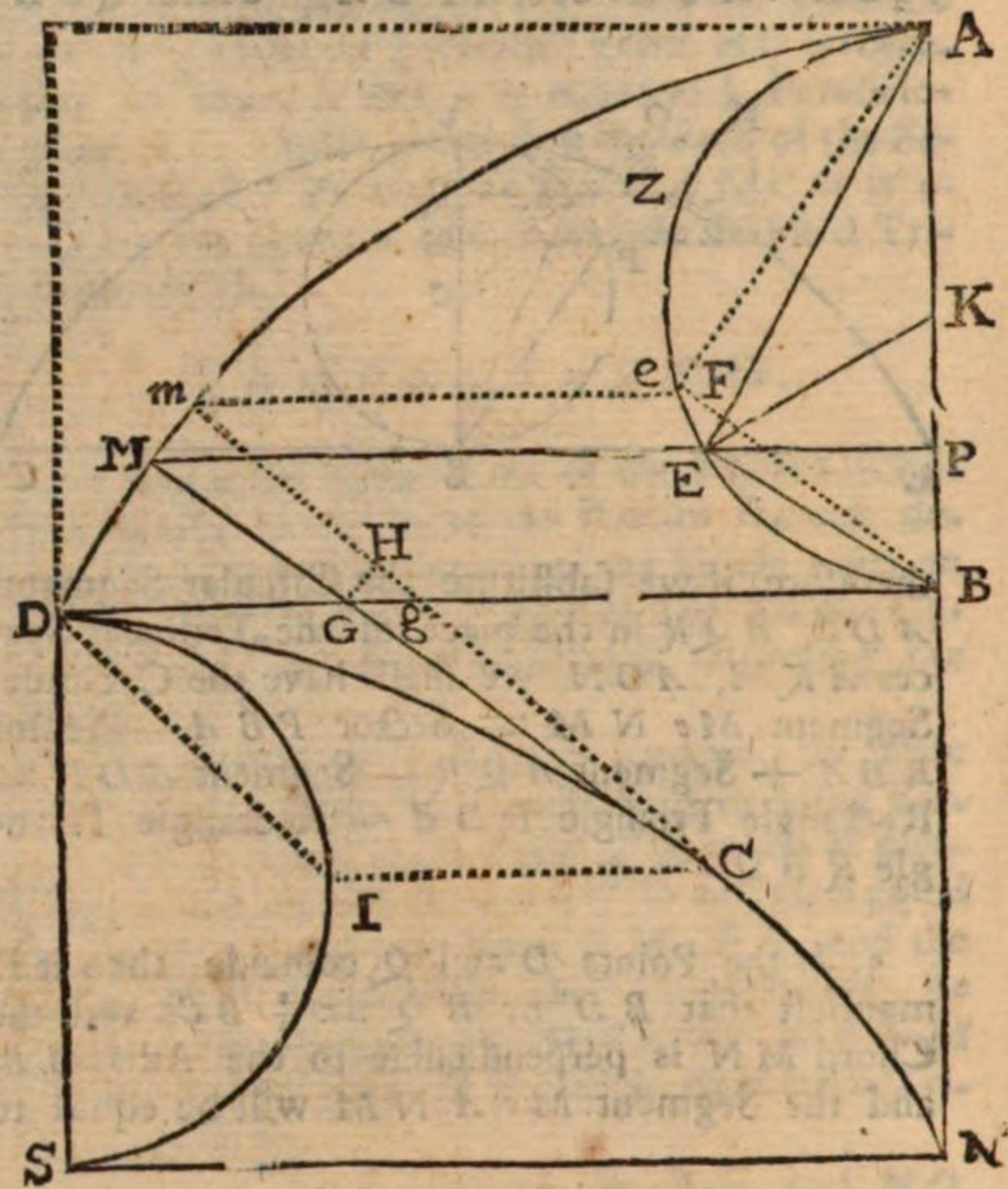
And to find the Value of $z$ in other Terms; if we ſuppoſe $C\,Q$ the Sine Complement of the Arch $A\,R$ to be given, then $C\,D$ the Sine Complement of Double, Triple, Quadruple, &c. that Arch may be found by common Algebra. Therefore if $c$ be $= 2\,u$, then $z = \frac{2\,x\,x - a\,a}{a}$; if $c = 3\,u$, then $z = \frac{4\,x^3 - 3\,a\,a\,x}{a\,a}$; or if $c = 4\,u$, then $z = \frac{8\,x^4 - 8\,a\,a\,x\,x + a^4}{a^2}$, &c. and comparing theſe Values of $z$ with thoſe formerly found, we may find the Value of $x$ in any Suppoſition. *V. g.* If $c$ be $= 2\,u$, then $z = \frac{a + 2\,x}{4} = \frac{2\,x\,x - a\,a}{a}$; and conſequently $8\,x\,x + 2\,a\,x = 5\,a\,a$. Whence $x$ is $= \frac{1}{8}\,a + \sqrt{\frac{5}{8}\,a\,a + \frac{1}{64}\,a\,a} = \frac{1}{8}\,a + \sqrt{\frac{41}{64}\,a\,a} = \frac{1}{8}\,a + \frac{1}{8}\,a\,\sqrt{41}$.

Hence it is manifeſt, that if $C\,Q$ be taken $= \frac{1}{8}\,a + \frac{1}{8}\,a\,\sqrt{41}$. And if the Ordinate $Q\,N$ be applied to the Axis in the Point $Q$, and if the Arch $R\,P$ be taken $= A\,R$, and the Ordinate $M\,P\,D$ be drawn; then the Cycloidal Zone $D\,M\,N\,Q$ will be $= a\,q - \frac{1}{2}\,q\,z - a\,p + \frac{1}{2}\,p\,x$ = the Rectilineal Triangles $C\,A\,P + D\,A\,P - C\,A\,R - A\,Q\,R$.

*And thus an infinite Numbers of Cycloidal Zones may be determin'd, which admit of a Quadrature, when the Proportion between the Arches* A R, R P *is expreſs'd in given Numbers.*

*If the Curve Line* A M D *be a ſimple Semi-cycloid, whoſe Baſe* B D *is equal to the Semi-periphery of the Generating Circle* B E A. *'Tis required to find the Value of the Ray of the Evoluta* M C.

Suppoſe $A\,P = x$, $P\,M = y$, the Arch $A\,E = n$, and the Diameter $A\,B = 2\,a$; then, by the Property of the Circle, $P\,E$ is $= \sqrt{2\,a\,x - x\,x}$ and by the Property of the Cycl. $y = u + \sqrt{2\,a\,x - x\,x}$; therefore $\dot{y} = \dot{u} + \frac{a\,\dot{x} - x\,\dot{x}}{\sqrt{2\,a\,x - x\,x}}$: But $u$ equal $\sqrt{2\,a\,x = x\,x}$, therefore $\dot{y} = \frac{2\,a\,\dot{x} - x\,\dot{x}}{\sqrt{2\,a\,x - x\,x}} = \dot{x} \times \frac{2\,a - x}{\sqrt{2\,a\,x - x\,x}} = \dot{x} \times \frac{2\,a - x}{\sqrt{x} \times \sqrt{2\,a - x}} =$




(dividing by $\sqrt{2\,a - x}$) $\dot{x} \times \frac{\sqrt{2\,a - x}}{x}$; whence $\ddot{y} =$ (ſuppoſing $\dot{x}$ invariable) $\frac{-a\,\dot{x}^2\,\sqrt{x}}{x\,x\,\sqrt{2\,a - x}} = \frac{-a\,\dot{x}^2}{x\,\sqrt{2\,a\,x - x\,x}}$; and ſubſtituting this Value in the General Theorem $\frac{\dot{x}^2 + \dot{y}^2\,\sqrt{\dot{x}^2 + \dot{y}^2}}{-\dot{x}\,\ddot{y}}$, or $\frac{\dot{x}^2 + \dot{y}^2\,|^{\frac{3}{2}}}{-\dot{x}\,\ddot{y}}$ we ſhall have (becauſe $\dot{y} = \dot{x}\,\sqrt{\frac{2a - x}{x}}$)

$$\frac{\frac{2\,a\,\dot{x}^2}{x}\Big|^{\frac{3}{2}}}{-\dot{x}\,\ddot{y}} = \frac{\sqrt{\frac{8\,a^3\,\dot{x}^6}{x^3}}}{-\dot{x}\,\ddot{y}} = \frac{\sqrt{\frac{8\,a^3\,\dot{x}^6}{x^3}} \times x\,\sqrt{2ax - xx}}{a\,\dot{x}^3}$$

$$\frac{\sqrt{\frac{8\,a^3}{x^3}} \times x\,\sqrt{2ax - x_x}}{a} = \frac{\sqrt{\frac{16\,a^4\,x^3 - 8\,a^3\,x^4}{x^3}}}{a}$$

$2\sqrt{4\,a\,a - 2\,a\,x} = MC = (2\sqrt{EP\,q + PB\,q} = 2\,E\,B) = 2\,M\,G$, becauſe $M\,C$ perpendicular to the Curve in the Point $M$ is parallel to the Chord $B\,E$.

## CONSECTARY I.

If $x$ be ſuppoſed $= o$, then is $A\,N = 2\sqrt{4\,a\,a} = 4\,a =$ to the Ray of the Evoluta in the Vertex $A$; and if we ſuppoſe $x = 2\,a$, then $M\,C = 2\sqrt{4\,a\,a - 4\,a\,a} = o$; that is, the Ray of the Evoluta in $D$, is equal to nothing; and in $A$ it

it is equal to twice the Diameter of the generating Circle; and hence 'tis evident, that the Evoluta begins in *D* and ends in *N*, ſo that *B N* is = *B A*.

### *CONSECTARY* II.

The Evoluta *DCN* is a Semi-cycloid equal to the given Semi-cycloid *DMA*: Compleat the Parallelogram *BS*, and on the Diameter *DS* deſcribe the Semi-circle *DIS*, and draw *DI* parallel to *MC* parallel to *EB*; then is the Angle *BDI* = *EBD*, and conſequently the Arches *DI*, *BE* are equal; but *EB* = *MG* = *GC*; therefore *GC* = *DI*, and if *IC* be drawn, it will be equal and parallel to *DG*. Now by the Nature of the Cycloid *DG* = Arch *EB* = Arch *DI*; therefore *IC* is = Arch *DI*, and conſequently the Evoluta *DCN* is a Semi-cycloid, whoſe Baſe is *SN* = ½ the Periphery of the Generating Circle *DIS*; that is, the Evoluta is equal to the given Cycloid, and the ſame with it, only placed in a contrary Poſition.

### *CONSECTARY* III.

The Length of the Curve of the Cycloid *DCN* is = 2 *AB* (= twice the Diameter of the Generating Circle) and any Portion of the Cycloid, as *DC*, is = 2 *CG* = 2 *DI* = twice the correſponding Chord in the Generating Circle.

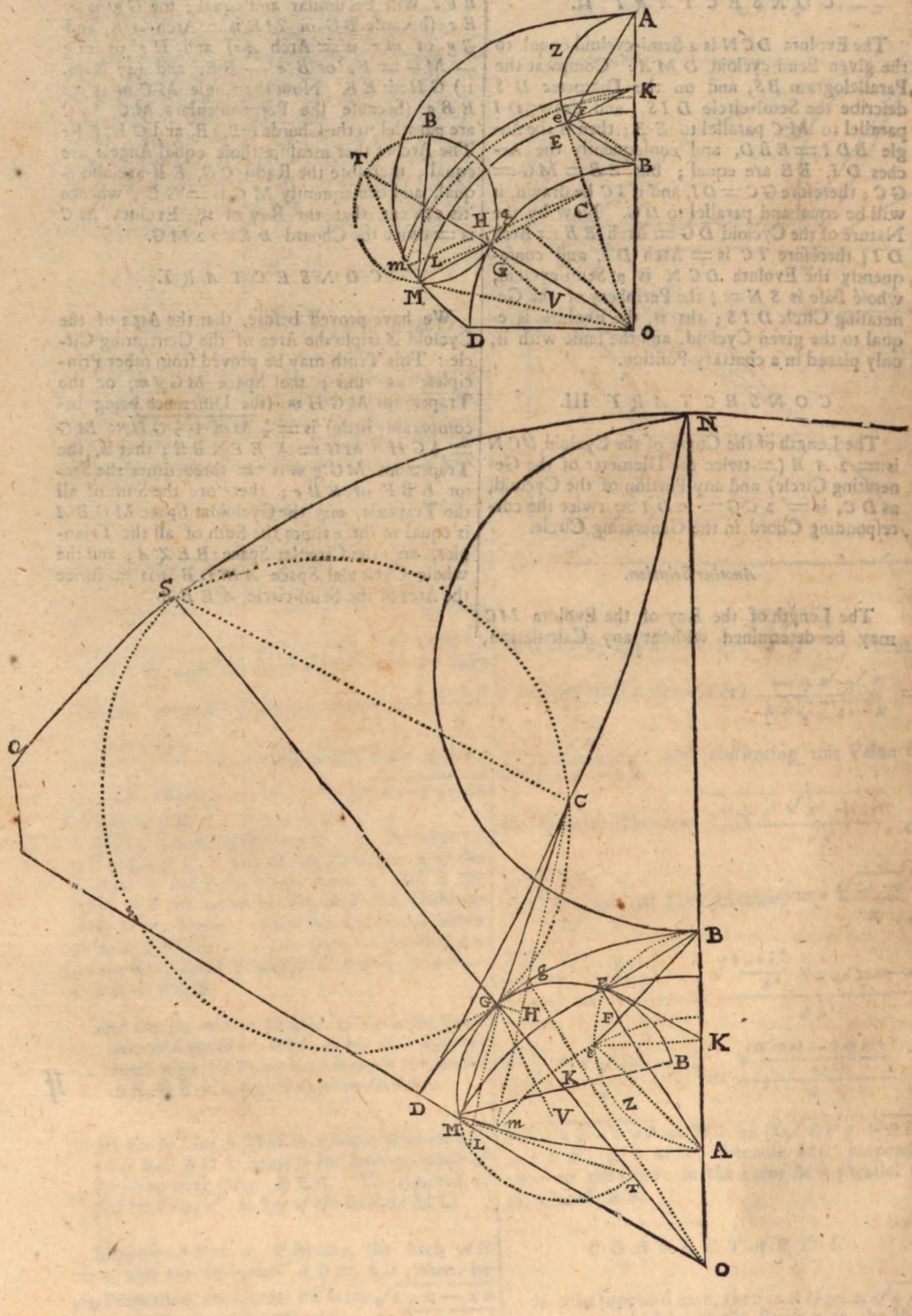
*Another Solution.*

The Length of the Ray of the Evoluta *MC* may be determined without any Calculation, thus: Draw another Perpendicular, *mC*, infinitely near the former, and another Ordinate *me* parallel to *ME*, and another Chord *Be*; and on the Centers *C* and *B* deſcribe the little Arches *GH*, *EF*; then the Rectangular Triangles *GHg*, *EFe* will be ſimilar and equal; for *Gg* is = *Ee* (becauſe *BG* or *ME* is = Arch *AE*, and *Bg* or *me* is = Arch *Ae*) and *Hg* or *mg* — *MG* = *Fe* or *Be* — *BE*, and (47 *Elem.* 1.) *GH* = *EF*. Now the Angle *MCm* is = *EBe* (becauſe the Perpendiculars *MC*, *mC* are parallel to the Chords *EB*, *eB*, and *GH*, *EF*: The Arches that meaſure thoſe equal Angels are equal; therefore the Radii *CG*, *EB* are alſo equal, and conſequently *MG* is = *GC*; whence 'tis evident, that the Ray of the Evoluta *MC* is = twice the Choard *BE* = 2 *MG*.

### *CONSECTARY*.

We have proved before, that the Area of the Cycloid is triple the Area of the Generating Circle: This Truth may be proved from other Principles, as thus; the Space *MGgm*, or the Trapezium *MGHm* (the Difference being incomparably little) is = ½ $\overline{Mm + \frac{1}{2}GH}$ × *MG* = ½ *GH* × *MG* = ¾ *EF* × *BE*; that is, the Trepezium *MGgm* is = three times the Sector *EBF* or *EBe*; therefore the Sum of all the Trapezia, *viz.* the Cycloidal Spacc *MGBA* is equal to three times the Sum of all the Triangles, *viz.* the Circular Space *BEZA*; and the whole Cycloidal Space *AMDBA* is = thrice the Area of the Semi-circle *AEBA*.

*If the Curve* A M D *be a Semi-cyloid deſcrib'd by the Revolution of the Semi-circle* A E B, *on the Periphery of another immovable Circle* B D G. *'Tis requir'd to deſcribe the Evoluta of the ſaid Curve.*




The Movable or Generating Circle may be ſuppoſed to move either on the Convex or Concave Side of the Periphery of the immovable Circle; and when the Semi-circle *A E B* comes into the Poſition *M G B*, in which Poſition it touches the Baſe *B D* in *G*, and the deſcribing Point

Point *A*, is in *M*, in the Curve of the Cycloid; then, from the Geneſis of the Curve, I infer,

1. The Arch *G M* is = Arch *G D*, and the Arch *G D* of the movable Circle is equal to the Arch *G B* of the immovable Circle.

2. *M G* is perpendicular to the Curve *A M D*; for if we conſider the Semi-circumference *M G B*, or *A E B*, and the Baſe *B G D*, as being compos'd of an infinite Number of little ſtreight Lines, and every one in one, equal to the correſponding one in the other, 'twill be manifeſt, that the Semi-cycloid *A M D* is compos'd of an infinite Number of Circular Arches, which have for their Centers all the Points of Contact *G* ſucceſſively, and are all deſcrib'd by the ſame Point *M*.

3. If on *O*, the Center of the immovable Circle, the Concentrick Arch *M E* be deſcrib'd, then the Arches of the movable Circle, *viz*. *M G*, and *E B* will be equal, and alſo the Chords *M G* and *E B*, and the Angles *O G M*, *O B E* will be equal between themſelves; for in the Triangles *O K M*, *O K E*, the three Sides of the one are equal to the three Sides of the other reſpectively; therefore the Angles *M K O* is = *E K O*, and the Arch *M G* is = Arch *E B*, and the Chord *M G* is = Chord *E B*, and *K G M* is = *K B w*, and conſequently *O G M* is = *O B E*.

Theſe things being premis'd, let *m C* be drawn perpendicular to the Curve *A M D*, and infinitely near *M C*; draw alſo another Concentrick Arch *m e*, and another Chord *B e*; and on the Centers *C* and *B* deſcribe the Arches *G H*, *E F*: Then the Rectangular Triangles *G H g*, *E F e* are equal and ſimilar; for *G g*, or *D g* — *D G* = *E e*, or the Arch *B e* — Arch *B E*; and *H g* or *m g* — *M G* is = *F e* or *B e* — *B E*, and conſequently the little Arch *G H* is = Arch *E F*; whence it follows, that the Angle *G C H* is to the Angle *E B F*, as *C E* is to *C G*. It remains therefore to find the Proportion between thoſe Angles, which we may do in this manner:

Having drawn the Radii *O G*, *O g*, *K E*, *K e*, ſuppoſe *O G* or *O B* = *b*, *K E* = *a*, 'tis evident that the Angle *E B e* is = *O B e* — *O B E* (or *O B E* — *O B e*) = *O G m* — *O G M* (or *O G M* — *O G m*) = (having drawn *G L*, *G V* parallel to *C m*, *O g*) *L G M* ∓ *O G V* = *G C H* ∓ *G O g*; therefore the Angle *G C H* is = Angle *E B e* ± *G O g*. Now the Arches *G g*, *E e* being equal, it is, *G O g* : *E K e* or 2 *E B F* :: *K E* (*a*) : *O G* (*b*); and conſequently the Angle *G O g* is = $\frac{2a}{b}$ *E B F*, and *G C H* is = (*E B F* ± *G O g*) = $\frac{b \pm 2a}{b}$ *E B F*; therefore *G C H*: *E B F* (:: *A E*: *C G*) :: $\frac{b \pm 2a}{b}$ : 1, and conſequently the unknown Quantity *C G* is = $\frac{b}{b-2a}$ *B E*: Which gives this

## CONSTRUCTION.

Say, As *O A* (*b* ± 2 *a*) : *O A* (*b*) :: *B E* or *M G* : *G C*; then the Point *C* will be in the Evoluta requir'd.

## CONSECTARY I.

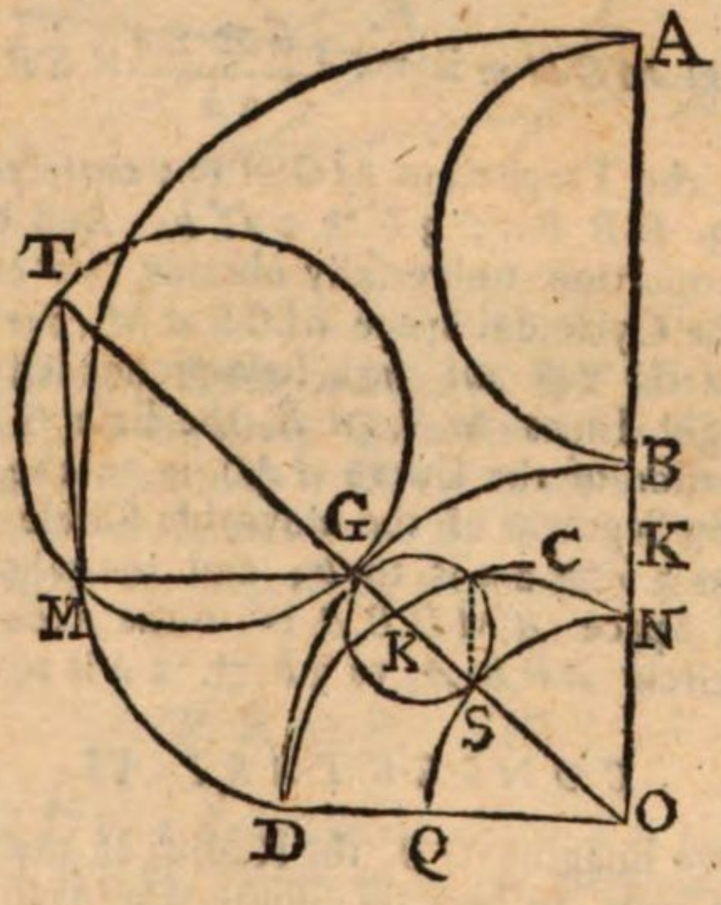
The Evoluta begins in the Point *D*, and touches the Baſe *B G D* in *D*; for the Chord *G M* (the Third Term in the Analogy) vaniſhes in that Point.

## CONSECTARY II.

The Evoluta *D C N* terminates in the Point *N*, ſo that then *O A* : *O B* :: *A B* : *B N* :: *O A* ± *A B* (= *O B*) : *O B* + *B N* (= *O N*); that is, *O A*, *O B*, *O N* are continually proportional.

## CONSECTARY III.

If the Arch of the Circle *N S Q* be deſcribed on the Center *O*, I ſay the Evoluta *D C N* may be deſcrib'd by the Revolution of the movable Circle *G C S* (whoſe Diameter is *G S* = *B N*) about the immovable Circle *N S Q*; that is, the Evoluta *D C N* is a Semi-cycloid, ſimilar to the given Semi-cycloid *A M D* (becauſe the Diameters *A B*, *B N* of the movable Circles, are proportional to the Radii of the immovable Circles *O B*, *O N*; for *A B* : *O B* :: *B N* : *O N*) and in an inverted Poſition, having its Vertex in *D*; for ſuppoſe the Diameters of the movable Circles to be in *O T* (drawn at pleaſure from the Center *O*) it will paſs through the Points of Contact *S* and *G*; then if we ſay, *A B* or *T G* : *B N* or *G S* :: *M G* : *G C*, the Point *C* will be in the Evoluta, (by Conſtruction) and in the Circumference of the Circle *G C S* (*Prop.* 31. *Elem.* 3. *Prop.* 6. *Elem.* 6.) becauſe the Angle *G M T* being a Right Angle, the Angle *G C S* is alſo; and becauſe *M G T* = *C G S*, therefore the Arch *T M* (= *G B*) *C S* :: *G T* : *G S* :: *O G* : *O S* :: *G B* : *N S*; therefore the Arch *C S* is = Arch *N S*; *ergo*, *&c.*




## CONSECTARY IV.

Hence 'tis evident, that the Portion of the Curve of the Cycloid *D C* is = Right Line *C M*, and conſequently that *D C* : Tang. *G C* :: *A B* + *B N* : *B N* :: *O B* + *O N* : *O N*; that is, the Sum (or Difference) of both Diameters (of the movable and immovable Circles) is to the Semi-diameter of the immovable Circle, as *D C* is

is to the Tangent $C G$; for the Triangles $C M m$, $C G H$ are similar, therefore $M m : G H$ or $E F :: M C : G C ::$ (by Conſtruct.) $O A + O B (2 b \pm 2 a) :$ (*See Fig. 2. in Page the laſt but one*) $O B (b)$ and conſequently the Sum of all the $M m$, or the Portion of the Cycloid $A M$, is to the Sum of all the $E F$. or Chord $A E$, or Tangent $T M$, as $O A + O B$ is to $O B$; whence 'tis evident, that $O B : O A + O B (= 2 O K) :: A B : A M D$, and $O B : 2 O K :: A B - A E : D M ::$ twice the Verſed Sine of $\frac{1}{2}$ the Angle $M K G$ or $E K B$ : the Portion of the Curve $D M$.

And becauſe it is $A M$ : Tang. $T M :: O A + O B : O B$; therefore in the Vulgar Cycloid, $A M$: Tang. $T M :: 2 : 1$.

## CONSECTARY V.

The Trapezium $M G H m$ is $= \frac{1}{2} \overline{G H + \frac{1}{2} M m} \times M G$; but $C G (= \frac{b}{b \pm 2 a} M G : C M (= \frac{2 b \pm 2 a}{b \pm 2 a} M G) :: G H : M m = \frac{2 b \pm 2 a}{b} G H$; therefore (becauſe) $G H$ is $= E F$, and $M G = E B$) $M G H m$ is $= 3 \frac{b \pm 2 a}{2 b} \times E F \times E B$; that is, the Trapezium $M G H m$ : correſponding Triang. $E B F :: 3 b \pm 2 a : b$. And becauſe the Proportion univerſally obtains, 'tis evident, that the Cycloidal Space $M G B A M$ (*See Fig. 2. in Page the laſt but one*) (comprehended under the Right Lines $M G$, $A B$, the Baſe $G B$, and the Portion of the Curve $A M$) is to the correſponding Segment of the moveable Circle $B E Z A B$, as $3 b \pm 2 a$ is to $b$; and the whole Cycloidal Space $A M D B A$ is to the Area of the Semi-circle $A E B A$, as $3 b \pm 2 a$ is to $b$.

## CONSECTARY VI.

If we imagine $O B$, the Radius of the immovable Circle, to become infinite, the Arch $A G D$ will become a ſtreight Line, and the Curve $A M D$ will be the Vulgar Cycloid; and in this Caſe $A B$, the Diameter of the movable Circle, is $= 0$, in reſpect of that of the immoveable Circle: Whence, 1. becauſe $b \pm 2 a$ is $= b$, it is $M G : G C :: b : b$; that is, $M G$ is $= G C$, and conſequently if $B N$ be taken $= A B$, and $N S$ be drawn parallel to $B D$, the Evoluta $D C N$ will be generated by the Revolution of a Circle (on the Baſe $N S$) whoſe Diameter is $= A N$. 2. The Portion of the Cycloid $A M$, is to the correſponding Chord of the Circle $A E :: 2 b : b$; this is evident from §. 4. of *Hayes's Fluxions*. 3. The Space $M G B A$ is to the Segment $B E Z A :: 3 b : b$; which is alſo evident from §. 5. of the ſame Book.

## CONSECTARY VII.

The Length of the Semi-cycloidal Curve is proportional to the Rectangle $B K O$, if the Semi-diameter of the immovable Circle be the ſame. Let $B A$ be the Diameter of one, and $B a$ the Diameter of another movable Circle; and let $O B$ be the Radius of the immoveable Circle common to both: Then, by §. 4.

$$O B : O A + O B :: A B : A M D;$$

And $O B : O a + O B :: a B : a m d$;

And by Proportion of Equality and Div. $\left\{ \begin{array}{l} O A + O B : O a + O B :: \\ a B \times A M D : A B \times a m d \end{array} \right.$

That is, $2 O K : 2 o k :: a B \times A M D : A B \times a m d$

Whence $O K \times A B : o k \times a B :: A M D : a m d$;

And dividing by 2, $B K O : B k O :: A M D : a m d$.

Q. E. D.

## CONSECTARY VIII.

Becauſe the Arches $G D$, $G M$ are always equal between themſelves, it follows that the Angle $D O G$: Ang. $G K M :: G K : O G$; therefore if the Point $D$ (where the Cycloid begins) the Radii $O G$, $G K$, and the Point of Contact $G$ be given, the Poſition of the Point $M$, which deſcribes the Cycloid, is found by drawing the Ray $K M$; ſo that $G K : G O :: D O G : G K M$; and all the Points of the Curve $A M D$ may be determin'd Geometrically, when the Proportion between the Radii $O G$, $G K$ can be expreſs'd in Numbers; and conſequently, in that Caſe, this *Cycloid is a Geometrical Curve*, and the ſaid *Cycloid is a Tranſcendent* (or Mechanick) *Curve*, when the Relation of $O G$ to $O C$ cannot be expreſs'd by any finite Number of Terms.

## CONSECTARY IX.

If in Concentrick Spheres ſimilar Cycloids be deſcrib'd, their Perimeters will be proportional to the Semi-diameters of the ſaid Spheres.

## CONSECTARY X.

And becauſe the Length of the Curve of the Cycloid $A M D$ is proportional to the Rectangle $B K O$, 'tis plain, that in Vulgar Cycloids the Curve is proportional to the Diameter of the Generating Circle.

## SCHOLIUM.

*By help of ſuch Principles as theſe, the Great Sir* Iſaac Newton *has advanced ſeveral wonderful Concluſions concerning the more exact meaſuring of Time by Pendulums: As for Inſtance,*

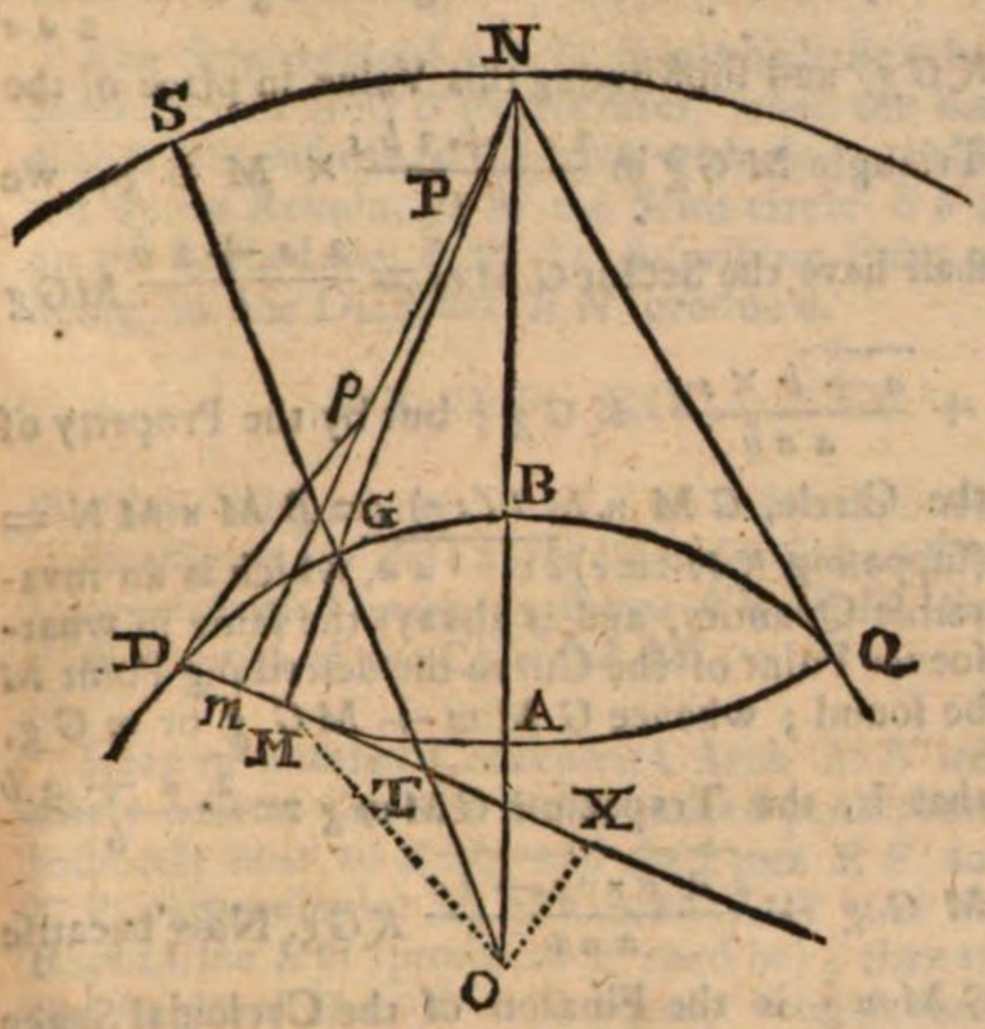
1. If within the Globe $B G D$ the Cycloid $D A Q$ be deſcrib'd, being biſected in $A$, and terminating in the Surface of the Globe in $D$ and $Q$, and if $O A$ be produc'd (biſecting $D Q$ in $B$) unto $N$, ſo that $O A$, $O B$, $O N$ $\div$ and the Globe $N S$ be deſcrib'd on the Center $O$, and the Semi-cycloids $N D$, $N Q$ be deſcrib'd within the ſaid Globe; then a Pendulum ſuſpended to the Point $N$, and equal to $N A$, will vibrate in the Cycloid $D A Q$, the ſame being deſcribed by the Evolution of the Cycloidal Cheeks $N D$, $N Q$. And thus a Pendulum may be made to vibrate in any ſuch given Cycloid.

2. If the ſaid Pendulum vibrate in the Cycloid $D A Q$ by the ſole Force of its own Gravity, and if the Force of Gravity in every Point of the Curve $D A Q$ be as its Diſtance from the Center $O$, then the Vibrations (equal or unequal) of the Pendulum, will be performed in equal times.

Let $M T$ touch the Cycloid in $M$, and draw $O X$ perpendicular to $M X$; then, becauſe the

Force

Force of Gravity is as *O M*, it may be resolved into the Parts *O X*, *M X*. Now 'tis evident, that the Force *O X*, being parallel to the Thread *P M*, has no other Effect but to distend the same, and is




totally destroyed by its Resistance; therefore the Force *M X* only accelerates the Motion of the Pendulum *M* in the Cycloid, and the Acceleration of the Pendulum in the Cycloid is always proportional to this Accelerating Force. Now the Triangles *O X T*, *M G T* are similar, and *O T* and *G T* are invariable Quantities; therefore *M X* is always proportional to *M T*, and *M T* is proportional to the Curve of the Cycloid *M A*: Therefore if two Pendulums *N P M*, *N p m* be demitted from *M*, *m* at the same Instant of Time, they they will be accelerated in proportion to the Arches *M A*, *m A*, they have to describe; and consequently the Portion of the Curve which they describe in the Beginning of their Motion, will be proportional to the Arches *M A*, *m A*; and the Portions yet to be describ'd, or the accelerating Forces, will be proportional to the said Arches *M A*, *m A*. Whence 'tis manifest, that the Portions to be describ'd, being always in the same Proportion of *M A* to *m A*, must vanish at the same time; that is, the Pendulums demitted from *M*, *m*, at the same Instant of Time, and descending in the Curve *M A*, *m A*, by the Force of their own Gravity, will arrive in the Point *A* together. And again, If we suppose the Pendules to ascend from *A* towards *Q*, with the Velocities which they have acquir'd *m A*, they will then be retarded every where, whereby the same Forces which accelerated their Motions before, and consequently the Velocities of the Pendulum's ascending and descending in the same Arches, will be the same, and the Arches themselves will be describ'd in the same time; whence it appears, that the whole Vibrations, as well as the Semi-vibrations, will always be Isochronal.

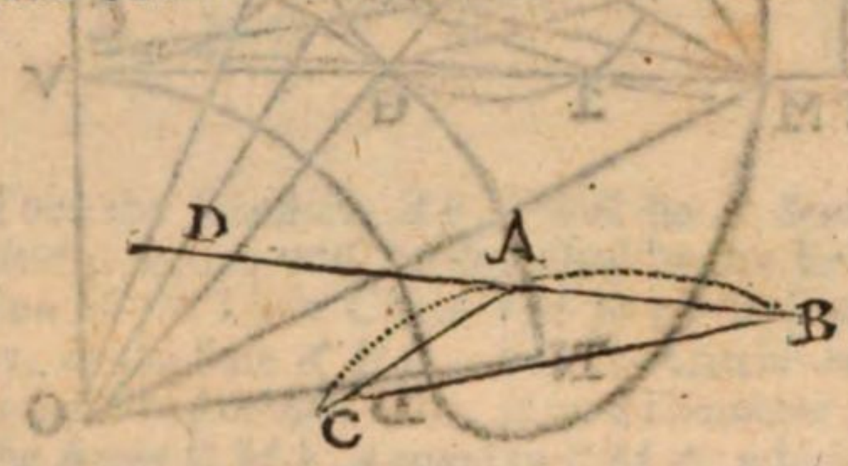
3. And if *O*, the Center of Attraction, be supposed at an infinite Distance from *B*, then the Curve *D A Q* (in which the Pendulum vibrates) will be a Vulgar Cycloid, and the Force of Gravity will always be the same in all Places of the Curve. And the Vibrations in this also will be Isochronal, for *D B Q* will become a streight Line, and *G T* and *M O* will be parallel to *B A*; whence, if *M O* be a determinate Quantity, and represent the Force of Gravity, then *M X*, or *M T*, or *M A*, will represent the accelerating Force in the Cycloid, *&c.* *Ergo*,

*The same Excellent Person has enrich'd this Theory with many more sublime Discoveries, which, for Brevity's sake, I omit; this being sufficient to give the unacquainted Reader a Taste of the Usefulness of the Doctrine concerning the Rectification of the Curves.*

## *LEMMA.*

*In every Triangle* B A C, *if the Angles* A B C, A C B, *and* C A D *the Complement of the Obtuse Angles* C A B *to two Right Angles, be infinitely little; I say, they are proportional to their opposite Sides* A C, A B, B C.

For if a Circle be circumscrib'd about the Triangle *A B C*, the Arches *A C*, *A B*, *B A C*, which measure double the said Angles, will be infinitely little also, and consequently they will be equal to their Chords or Subtendents.




And if the Sides *A C*, *A B*, *B C* of the Triangle *A B C* be finite Quantities, 'tis plain that then the circumscrib'd Circle must be infinitely great, that so the Arches *A B*, *A C*, may be infinitely little in respect of the whole Circumference.

## PROP. XIII.

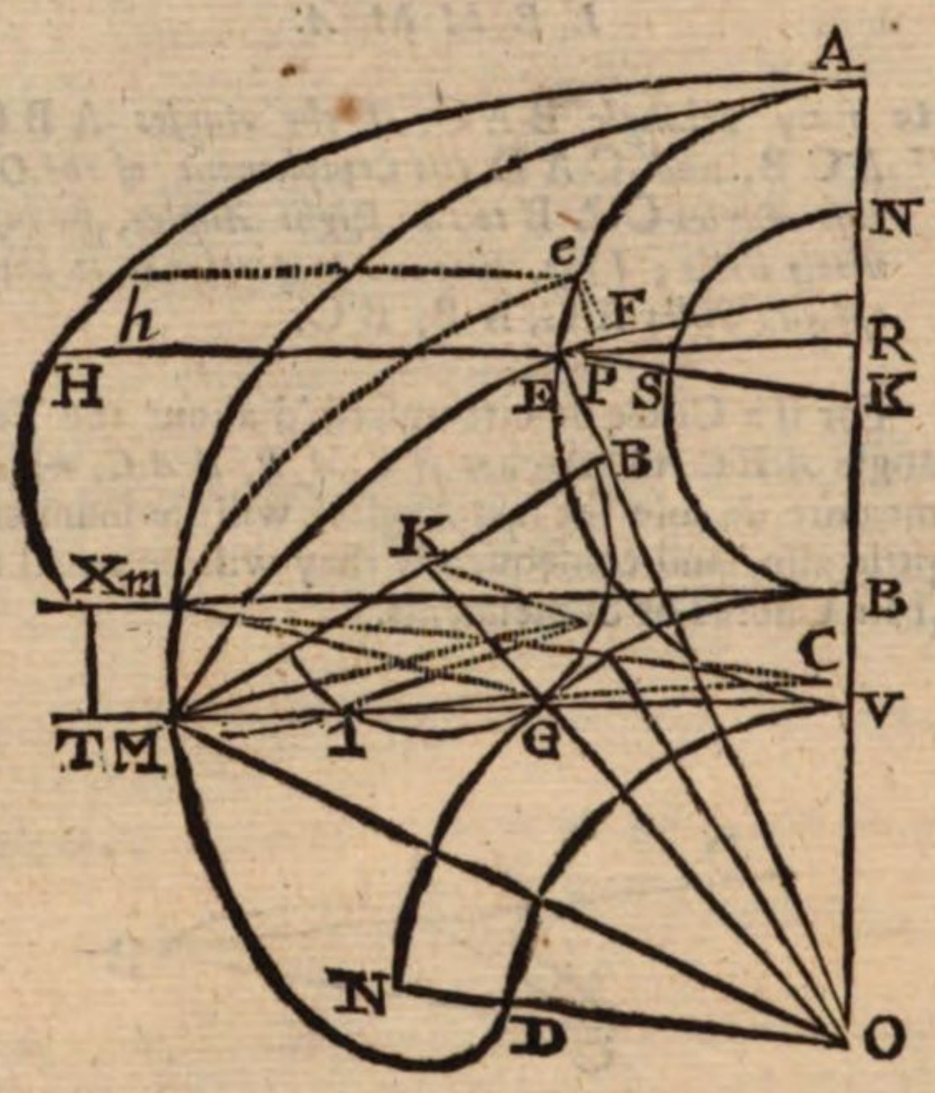
*If* A M D *be a Semi-cycloid describ'd by the Semicircle* B S N, *revolving on the immovable Arch* B G N, *so that the Evoluta or Arches* B G, B G *be always equal to one another; and if* A, *the Point which describes the Curve, be in the Diameter* B N, *within or without the Periphery of the movable Circle: 'Tis requir'd to investigate the Value of the Ray of the Evoluta* M C.

Imagine another Perpendicular *m g* infinitely near *M G*, intersecting *M G*, produced in *C*, the Point requir'd. Draw the Right Line *G m*, and take *G g* on the movable Circle = *G g* on the immovable Circle, (*see the following Fig.*) and draw the Lines *M g*, *I g*, *K g*, *O g*. Now if we consider the little Arches *G g*, *G g* is perpendicular to the Radii *K g*, *O g*, then 'tis manifest that the little Arch *G g* of the movable Circle falling the Arch *G g* of the immovable Circle, the Point *M* will fall on *m*, so that the Triangle *C M g* will exactly cover the Triangle *C M g*: Whence it is evident, that the Angle *M G m* is = *g G g*, = (because, adding to both the same Angles *K G g*, *O G g*, their Sum will be equal to two Right Angles) = *G K g* + *G O g*.

Now if we suppose *O G* = *b*, *K G* = *a*, *G M*, or *G m* = *r*, and *G I* or *I g* = *q*, then it will be, 1. *O G* : *G K* :: *G K g* : *G O g*, and *O G* (*b*) : *O G* + *G K* (= *O K* = *a* + *b*) :: *G K g* :

$GKg + GOg$ or $gGg$ or $MGm = \frac{a+b}{b}$

$GKg$. 2. $Ig : MI :: GMg : MGI$, and by Compoſition $Ig + MI$ or $MG\,(r) : Ig\,(q) :: GMg + MgI$ or $GIg = \frac{1}{2}GKg : GMg$ or $Gmg = \frac{q}{2r}GKg$. 3. $MCm$ or $MGm$, $MGm - Gmg \left(\frac{2ar+2br-bq}{2br}GKg\right) : Gmg \left(\frac{q}{2r}GKg\right) :: Gm\,(r) : GC = \frac{bqr}{2ar+2br-bq}$,




and conſequently the Ray of the Evoluta $MC$ is $= \frac{2arr+2brr}{2ar+2br-bq}$.

And if we ſuppoſe $OG\,(b)$ the Radius of the immovable Circle, to become infinite, the Circumference $BGN$ will become a ſtreight Line, and the Terms $2arr$ and $2ar$ will vaniſh in reſpect of the others, and the Value of the Ray of the Evoluta $MC$ will be $= \frac{2brr}{2br-bq} = \frac{2rr}{2r-q}$.

### CONSECTARY.

Hence to find the Area of the Cycloidal Space $MCB$, the Quadrature of the Circle being ſuppoſed, becauſe Sectors of Circles are in a Ratio compounded of the Duplicate Ratio of the Radii and the ſimple Ratio of their included Angles; it is, Angle $GMg \left(\frac{q}{2r}GKg\right)$ : Angle $MGm \left(\frac{a+b}{b}GKg\right)$ : : the little Triangle (or Sector) $MGg$ (whoſe Baſe is $Ggm$ the movable Circle) : to the little Triangle or Sector $GMm$. Whence the Sector $GMm$ is $= \frac{2r}{q} \times \frac{a+b}{b}MGg =$ (ſuppoſing $MI = s$, and conſequently $r = s+n$) $= \frac{2a+2b}{b}MGg + \frac{2as+2bs}{bq}MGg$.

Now the little Triangle or Sector $KGg$ is to the little Triangle $MGg$, in a Ratio compounded of the Square of $KG$ to the Square of $MG$, and the Ratio of the Angle $GKg$ to the Angle $GMg$, that is, as $aa \times GKg$ to $rr \times \frac{q}{2r}GKg$; and conſequently the little Triangle $MGg$ is $= \frac{rq}{2aa}KGg$, and ſubſtituting this Value in place of the Triangle $MGg$ in $\frac{2as+2bs}{bq} \times MGg$, we ſhall have the Sector $GMm = \frac{2a+2b}{b}MGg + \frac{\overline{a+b} \times sr}{aab}KGg$; but by the Property of the Circle, $GM \times \overline{MI\,(sr)} = BM \times MN =$ (ſuppoſing $KN = c$) $cc - aa$, which is an invariable Quantity, and is always the ſame in whatſoever Point of the Curve the deſcribing Point $M$ be found; whence $GMm + MGg$ or $mGg$, that is, the Trapezium $GMmg = \frac{2a+3b}{b}MGg + \frac{\overline{a+b} \times \overline{cc-aa}}{aab}KGg$. Now becauſe $GMmg$ is the Fluxion of the Cycloidal Space $MGBA$ and $MGg$, that of the Circular Space $MGB$ (comprehended between the Right Lines $MB$, $MG$, and the Arch $BG$) and $KGg$, that of the Sector $KBG$; it is manifeſt that the Cycloidal Space $MGBA$ is $= \frac{2a+3b}{b}MGB + \frac{\overline{a+b} \times \overline{cc-aa}}{aab} \times KGB$. Q.E.I.

### LEMMA II.

*The ſame things being ſuppoſed, if on the Center* K, *with the Radius* KA, *the Semi-circle* AEV *be deſcribed; and if on the Center* O, *with any Radius between* OV *and* OA, *the Arch* EM *be deſcrib'd, and the Radius* KSE *be drawn; I ſay, the Arch* EM : *Arch* SN :: OE : OB.

Suppoſe the movable Circle $BSN$ to come into the Poſition $BGN$, then the Point $A$ which deſcribes the Curve will be in $M$. Connect the Centers of the Generating Circles with the Line $OK$, which will paſs through the Point of Contact $G$; then 'tis evident that the Triangle $MOK$ and $EOK$ are equal and ſimilar, becauſe the Sides of one are equal to the reſpective Sides of the other; therefore the Angles $MKO$, $EOK$ are equal, and the Arches that meaſure thoſe Angles, *viz.* $GN$, $BS$, and their Complements to two Right Angles $BG$, $SN$, are alſo equal. And becauſe the Angles $MOK$ and $EOK$ are equal, therefore the Angle $MOE$ is $=$ Angle $GOB$, and Arch $EM$ : Arch $GB$ :: $OE$, the Radius of that : $OB$ the Radius of this. But it has been demonſtrated that the inferior Arch $GB =$ ſuperior Arch $GB$ is $= SN$; therefore the Arch $EM$ : Arch $SN$ :: $OE$ : $BB$. Q.E.D.

### CONSECTARY.

If the Radius $OB$ be ſuppoſed infinite, then 'tis evident that the Right Lines $OB$ and $OE$ will be Parallels, and the Concentrick Arches $VD$, $BN$, and $EM$, will degenerate into Right Lines $VT$, $BX$, and $EH$, perpendicular to the Axis $VA$, and conſequently the Right Line $EH$ will be $= SN$, becauſe $OB$ and $OE$ being infinite, are

are equal. Whence the Arch $EM : EH :: OE : OB$.

*SCHOLIUM.*

The Semi-cycloid $AHT$, into which the other Semi-cycloid $AMD$ degenerates, when the Radius $OB$ is infinite, is the same with that generated by the Revolution of the Semi-circle $BSN$ on the Right Line $BX$, the describing Point $A$ being in the Diameter $BN$ produc'd.

## PROP. XIV.

*The same things being suppos'd, let it be requir'd to investigate the Area of the Cycloidal Space* AEM, *comprehended under the Arches* AE, EM, *and the Portion of the Cycloid* AM.

Imagine another Concentrick Arch $ME$ infinitely near to the Arch $EM$, and $eh$ parallel and infinitely near to $EH$, and the Lines $EF$ and $EP$ perpendicular to the Arch $ME$ and the Right Line $EH$ (produced if need be); then are the Angles $FEe$, $OEK$ equal, because each added to the Angle $KEF$ makes a Right Angle, and the Angle $PEe$ is = Complement of $OKE$ to Two Right Angles, because $PEe + eEK + KER$ is = to Two Right Angles = $KER + EKR + EKR$; therefore the Sine of the Angle $FEe$ is to the Sine of the Angle $PEe$, as the Sine of the Angle $OEK$ is to the Sine of the Angle $OKE$: That is,

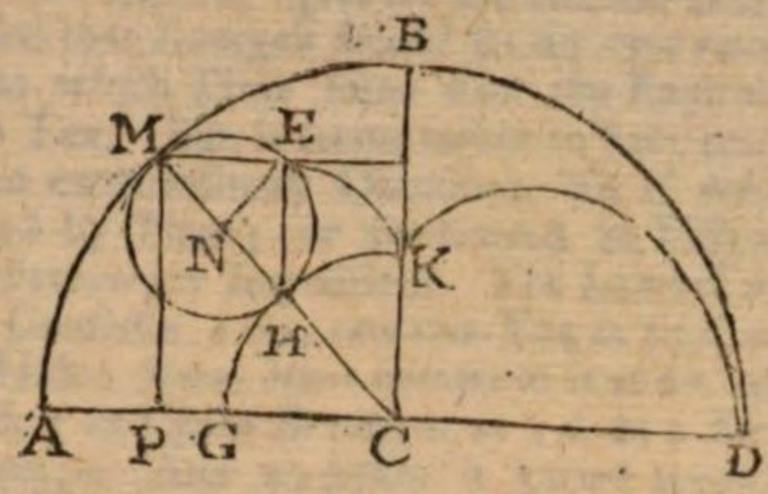
$$Fe : Pe :: OK : OE;$$

And by the Corol. of the preceding Lem. $\}$ $EM : EH :: OE : OB$.

Therefore $Fe \times EM : Pe \times EH :: OK : OB$.

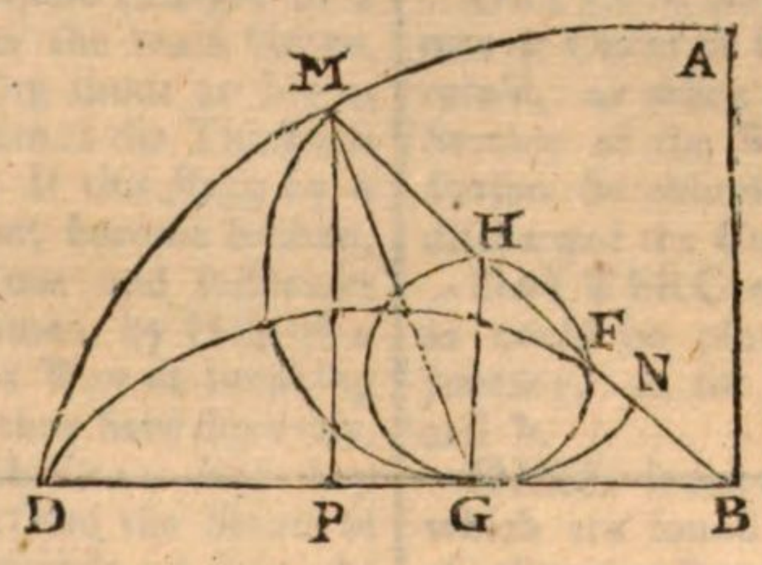
And because the infinitely little Spaces $EMme$, $EHhe$ are equal to the Products or Rectangles $Fe \times EM$, $Pe \times EH$ respectively, and the said Rectangles are always in the same Proportion to one another, that is, the Space $EMme$ is always to the corresponding Space $EHhe$, as $OK$ is to $OB$; 'tis plain that the Sum of all the $EMme$ is to the Sum of all the $EHhe$, that is, the Space $AME$ is to the Space $AEH$, as $OK$ is to $OB$.

I shall only add further, as to this Figure of the *Cycloid*; That, if a *Caustick Curve*, as $AFK$, were to be drawn to a Semi-circle, as $AMD$, whose Diameter is $AD$, and its Centre $C$: And when the Rays of Incidence, as $PM$, are supposed to be perpendicular to the Diameter $AD$:




Then the Caustick $AFK$ will be a *Semi-Cycloid*; which will be described by the Revolution of the Little Circle $MFH$ on the Periphery, or the Base $KHG$. For the Circle $MFH$ is described on half $MC$, as on a Diameter; and the Angle $CMF$ is equal to $CMP$, which is equal to $HCK$: And consequently the Angle $HNF$ is equal to twice $HCK$. Therefore the Arch $HF$ is equal to the Arch $HK$; and the Curve $KFA$ must be a Semi-cycloid, whose Beginning is in $K$, and its Vertex in $A$.

Let the Vulgar Semi-cycloid $AMD$ be given, and described by the Revolution of the Semi-circle $NGM$ on the Right Line $BD$: And let the Rays of Incidence $PM$, be parallel to the Axis $AB$: 'Tis required to draw a Caustick by Reflexion to the said Semi-cycloid $AMD$.



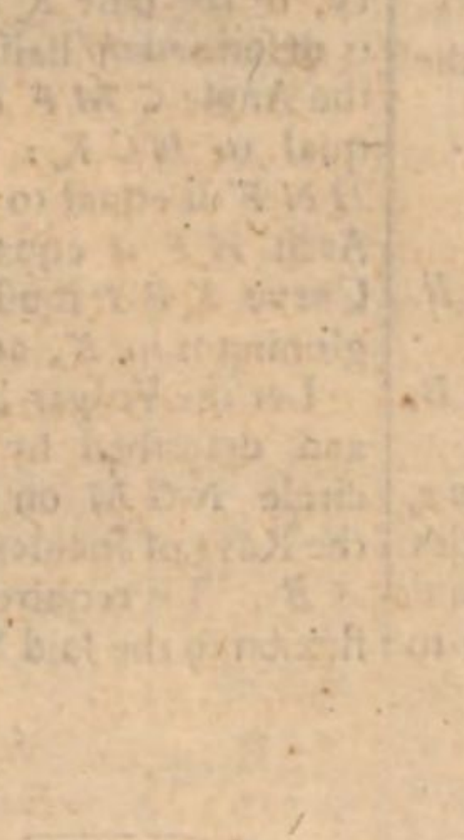

Because $MG$ is = $\frac{1}{2}$ the Ray of the *Evoluta*, and $GP$ perpendicular to $PM$: Therefore $MF = \frac{1}{2}a = PM$. Whence if $GF$ be drawn perpendicular to the reflected Ray $MF$, the Point $F$ will be in the Curve required.

If the Rays $HM$, $HG$, be drawn from $H$, the Center of the generating Circle, to the describing Point $M$, and the Point of Contact $G$; 'tis evident that $HG$ will be perpendicular to $BD$; and that the Angle $GMH = MGH = GMP$; whence it appears, that the reflected Ray $MF$ passes through the Centre $H$. Now the Circle whose Diameter is $GH$ passes also through the Point $F$; because $GFH$ is a Right-Angle: And therefore the Arches $GN$, and half $GF$, which measure the Angle $GHN$, are proportionable to the Diameters $MN$, $GH$, of their respective Circles: And consequently the Arch $GF$ = Arch $GN = GB$. Whence it is manifest, that the *Caustick* $DFB$ is a *Cycloid*, and describ'd by the Revolution of the Circle $GFH$ on the Right Line $BD$. *Q. E. D.*

### *COROLLARY.*

The Space *D A B F D* is equal to thrice the Area of the Circle *G F H*: For the Semicircle *M G N* is equal to twice the Area of the Circle *G F H*: Wherefore the Cycloidal Space *A M D B* is equal to 6 times the Area of the Circle *G F H*; and the Cycloidal Space *B F D* is equal to thrice the Area of the Circle *G F H*; and consequently the Space *D A B F D* is equal to thrice the Area of the Circle *G F H*; and the Curve *D F B* divides the Space *A M B D* into two equal parts.





DAKIR, by the Statute of 23 *H.* 3. *de compositione Ponderum, &c.* was a Number of Ten *Hides*, as a *Last* was of 20 *Dakirs*: But since, by 1 *Jac.* 33. a *Last* of *Hides* is 12 Dozen.

DAMNUM, did formerly signifie the Bounds or Limits of a Man's private Property or Jurisdiction; as is plain by *Bracton, lib.* 2. *de Coron. c.* 37. And perhaps our Word *Dam*, for a Boundary or Confinement came from hence.

DAMPS, in Mines, are noxious Exhalations, which in some Mines have proved very suffocating, and otherwise fatal to the Workmen. They reckon four Sorts of Damps.

The *First* is the most ordinary; they know when 'tis coming, by the Flame of their Candles becoming orbicular, and by the Flames lessening by degrees, 'till at last it quite go out; as also by their Shortness and Difficulty of Breathing. Those that escape Swooning, seldom suffer any great Harm by it; but such as swoon away, tho' they miss of downright Suffocation, are on their first Recovery tormented with very violent Convulsions. Their Way of Cure is to lay the Person down on the Earth in a prone Posture, with a Hole dug in the Ground under his Mouth; if this fail, they fill him full of good Ale; and if that won't do, they conclude him desperate.

2. The *Pease-Bloom Damp*, which is so called from its Smell; this *Damp* they say always comes in the Summer Time, and it hath not been known to be *Mortal.* The Miners in the *Peake* of *Derby* fancy it arises there from the Multitude of *Red Trefoil Flowers*, called by them *Hony-suckles*, with which the Lime-stone Meadows of the *Peake* do much abound. Perhaps the Smell of this gives timely Notice to get out of the Way.

3. The *Third* is the most Pestilential and the most Strange of all, if what they say of it be true: They which pretend to have seen it, (for 'tis visible they say) do thus describe it: In the highest Part of the Roof of those Passages in a Mine which branch out from the main Grove, they see a round Thing hanging about as big as a Foot-ball, covered with a Skin of the Thickness and Colour of a Cobweb: If this Bagg by a Splinter, or any other Accident, become broken, the *Damp* immediately flyes out and suffocates all the Company: The Workmen, by Help of a Stick and a long Rope, have a Way of breaking this at a Distance; and when they have done this, they purifie the Place well with Fire: And they will have it, that it gathers from the Steam of their Bodies and Candles, ascends up into the highest Part of the Vault, and there condenses, and in Time hath a Film grows over it, and then corrupts and becomes Pestilential.

4. The *Fourth* is the *Fulminating* or *Fire-Damp*, whose Vapour being touch'd by the Flame of the Candles, presently takes fire, and hath all the Effects of Lightning or fired Gunpowder. These are found frequently in the Coal-Mines, and sometimes, tho' rarely, in the *Lead* ones.

DANEGELT, or *Geld*, was a Tribute which the *Danes*, on their frequent Incursions imposed upon the *English* as the Arbitrary Terms of Peace and Departure. It was first imposed as a continual yearly Tax upon the whole Nation under K. *Ethelred*, *A. D.* 991. *Ælfred* and *Ingulgh* report, that King *Edward* the Confessor remitted and abrogated this Tax: But *William* the Conqueror, tho' he would not re-induce the Annual Payment, yet he ordered the raising of it, as often as the Necessities of Invasion or Expedition did require: And it was severely exacted and augmented by *William Rufus.* In the Reign of *Hen.* I. it was computed amongst the King's standing Revenues: But K. *Stephen*, upon his Coronation-Day, promised that *Danegelt* should be for ever remitted; from which Time some date the Expiration of this Tax. But it seems rather to have continued upon extraordinary Occasions, 'till it was abrogated by Time; or swallowed in Tillage and Parliamentary Impositions. The Laws of *Edward* the Confessor, *c.* 11. rate this Tax at 12 *d.* on every Hide: *Henry Hunt* computes it at 2 *s.* on each Hide; and *John Bramptou* at 3 *d.* on a *Bovate* or *Oxgange.* And no doubt it varied according to the different Exigencies on which it was levied. Dr. *Kennet's Glossary.*

DANGER, *Dangerium*, in some Places called *Lief-Silver* and *Lef-Silver*, was formerly a Payment of Money made by the Forest Tenants to their Lords, that they might have Leave to plow and sow in Time of *Pannage* or Mast-feeding.

DARREINE, in the Common Law, seems to be a Corruption from the French *Dernier*, *i. e. Last*; for 'tis now used in that Sense, in

DARREINE, *Continuance*: And

DARREINE, *Presentment.*

DATIRE *Tutelage*, is a Term in the Civil Law, for such a Tutelage of a Minor as is appointed by the Magistrate either *Ex Officio*, or by Petition, when a Guardian by *Will*, or by *Law*, is not already provided.

DAY, in our Common Law, is sometimes used for the Day of Appearance in Court, either Originally or on Assignation; and sometimes for the Return of Writs. Thus

DAYES *in Bank*, are Days set down by Statute or Order of Court, when Writs shall be return'd, or when the Party shall appear on the Service of the Writ. They say also, That if a Person be dismissed without *Day*, he is finally discharged the Court.

DAYWERC *of Land*, was anciently as much as could be plowed up in one Day's Work or Journey, as the Farmers in some Places still call it.

DAZE, is one of the *Weeds*, as they call them, which are found in our Tin Mines; 'tis a kind of glittering Stone enduring the Fire; and is of different Colours, as White, Black and Yellow. It seems to be a Spar.

DEAN. Originally the *Decanus*, was so called, because he was an Ecclesiastical Magistrate, which had Jurisdiction and Power over Ten Canons at least. He is next under the Bishop, and ordinarily Chief of the Chapter in a Cathedral Church.

As there are Two Foundations of Cathedral Churches, the *Old* and the *New*, (the *New* being those which *Henry* the Eighth founded on the Suppression of the Abbots and Priors, and turned their Convents into Dean and Chapter;) so there are Two Ways of Creating these Deans.



For

For those of the *Old* Foundation, are brought to their Dignity much like a Bishop: The Prince first sending out his *Conge d' Eslire* to the Chapter; the Chapter there chusing, the King yielding his Royal Assent, and the Bishop confirming him, and giving his Mandate to install him.

Those of the *New* Foundation are installed by a shorter Course; only by the King's Letters Patent, without either Election or Confirmation.

The Word *Dean* is also apply'd to divers that are the Chief of some peculiar Churches or Chapels; as Dean of the King's Chapel, of *Paul's*, of *Westminster*, of the *Arches*, of *Battel*, of *Boking*, &c.

DEAN *Rural*, or *Urban*, call'd *Decanus Christianitatis*, was formerly an Ecclesiastical Person, who had the District of ten Churches either in the Country or City, within which he exercised a useful Jurisdiction. These *Rural Deans* were sometimes called *Archipresbyteri*, and at first were both in Order and Authority above the Archdeacons. They were elected by the Clergy, and by their Votes again deposed; but afterwards they were appointed and remov'd at the Discretion of the Bishop: And hence they were called *Decani Temporarii*, to distinguish them from the Cathedral Deans, who were called *Decani perpetui*.

DEADS, in the Tin-Miners Language, are such Parcels of common loose Mould or Earth lying above the *Shelf*, as usually contain the *Shoad*, which they find when they are training a *Load*. They call also that part of the *Shelf* which contains no *Oar* or Metal, but encloseth the *Load* as a Wall between two Rocks, by this *Name*. See *Tin*.

In the *Mendip* Lead-Mines; when a Vein of *Oar* breaks off abruptly in an Earth, they call it a *Deading-Bed*; and Earth without an *Oar* they call *Dead Earth*.

DEAD *Ropes* in a Ship, are such as are not running, *i. e.* which do not run in any Block.

DECIMAL *Scales*, (*Vide Leybourne's Cursus*, *p.* 174.) are in the General any Scales that are divided Decimally. But for the expediting of Decimal Arithmetick, there are in use some *Scales* of Money, Weights, Measures, which are made from Tables bearing those Names, and serve readily, by Inspection only, to shew you the Decimal Fraction which properly belongs to any part of Money, Weight, or Measure, *&c.* These Scales are usually placed on a square Ruler, and are about Nine in Number:

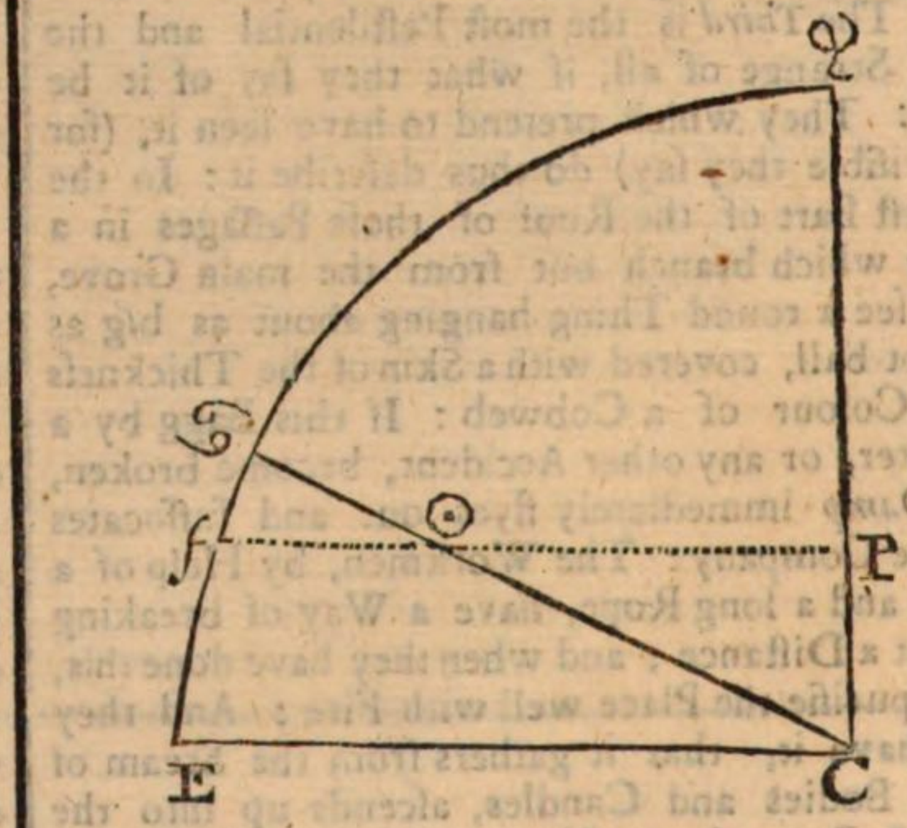
1. One of *English* Coin, 2 Shillings being the Integer.
2. *Troy* Weight, 2 Peny-weight being the Integer.
3. *Averdupois* Great Weight, 28 *lb.* being the Integer.
4. *Averdupois* Little Weight, 16 *oz* or 1 *lb.* being the Integer.
5. Liquid Measure, 36 Gallons being the Integer.
6. Dry Measure, 8 Bushels being the Integer.
7. Long Measure, one Ell or Yard being the Integer.
8. Foot Measure, where 12 Inches is the Integer. And,
9. Time and Motion, where one Hour, Minute, *&c.* may be the Integer.

To every one of these there is joined another Decimal Scale, divided into 100 or 1000 equal Parts; so that if you look on any Division in any of the Nine Scales, you may easily see what Division, or part of a Division, answers to it in the adjacent Decimal Scale: And consequently it will very readily shew you what Decimal Fraction answers to any Part of Money, Weight, Time, Measure, *&c.* as well as it will give the Value of any Decimal Fraction in the Corresponding Parts of any Integer. Thus if in the *Money Scale* you take out any Part of 2 Shillings, as suppose 8 Pence 3 Farthings, you will find the Corresponding Decimal to be .364. Or if in the Decimal Scale contiguous to it, you would know what Part of 2 Shillings answers to this Decimal Fraction .771, you will find the Corresponding Point in the Money Scale to be 18 Pence 2 Farthings. And so for the rest.

DECINERS, or *Decenniers*, or *Definers*. *Decennarii*, in our Old Law, where such as had the Jurisdiction over 10 *Friburghs* for keeping the King's Peace; and the Limits or Compass of their Jurisdiction was called a *Decenna*, saith *Bracton*, *Lib.* 3. *Tract.* 2. *Cap.* 15. In the *Saxons* Times, these seems to have had large Authority, taking Cognisance of Causes within their Circuit, and redressing Wrongs by way of Judgment. In latter Times, the Word came to signifie such an one, as by Oath of Loyalty to his Prince was settled in the Combination or Society of such a *Dozein*; and a *Dozein* seems then to be extended as far as a *Leet*, because in *Leets* only this Oath is administred by the Steward, and taken by all from 12 Years old and upward that dwell within the Leet. Now there are no *Decenniers*, but *Leets*.

DECK *Nails*, are such as are used for fastening Decks of Ships, doubling of Shipping, and for Floors laid with Planks: They are of two Sorts, *Dye-headed* and *Clasp-headed*. Their Sizes are from 4 to 9 Inches.

DECLINATION *of the Sun*. To find it readily by Projection of Part of the *Analemma*; having his Place in the Ecliptic, and his greatest




Declination: Draw *E C* for the Equinoctial, and *P C* for the Azimuth of East and West, and with 60 *Deg.* of the Chords sweep the Ark *E P*. Set 23 *Deg.* 30 *Min.* the Sun's greatest Declination, from *E* to ♋, and draw ♋ *C* for one Quadrant of the Ecliptic. Set the Sine of the Sun's Longitude, or Distance from the next Equinoctial Point from *C* to ⊙ in the Ecliptic *C* ♋, being, suppose, 42 *Deg.* then will the nearest Distance from ⊙ to *E C*, be the *Sine* of the Sun's present Declination = to *P C* = to the Ark *F E*, measured on the Chords.

DECREE, in the Civil Law, is a Determination that the Emperor pronounces, upon hearing a particular Cauſe between Plaintiff and Defendant.

DECRETALS, are a Volume of the Canon Law, containing the Decree of ſundry Popes; or elſe a Digeſt of the Canons of all the Councils pertaining to one Matter and under one Head.

DEDI, is a Warranty in Law to the Feoffee and his Heirs; as if it be ſaid in a Feoffment, *A. B.* has *given* and granted, *&c.* they call it a *Warranty.*

DEEMSTERS, are a kind of Judges in the *Iſle of Man*, choſen from among and by themſelves, who without Proceſs, Writing, or Charge, decide all Controverſies there.

DEFAULT, is a Neglect or Omiſſion of Appearance before a Court of Juſtice, for which Judgment may be given againſt the *Defaulter.*

DEFEND, in our Ancient Laws and Statutes, ſignified to prohibit and forbid: *Leg. Edw. Confeſſ. c.* 37. and 5 *R.* 2. *c.* 7. And in this Senſe *Chaucer* alſo uſes it.

DEFERENTIA *Vaſa.* See *Vaſa Deferentia.*

DEFICIENT *Hyperbola*, is a Curve of that Name, having but one Aſymptote, and only two Hyperbolick Legs running out infinitely towards the Side of the Aſymptote, but contrary Ways. See *Curves.*

DEFLECTION *of the Rayes of Light*, is a Property which Dr. *Hook* obſerved 167$\frac{4}{5}$, and read an Account of it before the Royal Society, *March* 18. the ſame Year. He ſaith, he found it different both from Reflection and Refraction, and that it was made towards the Surface of the opacous Body perpendicularly. This is the ſame Property which Sir *Iſaac Newton* calls *Inflection*; of which, ſee an Account under that Word.

DEFORCEMENT, in the Law Senſe, is with-holding Lands or Tenements by force from the Right Owner. Wherefore a

DEFORCEOR, is he that overcometh and caſteth a Perſon out by Force.

DEFORCIATIO, is a Diſtraint or Seizure of Goods for Satisfaction of a Lawful Debt. In Aſſizes and Trials formerly, the *Claimer* or *Plaintiff* was called *Quærens*, and the *Poſſeſſor* or *Defendant* was called *Deforcians*: Tho' indeed the Original Senſe of the Verb *Deforciare* is to keep Poſſeſſion ones ſelf, or to turn another out of his by Violence and Force.

DEGRADING, or, as it has ſometimes been written, *Diſgrading*, is the Puniſhment of a Clerk, that being deliver'd to his Ordinary, can't purge himſelf of the Offence whereof he was convicted by the Jury; and it is the Privation of him from thoſe Holy Orders which he had, as of *Deacon*, *Prieſt*, *&c.*

Formerly alſo Knights have been degraded. See 18 *E.* 2.

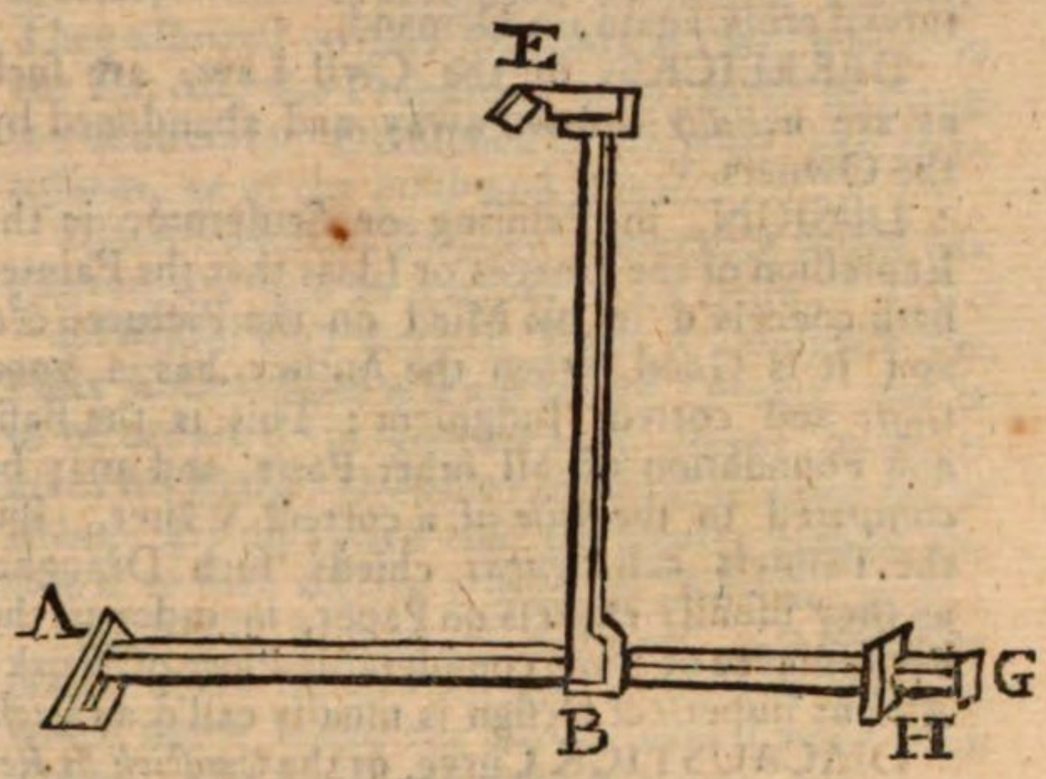
In the Common Law alſo there are two Sorts of *Degrading*; one *Summary*, by Word only; the other *Solemn*, by diveſting the Party *degraded* of thoſe Ornaments and Rites, which are the Enſigns of his Order and Degree. *See.* 13 *Car.* 2. *c.* 15.

DEGREE *of a great Circle*, on the Surface of the Earth (ſuppoſing it be of a Spherical Figure) is 69 *Engliſh* Miles and 288 Yards; as appears by the Concurrent Menſurations, nearly, of Mr. *Norwood* and the *French* Mathematicians. The *French* make a Degree 365184 Feet *Engliſh*, and Mr. *Norwood* 367196, the Difference being only 597 Yards, or 1791 Feet: And from hence, the Circumference of the Earth will be 24899 *Engliſh* Miles.

DELEGATION, in the Civil Law is a kind of *Novation*, whereby a Debtor appoints one that is Debtor to him, to anſwer a Creditor in his Place.

DEMANDANT, is the Plantiff in a real Action, and ſo called becauſe he demandeth Lands, *&c.*

DEMICROSS, is an Inſtrument, uſed by the *Dutch* to take the Sun's Altitude, or that of a Star at Sea; but 'tis not uſed by us, but the Croſs-ſtaff or Fore-ſtaff ſupplies its Place. The *Demi-croſs* is of this Figure;




The Staff *A G* is graduated eaſily, being only a Line of whole Tangents, whoſe Radius is *E B*, the Length of the Croſs-piece or *Tranſum*: It hath three Vanes; a Horizon-Vane, as *A*; a Sight-Vane, as *H*; and the Shade-Vane, as *E.*

When the Vanes are on the Staff and Croſs-piece, to take the Sun's Altitude, hold the Inſtrument with the Tranſum as upright as you can, and looking through the Sight-Vane, as *H*, look for the Horizon through the Slit in the Horizon-Vane, and then ſlide the Croſs-piece or Tranſum to and fro, 'till you cauſe the Shade of the Vane at *E* to fall at the ſame Time upon the Slit of the Horizon-Vane alſo at *A*; then are the Degrees cut on the Staff by the Edge of the Croſs-piece, the Sun's Altitude required. But to take the Height of a Star; you muſt remove the Horizon-Vane *A*, and put it on the End *G*, and transfer the Sight-Vane *H* to *A*; then holding up the Inſtrument upright, as before, looking through the Sight-Vane, ſee for the Horizon through the Horizon-Vane, and for the Star by the Shade-Vane, ſliding the Tranſum to and fro, 'till the Horizon and Star are both ſeen by their reſpective Vanes, and then the Tranſum will cut the Degrees of the Star's Altitude on the Staff, allowing about 8 or 10 Minutes for your Height above the Level of the Water, as muſt be done in all ſuch Caſes.

DENARII *de Caritate*, were the Pentecoſtals or Whitſun-Farthings, being anciently cuſtomary Oblations made to the Cathedral Church at the Time of *Pentecoſt*, when the Pariſh Prieſts and their People uſed to go viſit the Mother Church. In proceſs of Time this voluntary Oblation came to be claimed as a ſettled Due, and was charged on the Pariſh Prieſt, and it is now annually paid to the Biſhop in ſome Dioceſes.

DENARIUS. See *Penny.*

DE *deoneranda pro Rata Portionis*, is a Writ that lieth where one is diſtrained for a Rent that ought to be paid by others *proportionably* with him.

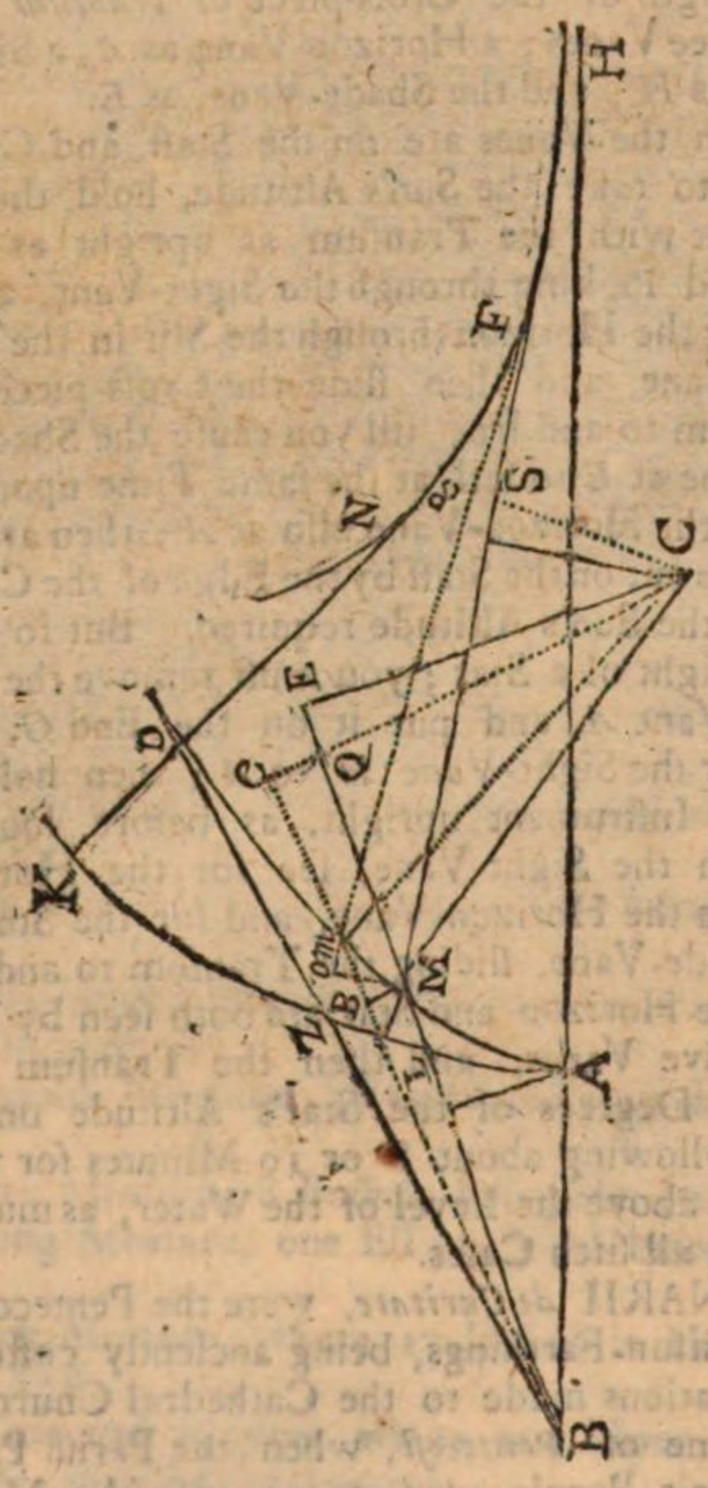
DEPARTURE, in Navigation, is the Eaſting or Weſting of a Ship with reſpect to the Meridian it *departed* or ſail'd from. Or 'tis the difference of Longitude (either Eaſt or Weſt) between the preſent Meridian the Ship is under, and that where the laſt Reckoning or Obſervation was made: This *Departure*, any where but under the Æquator, muſt be accounted according to the Number of Miles in a Degree proper to the Parallel the Ship is under. *See Mercator's Sailing.*

DEPOSITUM, in the Civil Law, is a Contract of the Law of Nations, by which a Thing is committed to the Cuſtody of one to be kept, without any Reward, on Condition to be returned truly again on Demand.

DERELICKS, in the Civil Law, are ſuch as are *wilfully* thrown away and abandoned by the Owners.

DESIGN, in Painting or Sculpture, is the Expreſſion of the Images or Ideas that the Painter hath conceiv'd in his Mind on the Picture, *&c.* and it is Good, when the Author has a good *Guſto* and correct Judgment: This is the Baſis and Foundation of all other Parts, and may be compared to the *Stile* of a correct Writer. But the Painters call *Deſigns* chiefly ſuch Draughts as they uſually expreſs on Paper, in order to the Performance of ſome conſiderable Piece of Work: A feint imperfect Deſign is uſually call'd a *Sketch.*

DIACAUSTICK Curve, or the *Cauſtick by Refraction.* If you imagine an infinite Number of Rayes, *B A*, *B M*, *B D*, *&c.* iſſuing from the




ſame Luminary Point *B*, to be refracted from or to the Perpendicular *M C*, at the Curve *A M D*; and ſo that *C E*, the Sines of the Angles of Incidence *C M E*, be always to *C G*, the Sines of the refracted Angles *C M G*, in a given *Ratio*; then the Curve Line *H F N*, which touches all the refracted Rays, is called the *Diacauſtick*, or Cauſtick by Refraction. How to find theſe *Cauſticks by Refraction* to all Sorts of Curves, ſee *Hayes's Fluxions*, *p.* 243, *&c.* where alſo the Doctrine of the *Foci* of Spherical Glaſſes of all Sorts, expoſed either to diverging, converging, or Parallel Rayes, is deduced from the Principles of the Cauſtick Curves. *Vid. p.* 249. Of the Relation of this Diacauſtick Curve to the *Evoluta*, ſee a Diſcourſe of Mr. *James Barnoulli* in the *Leipſick* Acts of *May*, 1693.

DIACENTROS, is a Word uſed by *Kepler*, to ſignify the ſhorteſt Diameter of the Elliptical Orbit of any Planet.

DIAGLYPHICE, is the Art of Cutting, or otherwiſe making hollow or concave Figures in Metals; ſuch as Seals and *Intaglias's.*

DIALLING. Some Authors on this Subject are,

*F. Bapt. Benedicti, de Re Gnomonica.*
*Kercheri, Ars magna Lucis & Umbræ. Rom.* 1646.
*Marignani Perſpectiva Horaria.*
*Leybourn's* Dialling.
*Colling's* Geometrical Dialling.
*Cir. Clavii Gnomonices, Libri* 8. Fol.
*Voellus de Sciotericis Horologiis.*
*Cæſtii Horologiographia Plana.*
*Hollwell's* Dialling. 4*to.*
*Fr. Comondini de Horologio Deſcriptione.* 4*to.*
*Sargue's* Univerſal Way of Dialling.
*Foſter's* Elliptical Horologiography.
*Fale's* Art of Dialling.
*Wells's* Art of Shadows. 8*vo.*

DIALLING in a *Mine*, which they call alſo *plumming*, is uſing a *Compaſs* (which they call a *Dial*) and a long Line, to know which Way the *Load* or Vein of Oar inclines, or where to ſink an *Airſhafe*, or to bring an Adit to a deſired Place. See the Manner of it under the Word *Tin.*

DIALLING *Lines or Scales*, are ſuch graduated Lines as being placed on Rulers or the Edges of Quadrants, and other ſuch like Inſtruments, are deſigned to expedite the Conſtitution of all Kind of Dials.

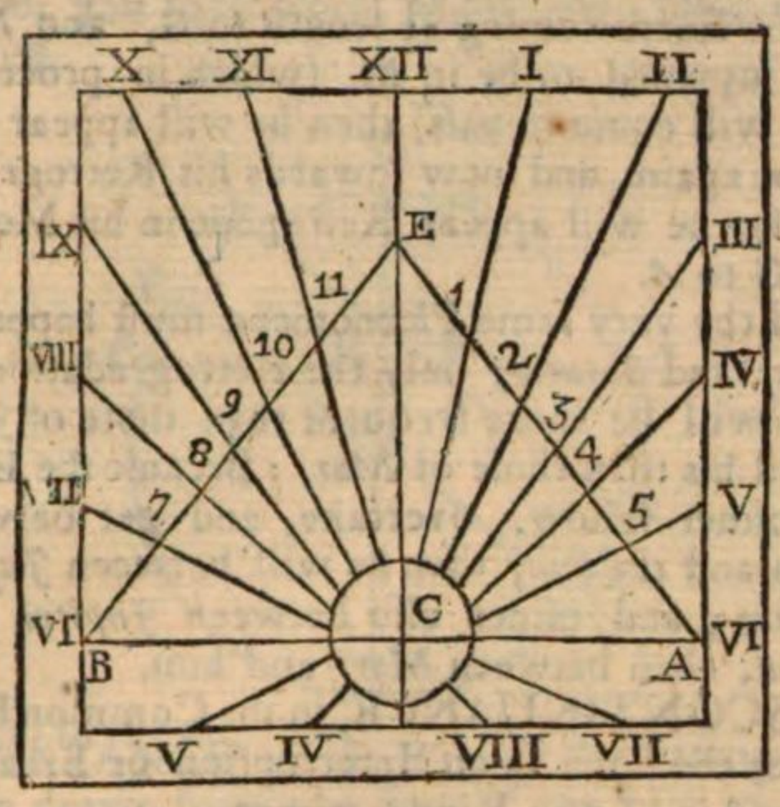
Theſe Lines are,

1. *A Scale of ſix Hours*; which is only a double Tangent, or 2 Lines of Tangents, each of 45 *Deg.* ſet together in the Middle, and equal to the whole Line of Sines, with the Declinations ſet againſt the Meridian Altitudes, in the Latitude of *London*, ſuppoſe, or whatever Place elſe it is made for. The Radius of which Line of Sines, is equal to the Dialling Scale of ſix Hours.

2. *A Line of Latitudes*; which is fitted to the *Hour Scale*, and is made by this Canon: *As Rad.: to the Chord of* 90 *Deg.:: So are the Tangents of each reſpective Degree of the Line of Latitudes: to the Tangents of other Arks.* And then the natural Sines of thoſe Arks are the Numbers, which taken from a Diagonal Scale of equal Parts, ſhall graduate the Diviſions of the Line of Latitudes to any Radius.

The Line of Hours and Latitudes is general for pricking down all Dials with Centres: As ſuppoſe. 1. an Horizontal Dial for the Latitude of *London*, 51 *Deg.* 30 *Min.* Draw *C E* for the Hour Line of 12, and croſs it at Right Angles with *AB*. Then out of the Scales of Latitudes ſet off *C B* and *C A* each equal to 51 *Deg.* 30 *Min.* or the Stile's Height. Then take the whole Scale of ſix Hours, and ſet it from *A* to *E*, and from *B* to *E*, dividing thoſe two Lines *A E* and *B E* with the Compaſ-

Compaſſes accordingly; as you ſee in the Figure:




Then Lines drawn from *C*, the Center of the Dial, through thoſe Points 1, 2, 3, 4, 5, and 11, 10, 9, 8, 7, *&c.* ſhall be the true Hour Lines. And this is a very ready and eaſy way to deſcribe the Hour Lines on any Plane.

See *Collin*'s *Sector on a Quadrant.*

The other Scales are particular, and give the ſeveral Requiſites for all upright declining Dials by Inſpection.

They are theſe:

3. A Line of Chords.
4. A Line for the Subſtile's Diſtance from the Meridian.
5. A Line for the Stile's Height.
6. A Line of the Angle of 12 and 6.
7. A Line of Inclination of Meridians.

When theſe are placed all together on a Ruler in order as they ſhould be;

Count the Plane's Declination in the Line of Chords, and then a Square laid over it will interſect all the other Lines in their proper Points: Or you may open the Compaſſes to the Planes Declivation in the Chords, and then that Diſtance will find all the reſt in the other Scales. Thus, ſuppoſe a Plane decline 35 *Deg.* from the Meridian, then all the Requiſites by theſe Scales will be found thus:

| | *Deg.* | *Min.* |
|---|---|---|
| The Subſtile's Diſtance from the Meridian . . . . . | 24 | 30 |
| The Stile's Height . . . . . | 30 | 38 |
| The Inclination of Meridians . . | 41 | 49 |
| The Angle of 12 and 6 . . . . | 84 | 10 |

All which previous Requiſites being found, the Dial may be drawn eaſily and readily by applying in the Hour Scale by the Help of the Line of *Latitudes* and the *Subſtilar Line*, as *Collins* ſhews how to do in his Sector on a Quadrant, *p.* 268. or by any other Method of deſcribing Hour Lines on a given Plane.

DIAMETER *of Gravity*, in any Surface, Body, or Solid, is that Right Line in which the Center of Gravity is placed.

DIHELIOS, in the Elliptical Aſtronomy, is that Ordinate of the Ellipſis which paſſes through that Focus in which the Sun is ſuppoſed to be placed. *Kepler.*

DILAPIDATION, is a waſteful deſtroying, or letting of Buildings run to Ruin and Decay for want of Reparation, 13 *Eliz. c.* 13. And the Money recover'd for Dilapidations, by 14 *Eliz.* 11. ſhall be employ'd in the Repair of the ſame Houſes.

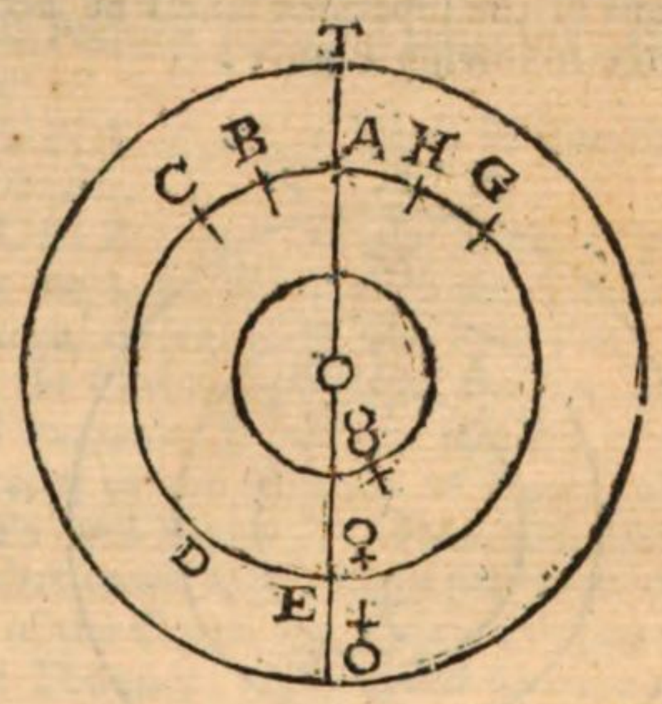
DILVING, is a Word uſed in the dreſſing of *Tin Oar*; and means, taking the Forehead of what is in the 2d Buddle after the 2d *Trambling*, and putting it into a Canvaſs Sieve, to ſhake it luſtily about in a large Tub of Water, ſo that the Filth goes over the Rim of the Sieve, leaving the *Black Tin* behind. See *Tin*, *Buddle*, and *Trambling.*

DIAZEUTICK *Tone*, in the Antient Greek Muſick, was that which disjoin'd two *Fourths*, one on each Side of it, and which being join'd to either, made a *Fifth.* This was in their Muſick that from *Meſe* to *Parameſe*; that is, in our Muſick, from *A* to *B*, ſuppoſing *Mi* to ſtand in *Bfabmi*, which is accounted its natural Poſition. They allowed to this *Diazeutick Tone*, which is our *La, Mi*, the Proportion of 9, to 8, as being the unalterable Difference of *Diapente* and *Diateſſaron*, or of the *Fifth* and *Fourth.*

DICASTRICK *Muſcles*, ſometimes called *Biventres*, are ſuch as have a double Belly.

DIMISSORY *Letters.* When a Candidate for Holy Orders hath a Title in one Dioceſe, and is to be ordain'd in another, the proper *Dioceſan* gives his *Letters Dimiſſory* directed to ſome other Biſhop, giving Leave that the Bearer may be ordain'd to ſuch a Cure within his Diſtrict.

DIRECT Motion of a Planet. To any Eye placed at the Earth's Surface, *Venus* and *Mercury*, which move round the Sun in leſſer Orbits than it doth, will ſometimes appear direct, and ſometimes *Stationary* and *Retrograde.*



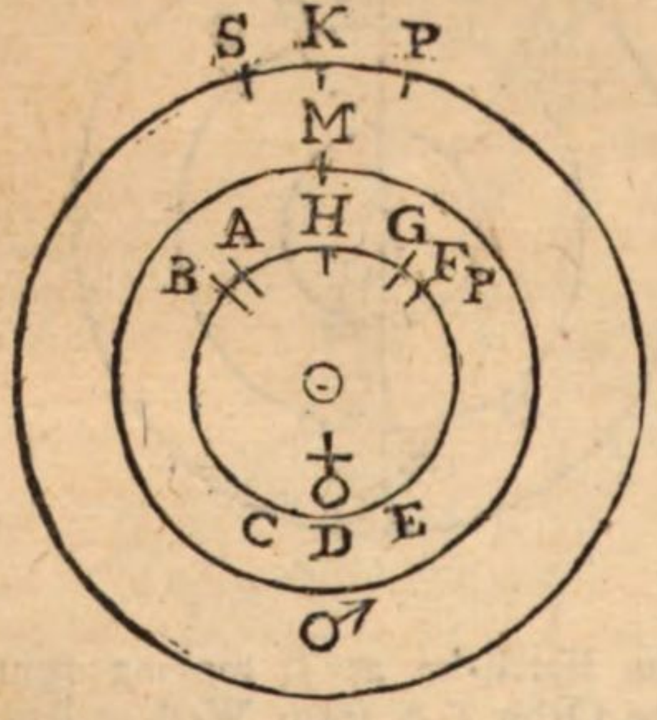

For let the Earth be at *T*, moving round the Sun in the Orbit *T* ♁ from Weſt to Eaſt. Let *A C D F* be the Orbit of ☿ revolving the ſame Way, but performing its Revolution in a ſhorter Time. It will then be plain, that when *Venus* is in that Part of her Orbit expreſſed in the Figure by *D E F*, and which is moſt remote from the Earth, ſuppoſed to be in *T*, I ſay, *Venus* will then appear to move forward directly, according to the Order of Signs, or *in Conſequentia*, as the Aſtronomers ſpeak, and ſo is ſaid to be *Direct.* And when ſhe comes to ſuch a Poſition, in reſpect of the Sun and Earth, as to be in *G*; then while ſhe moves from *G* to *H*, ſhe will ſeem to move with equal Celerity with the Sun, for then ſhe tends directly towards the Earth: Nor can ſhe appear to have any other Motion, than as if her Orbit were carry'd by the Sun moving towards the Eaſt. Therefore now ſhe will appear to move ſlower than before, but ſtill ſhe

will be direct. But when she gets beyond *H* towards *A*, and then to *B*, she in reality moving swifter than the Earth, (because nearer to the Sun) she will pass by between the Earth and the Sun; and therefore to an Eye placed at the Earth must appear to change her Place among the fix'd Stars, but yet contrary to the usual Order of the Signs: That is, she will appear to move *in Antecedentia*, and so is said to be *Retrograde*; tho', if viewed from the Sun, she would always appear to move *Direct*. And in the Part of the Orbit about *H*, she will appear *Stationary*, as they call it, because then Right Lines drawn from the Sun to the Earth and Her, will appear to be parallel to one another for a considerable Time. Also after her *Retrogradation*, and before she begins to *Direct* again, we will be again *Stationary*, as about *B*; and then she is said to be *Stationary towards her Direction*, as before she was *so towards her Retrogradation*.

And 'tis the same Case, with respect to the Earth consider'd, as moving on in her Orbit; for the *Directions*, *Stations*, and *Retrogadations*, above describ'd, and referred to *Venus*, will after the same manner appear to belong to the Earth, in the several Parts of her Orbit, to an Eye placed in *Venus*, or on the Surface of some Superior Planet.

And from what has been here said, it appears, that *Venus* will appear *Retrograde* when she is nearest to the Earth, and consequently then also appears bigger; and on the other hand, will be *Direct*, and appear least, when she is remotest from the Earth.

After much the same manner will the Phænomena of the Directions of the Stations and Retrogradations of the superior Planets be accounted for by the following Figure:




Let *M* ♂ be the Orbit of one of the Superiors, suppose of *Mars*; let *A C* ♁ *G* be the Orbit of the Earth, and nearer to the Sun than that of *Mars*; let that Planet be supposed at *M*, and the Earth in that Part of her Orbit design'd by the Letter *A*: Then will *Mars* appear *Stationary*, and that towards his Direction; because the Right Lines drawn from *Mars*, and from the Earth to the Sun, will for a while appear to be Parallel, altho' if *Mars* were seen from the Sun, his Motion would then appear to be Progressive, as at other Times. And while the Earth moves from *A* towards *B*, *C*, *D*, *E*, and *F*, to *G*, *Mars* will appear to move forward directly among the fixed Stars, for a double Reason; both because it is in reality carry'd about the Sun *in Consequentia*; and also because the Earth is carry'd the same way in the opposite Simicircle, and about the same Centre. *Mars* therefore being now most remote from the Earth, will appear to be direct. But the Earth coming at length to *G*, and *Mars* being supposed to be in *M*, (which in process of Time will come to pass) then he will appear *Stationary* again, and now towards his Retrogradation, for he will appear Retrogade in his Motion from *G* to *A*.

And the very same Phænomena must happen to *Jupiter* and *Saturn*; only the Retrogradations of *Saturn* will be more frequent than those of *Jupiter*, and his than those of *Mars*: Because the Earth will oftner follow, overtake, and get between *Saturn* and the *Sun*, than he will between *Jupiter* and him; and oftner also between *Jupiter* and the *Sun*, than between *Mars* and him.

DISCONTINUANCE, in the Common Law, signifies the same as an Interruption or Breaking off; and is of two Kinds, either

DISCONTINUANCE *of Possession*; the Effect of which is, that Man may not enter on his own Lands or Tenements alienated, whatsoever his Right be to them, of his own self, or by his own Authority; but must bring his Writ, and seek to recover Possession by Law. Or it is

DISCONTINUANCE *of Plea or Process*; the Effect of which is, that the Instant is lost, and may not be regain'd, but by a new Writ to begin the Suit afresh; for to be *discontinued*, and to be put *sine die*, signifies to be dismissed the Court finally.

DISGRADING. See *Degrading*.

DISPARAGEMENT, in the Law Sense is used especially for matching an Heir in Marriage under his or her Degree, or against *Decency*.

DISPAUPERED. When any Person, by reason of his Poverty, attested by his own Oath of not being worth 5 *l.* (his Debts being paid) is admitted to *sue* in *Forma Pauperis*; if afterwards, before the Suit be ended, the same Party have any Lands or Personal Estate fallen to him; or that the Court, where the Suit depends, think fit for that or any other Reason to take away that Privilege from him, he is then said to be *Dispaupered*, *i. e.* put out of the Capacity of suing any longer in *Forma Pauperis*.

DISPENSATION of a Law, is a Thing distinct from the Equity of it, or from an equitable Construction of it: For *Equity* is only the Correction of a Law that is too *Universal* or General; but a *Dispensation* suspends the Obligation of the Law itself. A *Dispensation* therefore must be from the *Legislative Power*, and should be but very rarely and sparingly used.

DISTANCE *of Places* on the Earth, are easily found by the Analemma. Thus:

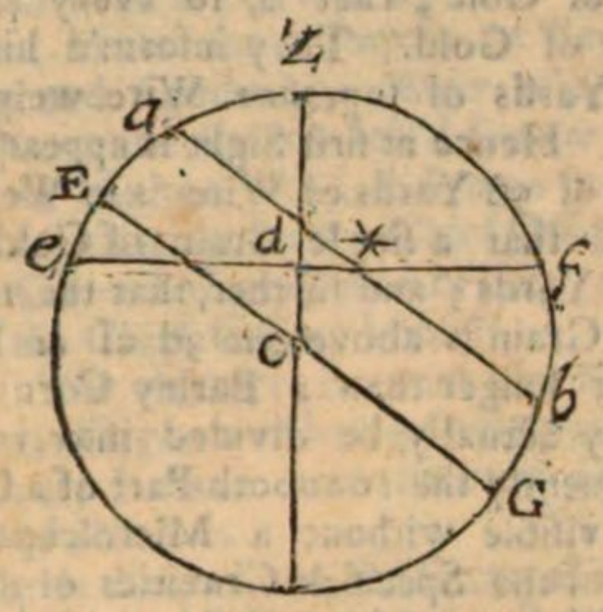
*Having the Longitudes and Latiudes of any two Places on the Earth; to find their Distance.*

Let *London* be one Place at Z, and let the other be in 20 *Deg.* Latitude North, and whose Difference of Longitude from *London* is 82 *Deg.* 30 *Min.* East. Take from the Chords Z E = 51 *Deg.* 30 *Min.* and draw *E C* ♎ for the Æquator; and to it, at 20 *Deg.* Distance draw *a b* for the Parallel of the other Place: Then from *b*, where the Meridian of *London* intersects that Parallel, set *b* ✳ = 82 *Deg.* 30 *Min.* the Difference of Longitude, and that will find the Point ✳ in the Parallel representing the Place. Thro' ✳ at Right Angles to ♑ *c*, draw *e d*, crossing the Vertical Circle in *d*; measure *c d* on the Sines, it will be a-



about

bout 20 *Deg.* whose Complement 70 *Deg.* is the Places Distance from *London*, or Z. Multiply 70 by 70, you have 4900 Miles, the Distance required.




DISTANCE *of the Eye*, in Perspective, is a Line drawn from the Foot of the Line of Altitude of the Eye, to the Point where a Line drawn at Right Angles to it will intersect the Object.

DISTRIBUTIVE Justice. See *Justice*.

DIVERGING *Hyperbola*, is one whose Legs turn their Convexities towards one another, and run towards quite contrary Ways. See *Curves*.

DIURNAL *Parallax of the Sun*. See *Parallax*, and *Sun*.

DOCKET, in the Law Sense, is a *Brief in Writing*. It hath been formerly written *Dogget*; and seems then to have been some small Piece of Paper or Parchment, containing the Effect of a larger Writing.

DOG-DRAW, is one of the four Kinds of an Apparent Deprehension of an Offender against Venison in the Forest: And it is, when a Man hath stricken or wounded a Deer, *&c.* by shooting at him with a Cross-Bow or Long-Bow, or otherwise, and is *found* with a Hound or other Dog drawing after him to receive the same. See *Manwood's Forest-Laws*, *c.* 18. N. 9.

DOGGER, is a small Ship built after the *Dutch* Fashion with a narrow Stern, and commonly but one Mast. See 31 *Ed.* 3. *Stat.* 3. *c.* 1.

DOG-NAILS, are such as are used for fastening Hinges.

DOM-BOC. See *Domes-day Book*.

DOMES-DAY *Book*. When King *Alfred* divided his Kingdom into Counties, Hundreds, and Tithings, he had an Inquisition taken of the several Districts, which were digested into a Register, which was called *Dom-Boc*; *i.e.* the Judicial or Judgment Book, reposited in the Church of *Winchester*, and thence call'd the *Winchester-Book*, to which King *Edward*, *Sen.* seems to refer in the first Chapter of his Laws. The General Survey taken afterwards by *William* the Conqueror was after this Precedent of King *Alfred*, and seems but a Corruption of, or rather an Addition to, the same Name, *Dom-Boc* into *Domes-day Book*: And it implying no more than *Doom-Book*, or a Register from which Sentence might be given in the Tenure of Estates; (whence by Latin Writers 'tis called *Liber Judicialis*) 'tis a trifling Etymology to derive the Word from either *Domus Dei*, or *Domes-day*, that is, the final Day of Judgment. And it is not improper to observe (because no Notice hath yet been taken of so small a Matter) that the Addition of *Dey*, or *Day*, in forming *Dooms-day Book* from *Dom-Boc*, doth not augment the Sense of the Word, but only doubles and confirms it. For the Word *Day*, in all Idioms, signifies Judgment: And in the North, to this Day, a *Daysman* is an Arbitrator, Umpire, or Judge; and so 'tis translated in our English Bible, in *Job.* ix. 33. *Domes-day Book* therefore is no more than the Book of *Judicial Verdict*, *Decretory Sentence*, or *Dooming of Judgment*. *Kennet's Paroch. Antiq. in Gloss.*

DORMANT *Tree*, is a Word used in Architecture, by some Workmen, for a great Beam lying a-cross the House; which is usually called a *Summer*.

DORMER, in Architecture, is a Window made in the Roof of an House, and it stands upon the Rafters.

DONATIVES. See *Benefices*.

DOUBLE *Quarrel*, is a Complaint made by any Clerk or other to the Archbishop of the Province against an inferior Ordinary, for his delaying of Justice in some Cause Ecclesiastical; as to give Sentence, to institute a Clerk presented, *&c.* The Effect whereof is, That the Archbishop taking Knowledge of the Delay, directs his Letters, under his Authentick Seal, to all and singular Clerks in his Province, thereby Commanding and Authorizing them, and every of them, to admonish the said Ordinary, within a certain Number of Days (*viz.* 9.) to do the Justice required; or otherwise to cite him to appear before him or his *Official*, at a Day in the said Letters prefixed, and there to alledge the Cause of his said Delay. And lastly, to intimate to the Ordinary, That if he neither perform the Thing enjoyned, nor appear at the Day assign'd, he himself will, without further Delay, proceed to perform the Justice required. And this seems to take its Name of *Duplex Querela*, from its being most times made both against the Judge and him at whose Petition Justice is delayed. *Cowel's Interpreter*.

DOUBLE *Aspect*, a Term in Painting. See *Aspect Double*.

DOUBLE *Point*. When all the Right Lines tending the same Way, with the Infinite Leg of any Curve, do cut it in one only Point (as happens in the Ordinates of the *Cartesian*, and in the *Cubical Parabola*, and in the Right Lines, which are parallel to the Abscissæ of Hyperbolism-Hyperbola's and Parabola's) then you are to conceive, that those Right Lines pass thro' two other Points of the Curve (as I may say) placed at an Infinite Distance. And those Coincident Intersections, whether they be at a Finite or at an Infinite Distance, Sir *Isaac Newton* calls the *Double Point*: And how such Curves as have a Double Point are describ'd, see under *Curves*.

DOUBLING the Cape or a Point of Land, in Navigation, signifies to come up with it, pass by it, and so to leave it behind the Ship.

DOVETAILING, in Architecture, is a Way of fastening Boards or Timber together, by letting one Piece into another indentedly, with a *Dovetail Joint*, or with a Joynt in the Form of a Dove's Tail.

DRAGON *Beams*, in Architecture, are two strong *Braces*, or *Struts*, which stand under a Breast Summer, and meet in an Angle on the Shoulder of the King-piece.

DRAGGS, in a Ship, are by the Seamen accounted whatever hangs over the Ship in the Sea, or is towed after the Ship in the Water, *&c.* Such as *Cloches*, a *Boat*, &c.

DRAUGHT-*Hooks*, are large Iron Hooks fixt on the Cheeks of a Cannon Carriage, two on each

each Side, one near the Trunion Hole, and the other at the Train. Large Guns have *Draught-hooks* near the middle *Tranſum*, to which are fix'd the Chains which ſerve to eaſe the Shafts of the *Limbers* on a March.

DRAW-*Bridges*, are made after ſeveral Faſhions, but the moſt common are made with Plyers twice the Length of the Gate, and a Foot in Diameter: The inner Square is travers'd with a St. *Andrew*'s Croſs, which ſerves for a Counterpoiſe, and the Chains which hang from the other Extremities of the Plyers, to lift up or let down the Bridge, are of Iron or Braſs.

DRENCHES, or *Drenges (Lat. Drengi)* ſome ancient *MS.* ſay, were Tenants *in Capite:* Such as at the Conqueſt being put out of their Eſtates, were afterwards reſtor'd by King *William*, becauſe they being Owners thereof, were neither againſt him by their Perſons or Councils. *Co.* on *Lit. Fo.* 6. ſays, theſe *Drenches* are Free Tenants of a Manor.

DRENGAGE, was the Tenure by which the *Drenches* held their Lands.

DRIFT WAY of a Ship, the ſame with *Lee-way.*

DUCTILITY. Captain *Halley*, in *Philoſoph. Tranſ. N.* 194, gives this further Account of the extreme Ductility, and exceeding Minuteneſs of the Parts of Gold. 'Tis evident, that Gravity is in all Bodies proportional to the Quantity of Matter in each; this is known by undoubted Experiment, ſo that there is no ſuch Thing as a Propenſion of ſome *more*, others *leſs*, towards the Earth's Centre, ſince the Impediment of the Air being remov'd, all Bodies deſcend, be they never ſo looſe or compact in Texture, with equal Velocity. It follows therefore, that there is 7 times as much Matter in a Piece of *Gold*, as in one of *Glaſs* of the ſame Magnitude, (their ſpecifick Gravities being as 7 to 1 nearly) and conſequently, that at leaſt 6 Parts in 7 of the Bulk of the Glaſs muſt be *Pore* or Vacuity. This ſome Favourers of the Atomical Philoſophy have endeavour'd to ſolve, by ſuppoſing the Primary or *Conſtituent* Atoms of Gold to be much *larger* than thoſe of other Bodies, and conſequently the Pores *fewer*. In order to examine this, he inform'd himſelf by the *Wire-drawers*, that every beſt *Double-gilt Wire* was made out of Cylindrick Ingots of Silver, four Inches in Circumference, and 28 Inches long, weighing 16 *lb.* Troy. To gild theſe, they beſtow 4 *oz.* of Gold; that is, to every 48 *oz.* of Silver, one of Gold. They inform'd him alſo, that two Yards of ſuperfine Wire weighs juſt one Grain. Hence at firſt Sight it appear'd, that the Length of 98 Yards of Wire is in Weight 49 Grains, and that a ſingle Grain of Gold covers the ſaid 98 Yards; and further, that the 100000th Part of a Grain is above one 3d of an Inch in Length, (or longer than a Barley Corn) which Length may actually be divided into 10 Parts, and conſequently the 1000000th Part of a Grain of Gold be viſible without a Microſcope. And by reaſon of the Specifick Gravities of the Metals, *viz.* Silver 10 $\frac{1}{3}$ and Gold 18 $\frac{1}{2}$; he found the Diameter of ſuch Wire to be $\frac{1}{1326}$th Part of an Inch, and its Circumference $\frac{1}{4163}$d Part of an Inch; but the Gold did not exceed in Thickneſs $\frac{1}{134500}$th Part of an Inch. Whence it may be concluded, that the Cube of an hundredth Part of an Inch would contain above 2433000000 (or the Cube of 1345) ſuch Atoms. And yet tho' the Gold be ſtretch'd to ſuch a prodigious Degree as is here demonſtrated, it ſtill ſhews itſelf of ſo even and united a Texture, as not to let the white Colour of the Silver that lies under it appear (even by a Miſcroſcope) thro' any the leaſt *Pores*. Which argues, that even in this exceeding Thinneſs, very many of thoſe Atoms may ſtill lie one over the other.

DULEDGE, in Gunnery, is a Peg of Wood, which joyns the Ends of the 6 *Fellows*, which form the Round of the Wheel of a Gun-Carriage; and the Joint is ſtrengthen'd on the Out-ſide of the Wheel by a ſtrong Plate of Iron call'd the *Duledge Plate.*

DUPLEX *Querela.* See *Double Quarrel.*

DUPLICATE, is uſed by *Crompton* for Second Letters Patents granted by the Lord Chancellor in a Caſe wherein he had formerly done the ſame, and was therefore thought void. But any Tranſcript or Copy of a Writing may be call'd a *Duplicate.*

EALDERMAN, was a Title among the *Saxons*, of the ſame Import as *Earl* among the *Danes*, and ſignified an *Elder* or *Stateſman*; ſuch an one as the *Romans* call'd *Senator*: And to this Day we uſe the Word *Alderman* in the ſame Senſe for an Aſſociate to the Chief Officer in the Common Council of any Town or City, and ſometimes for the Chief Officer himſelf.

EAR. The former Account (in *Vol.* I.) of this Curious Organ not being ſo ſatisfactory as I could wiſh it, I have here inſerted Dr. *Keill*'s Anatomy of the *Ear*.

The Ear is divided into the External and Internal. The External Ear (whoſe Parts have already been deſcrib'd) is compoſed of the Skin, a Cartilage, and a little Fat. The Skin of this Part is thin and ſmooth, it ſticks cloſe to the Cartilage by means of a fine Membrane. The Cartilage is in that Part of the External Ear call'd the *Pinna*; and the Fat in that Part call'd the *Lobe*. The Veſſels of the External Ear, are Arteries from the *Carotidale* Veins, which go to the *Jugulares*, and the Nerves from the *Portio Dura*, and ſecond Pair of the Neck.

The External Ear is tied to the *Os Petroſum* by a ſtrong Ligament, which comes from the Backſide of the *Pinna*. Though the Ear has but a very obſcure Motion, yet it has two Muſcles: The firſt ariſes from the Outſide of the Frontal Muſcle, where it joins the *Crotaphite*, and is inſerted into the Upper and Back-part of the *Pinna*. The ſecond ariſes from the upper and foremoſt Part of the *Proceſſus Mamillarïs*, and is inſerted into the middle and back Part of the *Concha*. The firſt ſhould draw the Ear upwards, and the ſecond downwards and backwards; but the continual binding of our Ears when young, deprives us of their Uſe. The Uſe of the External Ear is to gather the Sounds, and to carry them to the Internal. Its Inequalities and Circles do moderate the Violence of the Air.

The Internal Ear begins at the Conduit which goes from the Middle of the *Concha* to the *Tympanum*: it is call'd *Meatus Auditorius*. It is cartilaginous from the *Concha* till within a little of the *Tympanum*, where it is bony; yet this Cartilage goes not compleatly round, for towards the Temple its Edges do not meet by above a Line. The Paſſage is crooked, running firſt upwards and then downwards to the *Tympanum*. It is covered within by a pretty thick Membrane. Betwixt this Membrane and the Cartilage, eſpecially where it is ſlit, there are a great Number of little Glands, whoſe Execretory Chanels piercing this Membrane, carry a yellow ſort of Excrement into the *Meatus*, which hinders Inſects or any other thing to enter the Ear.

At the further Extremity of this Conduit, there is a thin tranſparent Membrane ſtretch'd out like the Head of a Drum, upon a bony Circle, which wants about half a Line of being compleat. The Handle of the *Malleolus* is tied to this Membrane, which it draws ſomewhat inwards, making it a little Concave towards the *Meatus Auditorius*: And there runs a ſmall Twig of a Nerve from the fifth Pair upon its Inſide, call'd *Chorda Tympani*; for the Membrane it ſelf is called *Tympanum*.

Behind this Membrane there is a pretty large Cavity called the Barrel; it is about three or four Lines deep, and five or ſix wide. It is lined with a fine Membrane, on which there are ſeveral Veins and Arteries. It is always full of a purulent Matter in Children. In this Cavity there are four ſmall Bones, of which,

The firſt is the *Malleolus*, or Hammer, ſo called becauſe of its Shape. Its Head has on its lower Side two Protuberances, and a Cavity whereby its joyned to the *Incus* by *Ginglymus*: Its Handle, which is pretty long and ſmall, is faſtened to the *Tympanum*. Near its Head it has two ſmall Proceſſes, and it is moved by three Muſcles.

The firſt is called the *Externus*; it ariſes from the upper and external Side of the *Meatus Auditorius*, and is inſerted into the upper and longer Proceſs of the *Malleolus*, which it draws outwards. This is neceſſary when Sounds are too great, which might break the *Tympanum*.

The Second is the *Obliquus*; it lies in the External Part of the Conduit which goes to the Palate, and entring the Barrel, it is contained in a Sinuoſity of the Bone by the upper Edge of the *Tympanum*, and is inſerted into the ſlender Proceſs of the Hammer, aſſiſting the former Muſcle in its Action.

The Third is the *Internus*, which ariſes from the Extremity of the bony Part of the Conduit which leads to the *Fauces*, and lies in a *Sinus* of the *Os Petroſum*, till it paſſes over a little Riſing of the Bone at the *Feneſtra Ovalis*, to be inſerted into the poſterior Part of the Handle of the *Malleolus*. This Muſcle, by pulling the Hammer inwards, diſtends the *Tympanum*.

The Second ſmall Bone is call'd *Incus*, the Anvil: It has a Head, and two Legs. Its Head has a Protuberance, and two Cavities, whereby it is articulated with the Hammer; the ſhorter of its Legs is tied to the Side of that Conduit which goes to the *Proceſſus Mamillaris*, and its longer Leg to the Head of the Third Bone, called,

The *Stapes* or Stirrop, becauſe of its Reſemblance. 'Tis of a Triangular Figure, being made of two Branches ſet upon a flat Baſis, which ſtands upon the *Foramen Ovale*. The Space between the two Branches is fill'd up by a fine tranſparent Membrane; the Union of the two Branches is called the Head of the Stirrop, in which there is a ſmall Cavity, in which lies the Fourth Bone. There is a ſmall Muſcle which ariſes out of a ſmall Canal in the bottom of the Barrel, and which is inſerted into the Head of the Stirrop.

The *Os Orbiculare*, which is a very ſmall Bone, being Convex on that Side which is received in the Cavity of the Head of the Stirrop, and hollow on the other Side, where it receives the long Leg of the Anvil, which is only joyned to the Stirrop by means of this Fourth Bone.

Beſides theſe Bones, there are ſeveral Holes in the Barrel. The Firſt is in its Fore-part neareſt the *Tympanum*. It is the Entry to the *Sinus* in the Mammillary Proceſs. The Second is the Oriſice of a Conduit, which opens behind the Palate of the Mouth. The Beginning of this Conduit is bony; and its Extremity, which is near the

*Vulva*,

*Vulva*, is membranous. Part of the Air which we breath, enters by this Conduit into the Ear. The Third and Fourth are in the Internal Proceſs of the *Os Petroſum.* The one is called *Feneſtra Ovalis* ; the Baſis of the Stirrop ſtands upon it ; it is the Entry to the *Veſtibulum.* The other is called *Feneſtra Rotunda* ; it is covered by a fine Membrane, inchaſed in a Rift of this Hole ; it leads to the *Cochlea.*

The *Veſtibulum* is a Cavity in the *Os Petroſum*, behind the *Feneſtra Ovalis* ; it is covered with a fine Membrane : In it open the Semi-circular Pipes of the Labyrinth. The upper Turning of the *Cochlea*, and the Auditory Nerve, pierces into it alſo.

The *Labyrinth* is made of three Semi-circular Pipes excavated in the *Os Petroſum* ; they open by five Orifices into the *Veſtibulum.* That which is called the Superior Pipe, joins one of its Extremities with one of the Extremities of that which is call'd the Inferior Pipe ; and theſe two Extremities open by one Orifice, but the middle Pipe opens at each End by it ſelf into the *Veſtibulum.*

The laſt Cavity of the Ear is the *Cochlea* ; it reſembles a Snail's Shell. Its Canal, which winds in a Spiral Line, is divided in two, the Upper and Lower, by a thin *Lamina Spiralis.* The Edge of this *Lamina* is membranous, where there are ſeveral Holes, through which Twigs of the Auditory Nerve paſs from the one Canal to the other. The Upper Canal opens into the *Veſtibulum*, and the Lower into the Barrel, by the *Feneſtra Rotunda.*

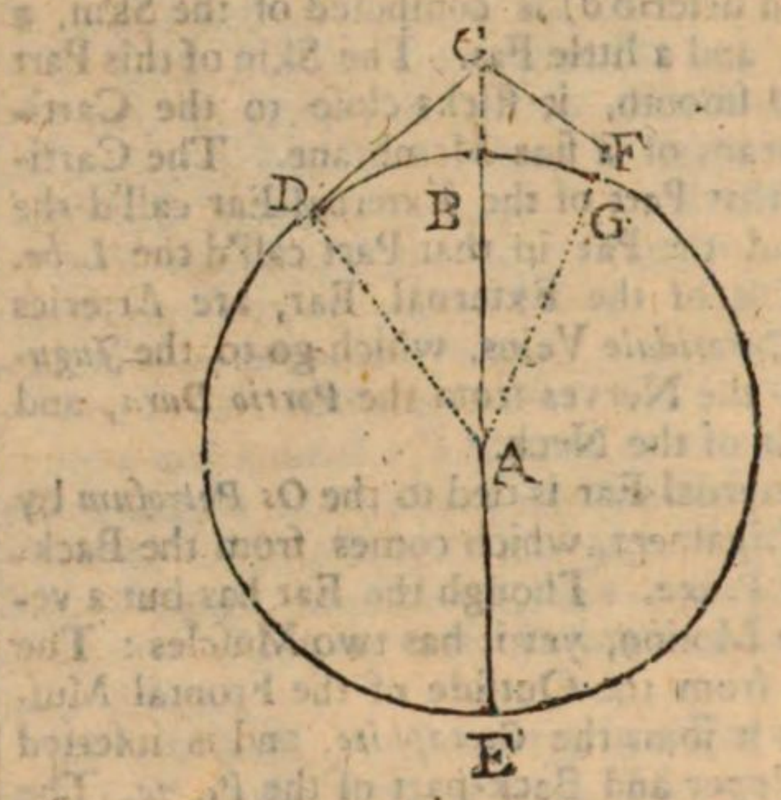
The Veſſels of the Internal Ear are Arteries and Veins from the Internal *Carotides* and *Jugulars.* The *Nervus Auditorius* enters by the Hole in the Internal Proceſs of the *Os Petroſum.* It conſiſts of two Bundles, of which one is hard, the other ſoft. Its *Portio Mollis* is diſtributed through all the *Cochlea* and *Labyrinth*, and the *Portio Dura* is beſtowed on the External Parts about the Ear.

Sounds being gather'd by the External Ear, paſs through the *Meatus Auditorius*, and beat upon the *Tympanum*, which moves the four little Bones in the Barrel. In like Manner as it is beat by the External Air ; theſe little Bones move the Internal Air which is in the Barrel and *Veſtibulum* : which Internal Air makes an Impreſſion upon the Auditory Nerve in the *Labyrinth* and *Cochlea*, accordingly as it is moved by the little Bones in the Barrel. So that, according to the various Refractions of the External Air, the Internal Air makes various Impreſſions upon the Auditory Nerve, the immediate Organ of Hearing : Theſe different Impreſſions repreſent different Sounds.

See *Maria Valtalva de Aure Humana Tractatus.*

EARL, anciently was the Title given to ſuch as were Aſſociates to the King in his Councils or Martial Expeditions ; as *Comes* was to thoſe who followed the Magiſtrates of *Rome*, as their Deputies to execute their Offices for them ; and this Title died always with the Man. The old Way of making Earls was only *Cincturam Gladii Comitatus*, without any formal Method of Creation. But *William* the Conqueror, ſaith *Cambden*, gave this Dignity in Fee to his Nobles, annexing it to this or that County, and allotting them a Proportion of Money, ariſing from the Prince's Profits, for the Pleadings and Forfeitures of the Province : Now, and long ſince, Earls are made by the Kings of *England*, by their Charters ; but without any Authority over any County, and without any Profit ariſing from thence, but ſome Annual Stipend out of the Exchequer for Honour's Sake. The Solemnity of their Creation you may find at large in *Stow*'s Annals. Their Place is next after a Marquiſs, and before a Viſcount.

EARTH. There have been ſeveral Methods thought of to find the Magnitude of the Earth : As, 1. *To find its Diameter, by having the Height of ſome very eminent Mountain, and the Length of a Viſual Ray, that ſhall be a Tangent to the Earth's Surface at ſome conſiderable Diſtance from the Top of the Hill :* For the Square of ſuch a Tangent being (by 35 *E.* 3.) equal to the Rectangle, under the whole Line made by the Earth's Diameter, and the Height of the Mountain together, if you divide *D C A* by *C B*, *i. e.*




the Square of the Diſtance, from the Top of the Hill to the Earth's Surface, by the Hill's Height, the Quotient will be the Line *C E*, (*viz.*) the Aggregate of the Earth's Diameter and the Mountain's Height ; the latter of which being given, the former is ſo.

2. Let a Spectator on the Top of a high Hill, as at *C*, with an Inſtrument, take the Angle *D C B* ; which may beſt be done by the Help of the Sun or Moon's being in the Horizon ; for that Way the Horizon will be the moſt accurately determin'd. Then the Length of the Tangent *C D*, being ſome-how known, in the Right angled △ *D C A*, the Line *D A* = to the Earth's Semidiameter may eaſily be drawn, and its Length found by Calculation.

3. The Angle *D C A* being taken, and the Mountain's Height *C B* known ; the Earth's Radius *B A* may be had without knowing the Diſtance *C D* : For in the △ *D C A* all the Angles are known, and the Length *B C* is only the Exceſs of the Secant *C A* above the Radius *B A* or *A D* ; wherefore by the Tables of Sines, Tangents, and Secants, the Radius *A D* will be known.

There is alſo another way a-kin to theſe, of finding a Part of the Circumference of a great Circle on the Earth, by having the Altitude of two high Mountains, and their Diſtance from each other. But none of theſe Ways can be depended upon, tho' they are built upon Geometrical Principles, and are great Inſtances of the due Thought and Penetration of the Inventers ; becauſe there will be ſo many unavoidable Difficulties in the different Refraction of the Atmoſphere, in taking the exact Height of the Mountains, or the Diſtance of their Tops from the Earth's Surface in *D*, that there can nothing certain be determin'd from hence.

The

The beſt Method therefore to gain this Point, is that which Mr. *Norwood* here in *England*, and Mr. *Picart* in *France*, proceeded in; which was to meaſure the Diſtance, in Miles, or rather in Yards or Feet, between two Places ſituate under the ſame Meridian, and at leaſt a Degree one from another; that ſo the Number of Miles contain'd in one Degree of a great Circle of the Earth, being exactly known, the Earth's Circumference will be eaſily had by only multiplying thoſe Miles by 360. And this the *French* Mathematicians ſeem to have done ſo nicely, that hardly any thing more exact is to be expected. They make the Ambit of the Earth to be 123249600 *Paris* Feet; that is, nearly, 131630573 *Engliſh* Feet, or 24930 of our Statute Miles. Whence the Diameter muſt be 41899310 *Engliſh* Feet, and nearly 7935 Statute Miles.

EARTH. Dr. *Hook*, *in Op. Poſt. p.* 467. ſaith, that the Semidiameter of the Earth, from the moſt accurate Obſervations that ever were made, is 3962¾ Statute Miles; or more exactly 20923500¾ Statute Feet.

Since 'tis known that the Orbit of the Earth is Elliptical, and that its Motion round the Sun is ſloweſt in the *Aphelion*, and ſwifteſt in the *Perihelion*; the Conſequence is, that the *Places* of the Earth's *Aphelion* and *Perihelion* may be found by Obſervation of her ſloweſt or ſwifteſt Motion. And the Places of theſe *Aſpides*, as they are called, may be found alſo by the Sun's Apparent Diameter; which will be leaſt when the Earth is in her *Aphelion*, and greateſt in the *Perihelion*: But their being ſome Difficulty in meaſuring this accurately, the former Way of finding the Place of the Earth's *Abſides* is the beſt.

The Motion of the Earth's *Aphelion* is only Apparent, and not Real; but it anſwers to the Proceſſion of the Equinoxes, which is annually about 50 Seconds.

EARTH. In the Year 1679, an Experiment being ſuggeſted to try, whether the Earth moved with a Diurnal Motion or not, by the Fall of a Body from a conſiderable Height, alledging it would fall to the *Eaſt* of a true Perpendicular: Dr. *Hook* read before the R. Society a Diſcourſe on that Subject, wherein he endeavoured to explain what Curve the falling Body would deſcribe; and in particular, he aſſerted, that the Fall of the Body would not be directly *Eaſt*, but to the *South-Eaſt*, and more to the *South* than the *Eaſt*. And on ſeveral Trials made, the Ball did always fall to the *South-Eaſt*. *Hook's Life, in Op. Poſt. p.* 22.

EARTH. If you ſuppoſe an heavy Body to deſcend 15 Feet in the firſt Second of Time, Mr. *Keill* ſaith, it follows by Calculation, (See Exam. of *Burnet*'s *Theory*, *p.* 117, 118.) That the Force of Gravity, to the Centrifugal Force, in a Body placed at the Equator of our Earth :: is as 289 to 1. So that by the Centrifugal Force ariſing from the Earth's Rotation, any Body placed in the Equator will loſe a 289th Part of its weight which it would have were the Earth at Reſt.

And ſince there is no Centrifugal Force at the Poles, a Body there weighs 289 ℔. which, at the Equator would weigh but 288 ℔.

And *p.* 123. He ſhews;

That on our Earth, the Decreaſe of Gravity, in going from the Pole towards the Equator, is always as *the Square of the Coſine of the Latitude*.

EARTH. According to Sir *Iſaac Newton*'s Principles, *Lib.* 3. *Prop.* 21. *The Axis of the Earth* doth, in every Annual Revolution of the Earth round the Sun, *twice incline towards the Ecliptic*, and twice return to its former Poſition; and on this *Nutation of the Earth's Axis* depends the Receſſion of the Equinoctial Points; and, as Mr. *Flamſtead* thinks, the Annual Parallel of the fixed Stars.

The Annual Regreſſion of the Earth's Nodes, is about 50 Seconds, and the Nutation of her Axis, about 42 Thirds.

EARTH. Dr. *Gregory*, *Aſtron. Phyſ. & Geom. p.* 76. That by reaſon of the Figure of the Earth, the Equinoctial Points do *recede*; and that the Axis of the Earth, in every one of its Annual Revolutions round the Sun, doth twice change its Inclination to the Ecliptic, and as often return again to its former Inclinationof 66 *Deg.* and half.

EASEL-*Pieces*, in Painting, are ſuch ſmall Pieces, either Portraits or Landskips, which are painted on the *Eaſel*; (the Frame on which the Painter places his ſtrain'd Canvaſs) and are ſo called to diſtinguiſh them from larger Pictures, which are drawn on Cielings, Roofs, or the Walls of Rooms.

EASEMENT, (*Aiſiumentum*) in the Law, is a Service which one Neighbour hath of another, by Charter or Preſcription, without Profit; as a Way through his Ground, a Sink, *&c.* and this, in the Civil Law, is called *Servitus Prædii*.

EAVESLATH, in Architecture, is a thick ſcather-edg'd Board, nail'd round the Eaves of a Houſe, for the lowermoſt Tiles, Slate, or Shingles to reſt upon.

EBDOMADARIUS, was formerly an Officer, ſo called in Cathedral Churches, appointed Weekly to ſuperviſe the Regular Performance of Divine Service, and other Duties of the Choir; and at the Beginning of each Week he drew up a Bill (which was called *Tabula*) of the Reſpective Perſons attending the Service of the Choir, and of their Duties allotted them; and thoſe Perſons which were entered in this Bill were called *Intabulati*.

ECCENTRICITY *of the Earth*, in the new Aſtronomy, is the Diſtance between the Focus and the Centre of the Earth's Elliptick Orbit: How to find which, Mr. *Whiſton* ſhews, *p.* 90. of his *Prelect. Aſtron.* from the Apparent Motion of the Sun, compared with the two Extreams of the *Apſides*. For ſince the *True Velocity* of the Earth in her *Aphelion* and *Perihelion* is in a *Reciprocal Ratio* of her Diſtances from the Sun; and that the *Apparent* and *Angular Velocity* is in a duplicate Ratio of her Diſtances reciprocally; from the Apparent Difference of theſe two Velocities, the Difference of the Diſtances, or the double Eccentricity, will eaſily be known. The Eccentricity of the whole Diſtance is, at a mean, about a 60th Part, or, more accurately, $\frac{3486}{10000}$.

ECHO. Dr. *Plot*, in his Natural Hiſtory of *Oxfordſhire*, *Cap.* 1. diſtinguiſhes Echoes into ſuch as are, 1. *Single*, which return the Voice but once; and of theſe, ſome may be called *Tonical*; becauſe they will not return the Voice but when modulated into ſome peculiar Muſical Note: And others *Polyſyllabical*; becauſe they will return many Syllables, Words, and Sentences; and ſometimes a whole Hexameter Verſe.

2. *Manifold* or *Tautological*, which return Syllables and Words the ſame oftentimes repeated.

In the *Polyſyllabical* and *Articulate* Echoes, the Place where the Speaker ſtands is called the *Centrum Phonicum*; and the Object or Place that returns

turns the Voice is called the *Centrum Phonocampticum*. He ſaith, he experienced what *Blancanus* writes in his *Echometria*, *Theor.* 5. That no one Syllable can be diſtinctly and clearly returned under the Diſtance of 24 Geometrical Paces, or 120 Feet. But by ſome Experiments I have made, I judge that Diſtance to be too large, as well as that of *Merſenus*, of 69 Feet, to be too little: And perhaps ſome Places may return the Voice ſooner, and ſome later, than others; which it would be worth while to try, where there is a Convenience of meaſuring perpendicularly from the *Centrum Phonocampticum*. When I was about 16 Years of Age, having Dr. *Plot*'s Book to direct me, I remember well, that I found an Echo, whoſe *Centrum Phonicum* was on the North Side of *Shipley* Church in the Wild of *Suſſex*; and which would repeat diſtinctly theſe Words, in the Night;

*Os Homini ſublime dedit, Cælumque tueri*
*Juſſit & Erectos*------

eſpecially, if you ſpoke the firſt Syllable very ſtrong, and all the reſt pretty faſt. I meaſured then alſo the Diſtance very accurately, but the Papers are loſt, and I can pronounce nothing certainly about them; but only that it was much the fineſt and moſt diſtinct Echo that ever I tried; tho' I tried the famous one at *Woodſtock* ſeveral Times, after I went to *Oxford*.

ECLIPSE *of the Sun*. In order to obſerve an Eclipſe of the Sun accurately, Mr. *Flamſted* directs to caſt the Species of the Sun through a good Teleſcope, of a tolerable Length, on an extended Paper behind the Eye-Glaſs; and ſo far as that the ſaid Species may appear at leaſt 6 Inches over. And then to divide both the Periphery of a Circle, equal to that, and drawn on the Paper, into 560 gr. for the better obſerving the Cuſps of each Phaſis; and alſo the Diameter into Digits, and their Parts, by Concentrick Circles, for meaſuring the Quantity of the obſcured Parts. When you look at an Eclipſe of the Sun, the beſt and readieſt way to ſave the Eye, is to take a Piece of plain Looking-glaſs Plate, and black one ſide of it over the Flame of a Candle; and then look through it at the Sun. And if you uſe a Teleſcope, ſuch a black'd Glaſs muſt be between your Eye and the Eye-glaſs.

To determine the Moment of the Immerſion, Duration, and other Requiſites of a Solar Eclipſe: *Vid. Whiſton's Prælect. Aſtron. p.* 160. and of a Lunar, *p.* 150.

ECLIPSES. 'Tis now diſcovered, that Lunar Eclipſes do not ariſe from the Interpoſition of the Earth's *Body* between ☉ and her, but only from the Interpoſition of her *Atmoſphere*.

Of which, and all the *Phænomena* of Eclipſes, ſee *Whiſton's Prælect. Aſtron. p.* 135.

EDICT, in the Civil Law, is any thing that the Emperor eſtabliſhes of his own Accord, that it may be generally obſerved by every Subject. And this differs both from a *Decree*, or a *Pragmatick Sanction*.

ELASTICITY. The Cauſe of the Elaſticity of Fluids, ſuch as our Air, may eaſily be acounted for, from their Particles being all endowed with a Centrifugal Force, like what Sir *Iſaac Newton* mentions *in Prop.* 23. *lib.* 2. of his Excellent *Principia*. And to ſolve the Springineſs or Elaſticity of ſolid and firm Bodies, we muſt have Recourſe to another univerſal Law of Nature, *Attraction*; by which the Parts of ſolid and firm Bodies are cauſed to cohere together. When therefore hard Bodies are either *bent* or *ſtruck*, ſo that the Component Particles are a little moved from one another, but not quite disjoined and broken off, nor ſeparated ſo far as to be out of the Power of that Attracting Force, by which they cohere together; they certainly will, on the Ceſſation of the external Violence, ſpring back with a very great Velocity to their former natural State: Suppoſing, as I ſaid before, that the Particles are not ſeparated by the *Flexure*, or the *Shock*, ſo far from one another, as that the Atoms of any foreign Fluid can get in between them, and hinder the Attractive Force; for then, as ſoon as ever the ſeparating Force ceaſes, the Attractive will act, and bring them back to their former State.

ELECTION, in Numbers, with Regard to Combinations, is the ſeveral Ways of taking any Number of Quantities given, without having reſpect to their Places. Thus the Quantities *a*, *b*, *c*, may be taken 7 Ways; as *abc*, *ab*, *ac*, *be*, and *a*, *b*, *c*.

See *Schooten* in his *Miſcellanea*; and *Strode* of *Combinations*. See alſo the Word *Combination*.

ELECTRICITY. In *Phil. Tran. N.* 308. there is an Account of an Experiment made before the R. S. at *Greſham* College, touching the extraordinary Electricity of Glaſs, produceable by a ſmart Attrition of it, with ſome odd Phœnomena thereon depending: As, that Moiſtneſs will at any Time hinder the Electrical Attraction: That the Interpoſition of the fineſt Lawn or Muſlin between the Body heated by rubbing, and the Light Bodies to be attracted, will deprive it of all Electrical Force: That when the Electrick Body (which was a Tube of Glaſs of $1\frac{1}{2}$ in Diameter, and 30 in Length) became hotteſt by the greateſt Rubbing, it ſent forth Effluvia that might ſenſibly be felt to ſtrike againſt your Face, when the Tube was held near it: That exhauſting the Tube of Air by the Pump, did almoſt totally deprive it of its Electrical Force, tho' rubb'd never ſo much, *&c.* All which Experiments I have often made myſelf, and find to be very truly related there. 'Tis obſervable, that on rubbing the Tube in the Dark, a Light would be produced; which was greater when the Tube was exhauſted of Air, and then ſeem'd to be all within the Tube; and when another Hand, or ones Finger was held near the Tube in the dark, a Light was ſeen to break from it, with a ſnapping Noiſe like that of a green Leaf in the Fire, but not ſo ſmart and loud.

He got alſo a Cylindrical Glaſs, and cauſed it by the Contrivance of a Wheel to be briskly turned round in an Horizontal Poſition: When this Glaſs, being exhauſted of Air, was turn'd round its Axis, a conſiderable Light would be produced, by the Attrition of ones Hand on the Outſide; and when the Air was let in, it was ſurpriſing to ſee, that on the Application of ones Finger towards the Glaſs, a vigorous Light would be produced, which began at the Finger firſt, and ſeem'd to gravitate on it, and was ſenſibly to be felt there, at half an Inch diſtance from the revolving Glaſs. And this Purple Light was viſible, even by Day, or in the Light. Mr. *Hawksbee* contrived alſo, that ſome looſe Threads ſhould be faſten'd at one End to a Circle of Wire, which was faſten'd at Right Angles to the Axis of the Glaſs, and within it; and then we obſerv'd ſeveral times, that when the Glaſs was ſwiftly moved round, and, by that means, ſtrongly rubbed and heated, all thoſe looſe Threads would ſtand upright, and

point directly towards the Axis of the revolving Glass.

He afterwards fix'd the Lower Ends of Threads into a Circle of Cork, which was placed at Right Angles to the Axis as before, but the upper Ends of the Thread hang loose; but as soon as the Glass was turn'd round as before, rubbed and warmed, the Threads would stand up an End in the same Plane with the Circle they were fastened to; and would point directly from the Axis towards the inward Surface of the Glass; unless when moved by the Application of ones Finger without; which would, surprisingly, make them bend and point towards it.

ELLIPSIS. To describe this Figure readily by means of the Sector, see *Analemma*, Vol. 1.

EMBER-WEEKS, are those Weeks in which the *Ember-Days* fall. In the Laws of K. *Alfred*, *c.* 39. and in those of *Canute*, *c.* 16. they are called *Ymbren*, *i. e. Circular* Days; from whence they are corrupted into *Ember-Days*: And by the Canonists they are called, *Quatuor Anni Tempora*, the Four Cardinal Seasons on which the Circle of the Year turns: They are the *Wednesday*, *Friday*, and *Saturday*, after *Quadragesima* Sunday; after *Whitsunday*; after *Holy-rood Day*, in *September*; and after St. *Lucy's* Day, in *December*: Which four Times answer well enough to the four Quarters of the Year, Spring, Summer, Autumn, and Winter. And Mr. *Somner* thinks, they were Fasts instituted to beg God's Blessing on the Fruits of the Earth. These Ember-Weeks are now chiefly taken notice of on the Account of the Ordinations of Priests and Deacons; because the Canon now appoints the Sundays next succeeding the Ember-Week, for the Solemn *Times* of Ordination. Tho' the Bishops, if they please, may ordain on any Sunday or Holyday.

EMBRACERY, is the Offence of an *Embraceur*; to pre-instruct the Jury.

EMBRE, or *Embring-Days*, are those by the Antients call'd *Quatuor Tempora*, and are of great Antiquity in the Church; being observed on the *Wednesday*, *Friday*, and *Saturday* next after *Quadragesima* Sunday, *Whitsundy*, *Holy-Rood Day*, in *September*, and St. *Lucy's Day*, in *December*, 2 & 3 *Edward* VI. *c.* 19.

EMENDATIO, in the Law, is the Power of amending and correcting Abuses according to stated Rules and Measures: As,

EMENDATIO *Panni*, is the Power of *Aulnage*, or *Ulnage*, or looking to the Assize of Cloth, that it be of the just Ell, or due Measure.

EMENDATIO *Panis & Cervisiæ*, is the Assize of Bread and Beer; or the Power of supervising and correcting the Weights and Measures belonging to them.

EMETICKS. Dr. *Cheyne*, in his Book of Fevers, says, the Action of vomiting by a Medicine is produced thus: The Particles of the Vomitory, by wedging themselves into the Orifices of the *Emissaries* of the Glands which are placed adjacent to the Surface of the Stomach, do *Dilate* the same (which by some extrinsical Cause had been contracted) and after the same Manner do *Dissolve* (at least in some Degree) the Cohesion of the Stagnant *Morbifick* Matter, rendring it more fluid, and consequently, making its Resistance less. Now the natural and constant Action of the *Glands* being *Secretion*; and the *Impediment* (by the Dilatation of the Orifice, and the Attenuation of the Fluid) being taken away, or at least made less than the natural *Momentum* of the Glands, the Matter must necessarily flow into the Cavity of the Stomack, till it be heap'd up in such a Quantity (which not being to be done in an Instant, must require some Time) as is sufficient (by the united Loathsomness, and the *Vis Stimulans* of the Emetick) to villicate and force the Fibres of the Stomach, *Abdomen*, and *Diaphragm* (by the Communication of the Nerves of the *First* with the two last) into a violent Contraction, and thereby, throw all out by the *Oesophagus*; and this makes all quiet for a while, till a new and sufficient Quantity be excerned from these Glands to reproduce the aforesaid Contraction. And thus there happens a Fit of Vomiting and Quiet alternately, till either all the *Morbifick* Matter be thrown out, or the Force of the Emetick is so dilated, that it is no longer able to elicit the *Morbifick* Matter from the Glands. And the *Strong Contraction* in so many *Muscles* and *Muscular Canals* as are at work in the Action of Vomiting, and the Violent *Concussion* which is produced over the whole Body, by a Power which, by just Computation, is not inferior to that of 26000 ℔. Weight, may, and often does take away the Obstructions in many other Canals besides those which are adjacent to the Stomach and Gullet; as we may plainly see by those vast Sweats which plentiful Fits of Vomiting occasion. *Emeticks* and purgative Medicines differ only in this, that the Particles of the latter do not immediately *vellicate* the Fibres of the Stomach, *dilate* the Orifices, and *attenuate* the Matter contain'd in the Glands of the Stomach, but act gently, and assist the natural Motion of *Digestion*, and so are carried down into the Intestines; and how they operate there, see under *Purgatives*.

EMINENTIAL *Equation*, is a Term used by the Algebrists in their Investigation of the Areas of Curvilineal Figures; and is so called, because 'tis an Artificial Equation, which contains another Equation eminently. See *Hayes's Fluxions*, *p.* 97, &c.

EMISSARY *of a Gland*, is the common Conduit, Canal, or *Pelvis*, in which all the little Secretory Canals of a Gland do terminate. See *Gland* and *Animal Secretion*.

EMPHYTEUSIS, in the Civil Law, is a Contract made by Consent, but created by the *Roman* Law, and not the Law of Nations; by which Houses or Lands are given, to be possess'd for ever, upon Condition that the Lands shall be improv'd, and that a small yearly Rent shall be paid to the Proprietor. The Tenant is call'd,

EMPHYTEATA, because of his being under an Obligation of planting and improving the Land.

EMPTIO-*Venditio*, in the Civil Law, is that Contract, by Consent only, which we call Buying and Selling, whereby the Seller is bound to deliver the Goods, and the Buyer to pay the Price for them, according to the Bargain.

EMPYREUMA, is that Taste and Smell of Fire, which some Things, too hastily distill'd, retain.

ENCAUSTICE, is the Art of *Enameling*.

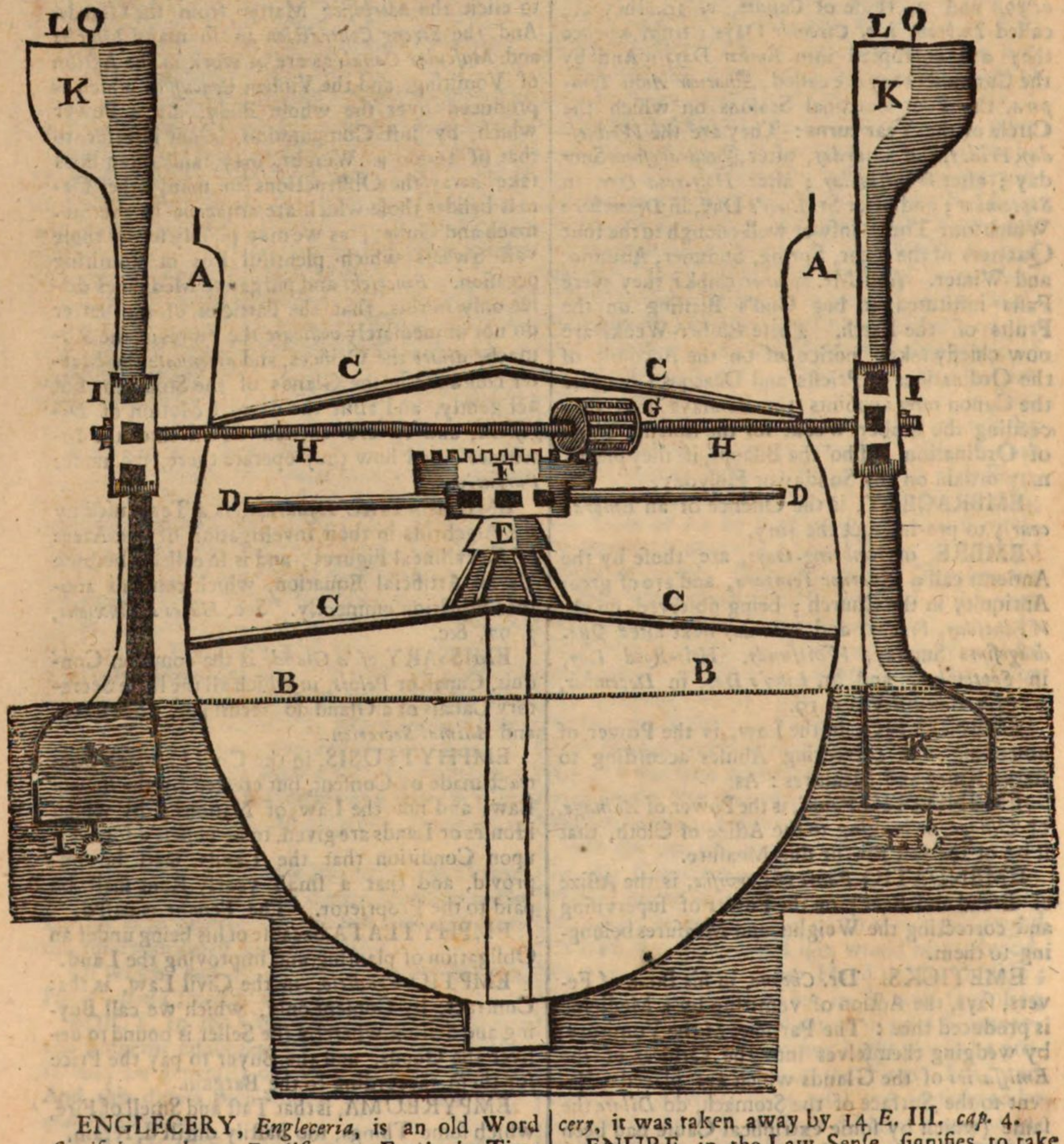
ENCHESON, is a *French* Word often used in our Law-Books; and seems to signify, the Occasion, Reason, or Cause of any Thing's being done.

ENCOLAPTICE is the Art of making Plates of Brass, and cutting in the Figures or Letters for Monumental Inscriptions and Laws.

ENGINE for Rowing Ships : The Figure of this Engine being omitted in *Vol.* I. is here added.

## Deſcription.

A. The Line the Ship makes.
B. The Water Line.
C. The Decks.
D. The Capſtand Barrs.
E. The Capſtand.
F. A Wheel on the Drum-head of the Capſtand.
G. A Trundle-head on the Wheel.
H. An Iron Bar going through the Trundle-head, and thorough the Sides of the Ship.
I. Two Drum-heads like thoſe on the Capſtand.
K. Paddles, of which Six, or Eight on each Side the Ship, are with Eaſe Fixed and Unfixed into the ſaid Drum-heads.
L. A Piece of Iron, to which a Luff-Tacle may be Fix'd, to lift thoſe that are too Heavy for Mens Strength, round each of which, by taking half Turns with a Cord, you make a Compleat Wheel on each Side the Veſſel.



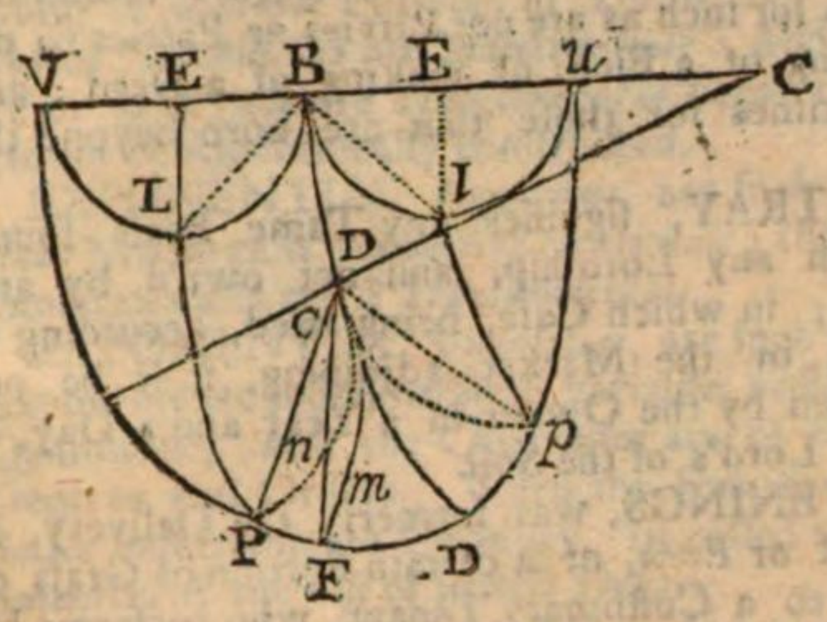

ENGLECERY, *Engleceria*, is an old Word ſignifying to be an *Engliſhman*: For in the Time of the *Danes*, if a Man were privily ſlain or murdered, it was accounted *Fracigena*, which Word then comprehended every Alien, until *Englecery* was prov'd, that is, 'till it was made manifeſt that he was an *Engliſhman*. *Vid. Bracton, Lib.* 3. *Tract.* 2. *Cap.* 15. *Fol.* 134. But there being many Abuſes and Troubles about this *Englecery*, it was taken away by 14 *E.* III. *cap.* 4.

ENURE, in the Law Senſe, ſignifies to take Place, or Effect, or to be Available. As a Releaſe ſhall *Enure* by way of Extinguiſhment; and a Releaſe made to a Tenant for Term of Life, they ſay, ſhall *Enure* to him in Reverſion.

EPICYCLOID, is a Curve generated by the Revolution of the Periphery of a Circle along the

*Convex*

*Convex* or *Concave* Part of another Circle; which Part of this other Circle is call'd the Base of the *Epicycloid*; as in this Figure, *D B* is the Base of




the *Epicycloid*; *V* its Vertex; *V B* its *Axis*; *D P V* half of the *Exterior Epicycloid*; made by the Revolution of the Semicircle *V L B*, (which is called the *Generant*) along the Convex Side of the Base *D B*: As *D P U* is the *Interior Epicycloid*, formed by the Generant's revolving along the *Concave* Side of the Base.

How a Portion of this Epicycloid is squarable, see *Phil. Transf.* N. 217. by Mr. *Caswell*, and in *Phil. Transf.* N. 218. you have a general Proposition for measuring the Areas of all Cycloids and Epicycloids. How to find the *Evoluta* to this kind of Curve, as also to find the Areas of Cycloidal and Epicycloidal Spaces. See *Hayes's Fluxions*, *p.* 210, &c.

EPISCOPALE *Onus*. See *Episcopalia*.

EPISCOPALIA, are Synodials, Pentecostals, and other Customary Payments, from the Clergy to their Diocesan Bishop; which Dues were formerly collected by the Rural Deans, by them transmitted to the Bishop.

These Customary Impositions were called *Onus Episcopale*, and were by special Privilege remitted to those free Chapels as were built on the *Demesne* of the King, and exempt from Episcopal Jurisdiction.

EQUATED *Bodies*. On *Gunter's* Sector there are sometimes placed two Lines, answering one another, and called, *The Lines of Equated Bodies*: They lie between the Lines of Solids and Superficies, and are noted with the Letters *D*, *I*, *C*, *S*, *O*, *T*, for Dodecahedron, Icosihedron, Cube, Sphere, Octahedron, and Tetrahedron.

Their Uses may be these;

1. The Diameter of a Sphere being given, to find the Sides of the 5 Regular Bodies, severally, equal to that Sphere.

2. The Side of any of the Bodies being given, to find the Diameter of the Sphere, and the Sides of the other Bodies, which shall be severally to the first Body given.

If the Sphere be first given, take its Diameter, and apply it over in the Sector in the Points *S*, *S*: If any of the other Bodies be first given, apply the Side of it over in its proper Points: So Parallels taken from between the Points of the other Bodies, shall be the Sides of those Bodies, equal severally to the first Body given.

EQUATIONS. Captain *Halley* in *Philosoph. Transf.* N. 190. *p.* 38. gives an Account of the Number of Roots in Cubick and Biquadratick Equations, together with their Signs and Limits. And in N. 210. he gives a Method for the Extraction of all Roots out of them without any previous Reduction.

In N. 309. there is an Analytical, Geometrical, Mechanical, and Universal Method for the Resolution of Cubick and Biquadratick Equations, by Mr. *J. Colson*. And an Analytical Resolution of some Equations of the 3, 4, 5, 7, 9, and Superior Powers; and so on Infinitely, in Finite Terms, and in such a Method as *Cardan* used for Cubicks.

Dr. *Gregory*, in the Preface to his excellent *Oxford Euclide*, in *G. L.* shews, that from the 86th and 87th Proposition of *Euclides Data*, even Biquadratick Equations, where the 2d and 4th Terms are wanting, may be resolv'd. As all *Quadratick Equations* may be, by the 84th and 85th Propositions of the same *Data*.

EQUES *Auratus*, is used to signify a Knight, which is called *Auratus*, because antiently none but Knights might guild or beautify their Armour, or other Habiliments of War, with Gold. However, in Law, this Term is not used; but instead of it *Miles*, and sometimes *Chevalier*.

EQUILATERAL *Hyperbola*. If the Transverse *Diameter* of any *Hyperbola* be equal to its *Parameter*, then all the other Diameters will also be equal to their *Parameters*: And such an *Hyperbola* as is this, is called an *Equilateral*, whose Asymptotes do always intersect each other at Right Angles in the Center.

EQUITY, is of two Sorts, and those of contrary Effects; for the one doth abridge and take from the Letter of the Law; and the other doth enlarge and add thereto.

The first is thus defined; *'Tis the Correction of the Law made generally in that Part wherein it fails*; which is a Correction much used in our Law: As suppose an Act made, That whosoever does such a Thing, shall be a Felon, and suffer Death: Yet if a Madman, or an Infant, who hath no Discretion, do the same, he shall neither be a Felon, nor suffer Death.

The other Equity is defined, to be an *Extension of the Words of the Law to Causes unexpress'd, yet having the same Reason*; so that when one Thing is enacted, all other Things are so too, that are of the like Degree: As the Statute, which ordains, that in Action of Debt against Executors, he that doth appear by Distress shall answer, doth extend by Equity to Administrators; for such of them as shall appear first by Distress, shall answer by *Equity* of the said Act: *Quia sunt in Equali genere. Cow. Interpret.*

EQUIVOCAL *Generation*. There is scarce any thing seems more to countenance Equivocal Generation, than the Production of Worms, *&c.* in the Bodies of Animals; and yet Mr. *Andey*, in his Discourse *de la Generation de Vers dans le Corps de l' Homme Paris*, in 8*vo.* 1700. shews, that they breed there by a *Seed* which finds Entrance some how into our Bodies; and in particular, he shews, that the *Ciron*, or Hand-Worm, issues perfectly from its Egg, and after that grows insensibly. He judges that the Eggs of small Insects enter our Bodies by the Air we breathe, and in our Food; and that they are hatch'd there, only when they find an agreeable Heat and Disposition of the Humours and Parts.

Dr. *George Garden* hath observ'd; See *Phil. Tran.* N. 237. that the *Bearers*, or Bearing Buds of Fruit-Trees, are full of Asperites, and not so smooth in their *Bark* as the other Parts of the

Tree; and that if after Harveſt you look on theſe with a common Microſcope, you will find the Cavities *there* full of Eggs of an oblong Figure, and of a Citron Colour; eſpecially, in ſuch *Years*, and in thoſe Trees, where the Caterpillers have been numerous. From whence he concludes, that we ſhould not ſay Inſects are bred out of Corruption equivocally, and not *ex Ovis*, only becauſe we cannot diſcern the particular Manner of their Propagation. See *Inſects*.

Mr. *Ray* ſaith, it ſeems to him *to be moſt probable*, that there is no ſuch Thing as *Spontaneous* or *Equivocal* Generation; but that all Inſects are the Natural Iſſue of Parents of the ſame Species with themſelves. *Fr. Redi*, in his Book *de Gener. de g'l Inſetti*, hath, I think, cleared up this Point, and ſhew'd there is no Generation of Animals *ex Materia Putrida*. And Dr. *Liſter* hath given an Account of the Inſects bred in the By-Fruits and Excreſcencies of Vegetables, *in Phil. Tran.* N. 71, 72, 75.

Mr. *Willoughby* accounts for the *Ichneumon Waſps*, and the Manner of their laying their Eggs in the Bodies of other Inſects; as of Caterpillers, *&c. Phil. Tranſ.* N. 76.

Dr. *Liſter*, *in Phil. Tranſ.* N. 83. hath refuted the vulgar Notion, that Horſe-hairs thrown into Water will become animated Bodies; and ſhews, that the Appearances of that Kind are *Hair-Worms* actually bred in the *Bodies of other Inſects*, as of the *Common Black Beetle*, &c.

ERRANT, in our Law, is the ſame as *Itinerant*, being attributed to Judges that go the Circuit; and to Bailiffs at large.

ESCAMBIO, is a Licence granted to one, for the making over a Bill of Exchange to another, at Sea, *Reg. Orig. Fol.* 194. For by the Statute of 3 *R.* 2. *c.* 2. no Merchant ought to exchange or return Money beyond Sea, without the King's Licenſe.

ESCAPE, ſignifies, in the Civil Law, a violent or Privy Evaſion out of ſome lawful Reſtraint.

ESNECY, *Æſnecia*, in the Law, is a Prerogative given to the eldeſt Co-partner, to chuſe firſt, after the Inheritance is divided.

ESPICURNANTIA, is the Office of *Spigurnel*, or Sealer of the King's Writs.

ESQUIRE, in *French Eſcuier*, i. e. *Scutiger*, was originally ſuch an one, as attending a Knight in Time of War, did carry his Shield. But now it ſignifies a Gentleman, or one that beareth Arms as a Teſtimony of his Nobility or Gentry; and is a meer Title of Dignity, next to and below a Knight. They who claim this Title now are, all the younger Sons of Noblemen; the Four Eſquires of the King's Body; the eldeſt Sons of all Barons, Knights of the Bath, and Knights Batchelors; thoſe that ſerve the King in any worſhipful Calling; ſuch as created Eſquires by the King with a Collar of SS's of Silver: The Chief of ſome Families are alſo Eſquires by Preſcription: Thoſe that bear any ſuperior Office in the Common-wealth, as a Juſtice of Peace, while in Commiſſion, and Utter Barriſters, *&c.*

ESSAY *Hatch*, is the Miners Term for a little Trench or Hole, which they dig to ſearch for *Shoad*, or *Oar*. See *Tin*.

ESSENTIAL *Oils of Vegetables*, are, according to the Chymiſts, ſuch are drawn from the Plant in a Limbeck, by the Help of Water.

ESTERLING. The ſame with *Sterling*.

ESTORERS. The ſame with *Huſe Bote*, or *Houſe Bote*: Which ſee.

ESTRANGERS, in the Law, are ſometimes taken for ſuch as are not Privies or Parties to the levying of a Fine, or making of a Deed; and ſometimes for thoſe that are born beyond the Sea.

ESTRAY, ſignifies any Tame Beaſt found within any Lordſhip, and not own'd by any Man; in which Caſe, being cried, according to Law, in the Market adjoining, if it be not claimed by the Owner in a Year and a Day, it is the Lord's of the Soil.

EVENINGS, was formerly the Delivery, at Night or *Even*, of a certain Portion of Graſs or Corn to a Cuſtomary Tenant, who performs his wonted Service of Mowing or Reaping for his Lord, and at the End of his Day's Work, did uſe to receive ſuch a Quantity of Graſs or Corn to carry Home with him, as a Gratuity or Encouragement for his bounden Service. *Kennet's Paroch. Antiq.*

EVICTION, in the Civil Law, is a Recovery of the Title to any thing ſold by a Stranger.

EVOLUTA. See in *Involute* and *Evolute* Figures, in *Vol.* I.

EVOLUTION. The Equable Evolution of the Periphery of a Circle, or any other Curve, is ſuch a gradual Approach of the Circumference to Rectitude, as that all its Parts do meet together, and equally *evolve* or unbend; ſo that the ſame Line becomes ſucceſſively a leſs Ark of a reciprocally greater Circle, till at laſt they turn into a ſtrait Line.

*In Philoſ. Tranſ.* N. 260. *p.* 445. you have a new *Quadratrix* to the Circle, found by this Means, being the *Curve deſcribed by the Equable Evolution of its Periphery.*

EUSTACHIAN *Tube*. The ſame with the *Aqueductus Tallopii*. See *Tuba Euſtachiana*.

EXACTION *Secular*, was any Sort of Tax or Impoſition formerly paid by ſervile and feudatory Tenants.

EXCEPTION, in the Law, is a Stop or Stay to an Action; being uſed in the Civil and Common Law both alike, and in both divided into *Dilatory* and *Peremptory*.

EXCLUSIONS. The *Method of Excluſions* is a Way of coming at the Solution of Problems (in numerical Caſes) by previouſly ejecting or excluding out of our Conſideration, ſuch Numbers as are of no Uſe in ſolving the Queſtion; and whereby conſequently the Proceſs may be regularly and judiciouſly abbreviated.

An Account of which Method, Mr. *Frenicle* gives, in the *Ouvrages de Mathematique, &c. in Fol. Paris*, 1693.

EXHIBITION, was anciently an Allowance for Meat and Drink, ſuch as the Religious Appropriators made to the poor depending Vicar. And this Word is ſtill retained in the Colleges of *Oxford* and *Cambridge*, in nearly the ſame Senſe.

EX OFFICIO. By a Branch of a Statute of 1 *Eliz.* 1. The Queen, by her Letters Patents, might authoriſe any Perſons, *&c.* to adminiſter an Oath *Ex Officio*; whereby the ſuppoſed Offender was forced to confeſs, accuſe, or clear himſelf of any Criminal Matter, *&c.* But this Branch, relating to the ſaid Oath, is repeal'd by *Stat.* 17 *Car.* 1. *c.* 11.



EXPLE-

EXPLETORY *Juſtice.* See *Juſtice.*

EXPONENTIAL *Curves*, are ſuch as partake both of the Nature of *Algebraick* and *Tranſcendent* ones. They partake of the former, becauſe they conſiſt of a *Finite* Number of Terms, tho' thoſe Terms themſelves are *Indeterminate*: And they are in ſome meaſure *Tranſcendental*, becauſe they cannot be Algebraically conſtructed.

EXPONENTIAL *Equations*, are ſuch as Sir *Iſaac Newton* calls *Geometrice Irrationals*; they are ſometimes alſo call'd *Tranſcendental.*

EXPONENTIAL *Quantities*, are ſuch whoſe Exponents are indeterminate, variable, or flowing Quantities; and the Quantities are of ſeveral Degrees and Orders. When the Exponent is a *ſimple* indeterminate Quantity, 'tis called an *Exponential* of the *firſt* or loweſt Degree.

When the Exponent it ſelf is an *Exponential* of the firſt Degree, then the Quantity is an *Exponential* of the ſecond Degree, *&c.*

Thus $z^y$ is an *Exponential* of the firſt Degree; becauſe the Quantity $y$ is a *ſimple* flowing Quantity. But $z^{y^x}$ is an Exponential Quantity of the ſecond Degree; becauſe $y^x$ is an Exponential of the firſt Degree. So alſo $z^{y^{x^y}}$ is an Exponential of the Third Degree; the Expotent $y^{x^y}$ being one of the ſecond.

See *D. Bernoulli's Tractatus de principiis Calculi Exponentialis*: And *Craig*'s Correction alſo of a Miſtake in it; *in Phil. Tranſ. N.* 245. *p.* 374.

*Hayes Fluxions*, *p.* 306. Where are Rules to find the Fluxions of *Logarithms* and of *Powers*, when the Exponents are Flowing Quantities. As alſo how to conſtruct *Exponential Curves*, and to determine their Tangents.

EXPROMISSOR, in the Civil Law, is one that diſcharges the firſt Debtor, and takes the Burden upon himſelf.

EXTEND. To extend, in a Legal Senſe, ſignifies the valuing of Lands and Tenements of one bound by Statute, *&c.* and hath forfeited his Bond to ſuch an indifferent Rate, as that, by the yearly Rent, the Obligator may in time be fully paid his Debt.

EXTREMITIES *of the Figures in Painting*, are the Head, Hands, and Feet; and theſe ſhould be drawn with more Nicety and Exactneſs, or more terminated than other Parts; and muſt help, by that Means, to render the Action more expreſſive.

EYE. Dr. *Hook*, in his *Poſthumous Works*, *p.* 12. ſaith, That the diſcerning Power of the Eye, is not capable of making Diſtinction of Parts, when they are ſmaller than the ſmall Pores of Wood; which he found by this Experiment: By a convenient *Lens*, he brought the Object ſo near the Eye, that the croſſing of the Rays in the Eye was about the middle Space between the viſible Side of the Object and the Bottom of his Eye; from whence it followed, that the Picture of the viſible Part of the Object was as big as the Thing repreſented; and the Eye being then at moſt but capable of ſeeing or diſtinguiſhing thoſe Pores; it follows, that if the Cauſe of that Diſtinction be from the Ends of the Filaments of the Optic Nerve, as *Deſcartes* ingeniouſly ſuppoſes, the Filaments can't be ſmaller than the Microſcopical Pores of Wood; and that the Eye is uncapable of diſtinguiſhing the Parts of any Object that are ſmaller than thoſe: So that any Object being ſo far remov'd from the Eye, as that its Picture on the Retina ſhall be leſs than a Microſcopical Pore, will become inviſible; at leaſt if it be but of a dull Radiation; for if it be of a bright one, (as the Stars are) the whole Filament is moved by having one Part of it powerfully acted on; and ſo we have a Senſation of the Object the ſame as if it were much bigger. And this ſeems to be the Reaſon, why the Stars appear to our naked Eye many thouſand Times bigger than they really are, and even as big as thro' a long Teleſcope, And *p.* 13, he ſaith, that if by the Help of Glaſſes, the Eye can be made capable of collecting a much greater Quantity of Rays from a Point, and make them meet in the Retina, 'tis not improbable, but that a much greater Number of Bodies may be diſcovered to be *Radiant*, which are now not ſuppoſed to be ſuch.

F. By Statute 5 & 6 *E.* 6. *cap.* 4. 'tis enacted, That whoever ſhall maliciouſly ſtrike any Perſon with a Weapon in the Church or Church-yard, or draw it there, with an Intent to ſtrike, ſhall have one of his Ears cut off; or if he have no Ears, ſhall be burnt on the Cheek with an *F*; that he may be known for a common Fighter or Fray-maker.

FABRICK *Lands*, are Lands given to the Rebuilding, Repair, or Maintenance of Cathedrals, and other Churches, and mentioned in the Act of Oblivion, 12 *Car.* 2. *c.* 8. Formerly every one almoſt gave by his Will ſomething, more or leſs, to the Fabrick of the Cathedral, or his Pariſh Church, and theſe were called *Fabrick Lands*; and by the *Saxons*, *Timber Lands*.

FACE *prolong'd*, in Fortification, is that Part of the Line of Defence Razant which lies between the Angle of the Shoulder and the Curtain; or 'tis the Line of Defence Razant diminiſhed by the Length of a Face.

FACIA's, in Architecture, as the Workmen call it, (for it ſhould be ſpelt *Faſciæ*,) are nothing but broad Liſts or Fillets, and are commonly made in Architraves, and in the Corners of Pedeſtals. In Brick Buildings, they call the Juttings-out of the Bricks over the Windows in all Stories but the higheſt, by this Name; theſe are ſometimes plain, and ſometimes moulded; and this moulding is only a *Scima Reverſa*, or an *O . . . G . . .* at the Bottom, and above this are two plain Courſes of Bricks, then an Aſtragal, and laſt of all, a *Boultine*; which the Workmen call a *Boultrea* and a *Boltell*.

FACK, in a Ship, is any one round of a Cable when it is quoiled up out of the Way.

FAGGOT, in Times of Popery here was a Badge worn on the Sleeve of the Upper Garment of ſuch Perſons as had recanted and abjured what the Powers that then were, did call Hereſy; which was put on after the poor Wretches had carried a Faggot, by way of Penance, to ſome appointed Place of Solemnity. And ſometimes they interpreted the leaving off this Badge of the Faggot to be a Sign of Apoſtacy.

FALDAGE, *Faldagium*, is a Privilege which antiently ſeveral Lords reſerved to themſelves of ſetting up Folds for Sheep in any Fields within their Manors, the better to manure them; and this not only with their own, but their Tenants Sheep, which they called *Secta Faldæ*. This Faldage in ſome Places they call a *Fold Courſe*, or Free-fold; and in ſome old Charters 'tis called *Fold-ſoca*, *i. e. Libertas Faldæ* or *Faldagii*.

FALDFEY, or *Faldfee*, was a Compoſition paid ſome Cuſtomary Tenants antiently, that they might have Liberty to fold their Sheep upon their own Ground.

FARDEL *of Land*, according to ſome Writers, is the 4th Part of a Yard Land; but *Noy*, in his *Complete Lawyer*, *p.* 57. ſaith, two Fardels of Land make a Nook, and four Nooks a Yard Land.

FARDING, or *Farthing* of Gold, ſeems to have been a Coin uſed in antient Times, containing in value the 4th Part of a Noble, *viz.* Twenty-pence in Silver: In Weight, the 6th Part of an Ounce of Gold, that is, of five Shillings in Silver. This Word is uſed 9 *H.* 5. *c.* 7. and there appears to have been a Coin as well as the Noble and Half Noble.

FARDING-*deal*, or *Farundel of Land*, was the 4th Part of an Acre.

FAST-*Country*. A Term uſed by the Tin-Miners, and ſignifies the ſame with *Shelf*; which ſee.

FASTING *Men*, *Homines habentes*. An old Term which ſome will have to ſignify Men of Repute and Subſtance: But 'tis more probable, that by it was meant rather Pledges, Sureties, or Bondſmen; which, according to the *Saxon* Cuſtom, were faſt bound to anſwer for one anothers peaceable Behaviour.

FAUSBRAYE. See *Falſe Braye*.

FEATHER *Edg'd*, is a Term uſed by Workmen for ſuch Boards as are thicker on one Edge or Side than on the other.

FELLOWS, in Fortification, are ſix Pieces of Wood, each of which form an Arch of a Circle; and theſe, joined all together by *Duledges*, make an entire Circle; and theſe, with 12 Spokes, make the Wheel of a Gun Carriage. Their Thickneſs is uſually the Diameter of the Ball of the Gun they ſerve for, and their Breadth ſomething more.

FEODARY, *Feodatorious*, was formerly the Title for the *Seneſchal* or Prime Steward, who received *Aids*, *Reliefs*, *Herriots*, &c. and ſuch Cuſtomary Fees due to any Lord.

FIBRES. There are other Diviſions and Diſtinctions of *Fibres*, beſides thoſe two mentioned in *Vol.* I. For, according to ſome Authors, there are in an Animal Body, *Carnous*, *Membranous*, *Cartaliginous*, *Tendinous*, *Oſſeous*, and *Nervous* Fibres, according to the Matter of which they conſiſt. The *Carnous* Fibres, of which the Fleſh is compoſed, are vaſcular and hollow, being full of little Cells: They are called *Fibræmotices*, becauſe they are the chief Organs of Muſcular Motion.

There is a Difference alſo among *Fibres*, as to their Situation and Courſe. For thoſe that run lengthwiſe in Right Lines, are called *Strait Fibres*: Thoſe that run about ſome Part, as thoſe do that form *Sphinter Muſcles*, are call'd Circular. Thoſe Fibres which croſs *Strait ones* at Right Angles are called *Tranſverſe*; but thoſe which interſect them at any other Angles, *Oblique Fibres*.

FIDE *Juſſor*, in the Civil Law, is the ſame with *Repromiſſor*, *Adpromiſſor*, *Sponſor*, *Prædes*, and *Vades*; That is, a *Surety*, or one that obliges himſelf in the ſame Contract with a Principal, for the greater Security of the *Creditor* or *Stipulator*.

FIELD-*Colours*, are ſmall Flags about a Foot and half Square, which are carried along with the Quarter-maſter-General, for marking out the Ground for the ſeveral Squadrons and Battalions of an Army.

FIELD-*Pieces*, are ſmall Cannon which are uſually carried along with an Army in the Field; ſuch as 3 Pounders, Minions, Sakers, 6 Pounders, Demi-Culverins, and 12 Pounders; and theſe being ſmall and light, are eaſily carried.

FIELD-*Staff*, is a Staff carried by the Gunners; 'tis about the Length of an Halbert, with a Speer at the End, which, on each Side, hath Ears

ſcrew'd on like the Cock of a Match-lock; and in theſe, the Gunners ſcrew in Lighted Matches when they are on Command. And this is call'd Arming the *Field-Staffs*.

FIFE *Rails*, in a Ship, are thoſe that are plac'd on Baniſters on each Side of the Top of the Poop, and ſo along with *Hances* or Falls they reach down to the Quarter-Deck, and to the Stair of the Gangway.

FIGURE. The Rectangle under any Diameter and its proper Parameter, is, in the Ellipſis and Hyperbola, called the Figure of that Diameter. *De la Hire, Lat. Con. p.* 47, 48.

FINERY, is the Name of one of the Fires in Forges in an Iron-work. See *Iron*. At the *Finery*, by the Working of the Hammer, they bring the Iron into what they call *Blooms* and *Anconies*.

FIRE. See *Light*. There is an Account of the Generation of Fire, by Mr. *Malbranche*, in the Fr. Memoirs for the Year 1699, which is ingenious enough; but it ſeems to depend entirely on the Hypotheſis of *Deſcartes*. In the ſame Book, Mr. *Amontons* ſhews a Method of making the Force of Fire ſupply that of Men or Horſes in Engines, *p.* 112.

FIRE-*Maſter*, in our Train of Artillery, is an Officer that gives the Directions and the Proportions of the Ingredients for all the Compoſitions of Fire-Works, whether for Service in War, or for Rejoycings and Recreations. His Orders are given to the Fire-Workers and Bombardeers, who are obliged to execute them.

FIRE-*Workers*, are ſubordinate Officers to the Fire-Maſters, but they command the Bombardeers: They receive the Orders from the Fire-Maſters, and ſee that the Bombardeers execute them.

FIRME, the ſame with a Farm, or Land and Tenements hired at a certain Rate. But it antiently ſignified the *Reception* and *Entertainment* of the King, or any other Lord and his Retinue; and frequently in the Doomſday Book, a Condition of Tenure was *pro firma per unum diem*, or *pro firmâ per unum noctem*: And ſo, becauſe in the *Saxon*, and part of the *Norman*, Times, the Rent of Lands was paid in Proviſions, *Firma* ſignified the Profits and Rent of an Eſtate: But *Henry* II. for better Convenience, alter'd this Cuſtom into an Equivalent of Money; which Pecuniary Rent was ſtill call'd *Firma Regis*.

FIRST-*Fruits*, *Primitiæ*, are the Profits of every Benefice for one Year, given before the Reformation to the Pope; but by 26 *H.* VIII. *c.* 3. tranſlated to the Crown: And by that Act, he which enters on any Spiritual Living before he pays or compounds for it, on Conviction, forfeits the double Value thereof. Every Clerk therefore, before his Induction, (or ſoon after,) ſhould go himſelf with one Friend of the City of *London*, Inns of Courts, or Parts adjacent, or ſend two ſuch Friends for him, to the Firſt Fruits Office, and there enter into Bond to pay the Firſt Fruits of his Benefice within two Years next enſuing, at four equal Half-yearly Payments. Only one Tenth of the whole Yearly Sum mention'd in the Queen's Books to be deducted; becauſe that muſt be paid by itſelf the firſt Year. Formerly four Bonds were given for the four ſeveral Payments; but by Statute 2 and 3 of Her preſent Majeſty, but one Bond only is appointed to be given; and the Rates of all Benefices, according to the Queen's Books, are declared unalterable. The Succeſſor is chargeable with Arrears of Tenths due from his Predeceſſor; and conſequently, by 27 *H.* VIII. *c.* 8. is impower'd to diſtrain his Predeceſſor's Goods, being upon the Benefice, and hath likewiſe a good Action at Law, againſt him, or his Executors.

FISH-*Block*, in a Ship, is the Block which is hung in a Notch at the End of the *David*, and ſerves to hawle up the Fluke of the Anchor to the Ship's Bow.

FISHES. *Rondeletius* diſtinguiſhes Fiſhes, from the Places where they are found, into *Sea Fiſh*, *River Fiſh*, and *Lake* or *Pond Fiſh*; and of theſe he makes ſome other Subdiviſions. But Mr. *Willoughby* ſaith rightly, That *Fiſhes* are much better divided by *Ariſtotle* into theſe three Kinds, *Cetaceous*, *Cartilaginous*, and *Spinous*.

The *Cetaceous* Kind (which are ſometimes therefore call'd the *Bellæ Marinæ*) have Lungs and Breath like Quadrupeds, they copulate alſo like them, conceive and bring forth their Young alive, whom they ſuckle with their Milk.

The *Cartilaginous* Sort, are produc'd from large Eggs like Birds, which are excluded the Womb alſo like thoſe of Birds.

The *Spinous* Kind, are alſo *Oviparous*, but their Eggs are ſmaller, and they have *Spinæ* up and down in their Fleſh to ſtrengthen it.

But he thinks it would be yet more proper to divide Fiſhes into the *Cetaceous* Kind, or ſuch as *breath with Lungs*, and into ſuch as *breath with Gills*. And then, to ſubdivide thoſe that *breath with Gills*, not into *Cartilaginous* and *Spinous*, but into *Viviparous and Oviparous*.

The *Viviparous Kind*, that *breath with Gills*, he ſubdivides into *Long*, ſuch as the *Galei*, and *Canes* or *Sharks*, and *Dog-Fiſh*: And the *Broad Kind*; ſuch as the *Paſtinacæ*, *Rajæ*, *Squatinæ*, &c. all whoſe Subdiviſions he gives in his Chapter of *Cartilaginous Fiſhes* in general.

The *Oviparous Kind*, that *breath with Gills*, are the moſt numerous; and theſe he ſubdivides into ſuch as are what we uſually call *Flat Fiſh*; and ſuch as ſwim with their Backs upright, or at Right Angles to the Horizon.

The *Plain* or *Flat Fiſh Kind*, called uſually *Plani Spinoſi*, are either *Quadrati*, as the *Rhombi* and *Paſſeres*; or *Longiuſculi*, as the *Soleæ*.

Such as *ſwim with their Backs erect*; are either *Long* and *Smooth*, and *without Scales*, as the *Eel Kind*; or *Shorter* and leſs *Smooth*: And theſe have either but *one Pair of Fins* at their Gills, which are call'd *Orbes* and *Congeneres*; or elſe *another Pair of Fins* alſo on their Bellies. And this latter Kind he divides into two others; 1. Such as have *no Prickly Fins on their Backs*, but *Soft* and *Flexile ones*. 2. Such as have *Prickly Fins upon their Backs*.

Thoſe Fiſhes which have only Soft and Flexile Fins on their Backs, may be divided into ſuch as have *Three*, *Two*, or *but One ſingle Fin* there. No Fiſh but the *Aſelli* have *Three* Fins on their Backs.

Fiſhes with *Two* Fins on their Backs, are either the *Truttaceous* or *Trout Kind*, or the *Gobionite*, or *Loch* or *Gudgeon* Kind.

Fiſhes with *but one ſoft Back Fin*, are of three Sorts; the firſt Kind have one long continued Fin from Head to Tail, as the *Hipparus* of *Rondeletius*, &c. the ſecond have this Fin, but ſhort, and placed juſt in the Middle of their Back; and theſe are either *Marine*, as the *Herring Kind*; or *Fluviatile*, as thoſe we call *Lether-mouthed Fiſhes*; ſuch as *Carp*, *Tench*, &c. Such

Such Fiſhes as have Prickly Fins on their Backs, are of two Kinds:

1. Such as have *Two prickly Fins on their Backs*; and in theſe the Anterior *Radii* of their Fins are always prickly: Or,

2. Such as have but one prickly Fin there.

Mr. *Willoughby* gives us this Catalogue of our *Engliſh* Fiſhes.

1. Of the *Long Cartilaginous Kind*; are the
   1. *Canis Carcharius*, or *Lamia*, the *White Shark*.
   2. *Galeus Glaucus Rondeletii*, the *Blue Shark*.
   3. *Canis Galeus Rondeletii*; called a *Tope* in *Cornwal*.
   4. *Galeas acanthias ſive Spinax*, the *prickled Dog* or *Hound Fiſh*.
   5. *Galeus ſeu Muſtela lævis*, the *ſmooth* or *unprickled Hound Fiſh*.
   6. *Catulus major, vulg. Canicula Ariſtotelis*, the *Rough Hound*; in *Cornwal*, the *Bounce*.
   7. *Catulus minor*, the leſſer *Hound Fiſh* or *Morgay*.
2. Of the *Plain Cartilaginous Kind*; are the
   1. *Raja levis undulata*, the *Skate* or *Flare*.
   2. *Raja Clavata*, the *Thornback*.
   3. *Raja Aſpera Noſtras*, the *White-horſe*.
   4. *Squatinu*, the *Angel* or *Monk-Fiſh*.
   5. *Rana Piſcatrix*, the *Toad Fiſh* or *Sea-Devil*.
3. Of the *plane Spinous Kind*; are the
   1. *Rhombus Maximus Aſpero Squammoſus*, the *Turbot* or *Brett*.
   2. *Rhombus non acculeatus ſquammoſus*; in *Cornwal* call'd the *Lug-alefe*.
   3. *Paſſer Bellonii*, the *Place*.
   4. *Paſſer Aſper ſive Squammoſus*, the *Dab*.
   5. *Paſſer Fluviatilis ſive Amphibius*, the *Flounder*, *Fluke*, or *Butt*.
   6. *Hippogloſſus Rondeletii*, the *Holy-Butt*; call'd in the *North* the *Turbot*.
   7. *Bugloſſus* or *Solea*, the *Sole*.
4. Of the *Eel Kind*; we have,
   1. *Lampetra major*, the *Lamprey*, or *Lamprey Eel*.
   2. *Lampetra parva* and *Fluviatilis*, the *Lampern*.
   3. *Anguilla*, the *Common Eel*.
   4. *Conger*, the *Conger* or *Sea Eel*.
   5. *Ammodytes Geſneri*, the *Sand Eel* or *Launce*.
   6. *Gunnellus Cornubienſis*, the *Butter Fiſh*.
   7. *Muſtela vulgaris Rondel*, the *Sea Loach* or *Whiſtle-Fiſh*.
   8. *Muſtela Fluviatilis*, the *Eel Pout*, or *Turbou*.
   9. *Lupus Marinus*, the *Wolf Fiſh*, or *Sea Wolf*.
   10. *Alauda non criſtata*, the *Sea Lark*; called in *Cornwal Mulgranoc* and *Bulcard*.
   11. *Alauda Chriſtata*, the Creſted *Sea Lark*.
   12. *Liparis Rondeletii*.
   13. *Gobio Fluviatilis*, the *Bull-head* or *Millers-thumb*.
   14. *Scorpana Bellonii Similis*, the *Dutch-Pots-Hog*; the *Corniſh* Boys call it *Father-Laſher*.
5. Of the Kind of Fiſhes *wanting the Belly Pair of Fins*; we have,
   1. *Mola Salviani*, the *Sun Fiſh*.
   2. *Acus Ariſtotelis, Species major*.
   3. *Acui Ariſtotelis congener*, the *Sea Adder*.
   4. *Xiphias, ſeu Gladius piſcis*, the *Sword Fiſh*.
6. Of the *non Spinous Kind* of Fiſhes, with 3 *unprickly ſoft Fins* on their Backs; we have,
   1. *Aſellus vulgaris major*, the *Cod-fiſh*, or *Kaling*.
   2. The *Whiting Pollack*.
   3. *Aſellus Niger*, the *Colefiſh*, or *Rawling Pollack*.
   4. *Aſellus Lucus*, the *Bib* or *Blinds*.
   5. *Aſinus Antiquorum* (Turn.) the *Haddock*.
   6. *Aſellus mollis major*, the *Whiting*.
7. Of the *non Spinous Kind*, with only 2 *ſoft Fins* on their Backs; are found with us,
   1. *Merlucius*, the *Hake*.
   2. *Aſellus longus*, the *Ling*.
   3. *Thynnus*, ſee *Thunnut*; the *Tunny*, or *Spaniſh Mackrel*.
   4. *Scomber*, the *Mackrel*.
   5. *Thymallus*, the *Gragling*, or *Umber*.
   6. *Albula Salmoni Similis*, the *Guinnard*.
   7. *Albula Harengi formis*, the *Schelley*.
   8. *Salmo*, the *Salmon*.
   9. *Salmulus*, the *Samlett*, or *Branlin*.
   10. *Salmo Griſeus*, the *Gray*.
   11. *Trutta Salmonata*, the *Salmon Trout*.
   12. *Trutta Lacuſtris*, the *Scurf*, or *Bull Trout*.
   13. *Trutta Fluviatilis duum generum*, the *Trout*.
   14. *Umbia Minor Geſn*, the *Red Charr*, or *Welſh Torgoch*.
   15. *Carpio Lacus Benaci*, the *Guilt* or *Guilt Charr*.
   16. *Eperlanus ſeu Violæ*, the *Smelt*.
   17. *Golius Niger*, the *Rock Fiſh* or *Sea Gudgeon*.
   18. *Lumpus Anglorum*, the *Lump* or *Sea Owl*.
   19. *Cataphractus Schonfeldii*, in the *Weſt* of *England*, a *Dog*.
8. Of the *non Spinous Kind*, with only 1 *Fin* on the Back; we have,
   1. *Harengus*, the *Herring*.
   2. *Harengus minor*, the *Pilchard*, called alſo *Calchis*.
   3. *Encraſſicholus*, the *Anchoris*.
   4. *Aloſa ſeu Clupea*, the *Shad* or Mother of Herrings.
   5. *Sardina*, the *Sprat* or *Sparling*; which is nothing elſe but the *Fœtus* of a Herring.
   6. *Acus Vulgaris*, the *Garr-Fiſh*, or *Horn-Fiſh*.
   7. *Sturio*, the *Sturgeon*.
   8. *Lucius*, the *Pike* or *Pickrel*.
   9. *Cyprinus*, the *Carp*.
   10. *Cyprinus Latus*, the *Bream*, or *Bruma*.
   11. *Tinca*, the *Tench*.
   12. *Orfus Germanorum*, the *Rudd*, *Oerve*, or *Nerſling*.
   13. *Capito, ſeu Cephalus*, the *Chub* or *Chevin*.
   14. *Barbus*, the *Barbel*.
   15. *Leuciſcus*, the *Dace* or *Dare*.
   16. *Rutilus, ſeu Rubellas*, the *Roach*.
   17. *Alburnus*, the *Bleak* or *Bley*.
   18. *Gobius Fluviatilis*, the *Gudgeon*.
   19. *Bobites Fluviatilis barbatula*, the *Loche*.
   20. *Varias, ſeu Phoxinus lævis*, the *Pink* or *Minnow*.

The laſt Twelve of theſe are called by us (*Malacoſtomi*) *Leather-mouthed Fiſhes*; becauſe they have no Teeth in their Jaws, but only deep down in their Mouths.

9. Of the *Spinous Kind* with 2 *Fins* on their Back, of which the Foremoſt is *aculeate*; we have,
   1. *Lupus*, the *Baſſe*.
   2. *Mugil*, the *Mullet*.
   3. *Gurcardus Piſcis*, the *Gray Garnard*.
   4. *Hirundo Aldrovandi*, the *Tub-Fiſh*.
   5. *Cuculus Aldrovandi*, the *Red Garnard*, or *Rotchet*.
   6. *Lyra prior Rondel*, the *Piper*.
   7. *Mullus major*, the *Sur-Mullet*.
   8. *Draco, ſive Araneus Plinii*, the *Spider*.
   9. *Frachurus*, the *Scud*.
   10. *Perca Fluviatilis*, the *Perch*.
   11. *Faber Piſcis*, the *Dorge*.

10. Of the *Aculeat Kind*, with only one Fin on the Back, whoſe *Radii* are ſome prickly, and ſome ſoft; we have,

1. *Aurata*, the *Gilt-head*, or *Gilt-poll*.
2. *Pagrus*, the *Bream*.
3. *Turdus vulg.* the *Old Wife* or *Wraſs*.
4. *Perca Fluviatilis minor, ſeu auratu*, the *Ruff*.
5. *Piſcis Aculeatus vulgaris, ſeu pungitius Aberti*, the Common *Prickle-Back*, or *Sharpling*, or *Banſtickle*.
6. *Piſcis aculeatus minor*, the leſſer *Prickle-Back*.

11. Of the *Cetaceous Kind*, we account only,

1. *Balæna Britannica Antiquorum*; which now ſeems to be gone from our Seas, and we ſcarce know what kind of Fiſh it was.
2. *Balæna vulg. Rondel*, the *Whale*, which is ſometimes found ſtranded on our Coaſts; or rambles up our Rivers.
3. *Delphinus Antiquorum*, the *Dolphin*, very rarely, but ſometimes ſeen here.
4. *Phocæna*, the *Porpuſs*, call'd by *Schonfeld*, the *Northern Dolphin*.

**FITS** *of eaſy Reflection* of the Rays of Light; ſo Sir *Iſaac Newton*, in his *Opticks*, calls the Diſpoſition of the Rays to be reflected at any Time; and their Diſpoſition to be tranſmitted, he calls,

**FITS** *of eaſy Tranſmiſſion*: And the Space it paſſes between every Return and the next Return, he calls the *Interval of its Fits*. *Opt.* Book II. *p.* 3. See *Light*.

**FIXED** *Stars*. The Phœnomena's that have been oſerv'd by Aſtronomers about the Fix'd Stars are theſe:

1. That they all, together alſo with the Planets, or Erratick Stars, and all the Celeſtial Bodies, do appear every Day to riſe and ſet; and to move with a Circular Motion from Eaſt to Weſt; the Plains alſo of theſe Diurnal Circular Revolutions being at Right Angles to the Earth's Axis, or Parallel to the Equator.

All which is fairly and eaſily accounted for, by ſuppoſing our Earth to revolve round its own Axis in 24 Hours, from Weſt to Eaſt. But the Eye of the Spectator moving together with the Earth, that muſt appear to him immovable; as a Ship doth to thoſe that are in it, till by Obſervation and Judgment they come to find it otherwiſe.

*Provehimur Portu, Cælique ac Aſtra recedunt.*

2. It hath been obſerv'd of the Fix'd Stars, that beſides the former apparent Motion round the Earth in 24 Hours, they alſo ſeem to have another which is quite contrary to that; for they appear to change their Longitude, or Diſtance from the Beginning of *Aries*, forward according to the Order of the Signs, or to move *in Conſequentia* by a ſlow Motion of about a Degree in 70 Years. So that thoſe Stars which in *Hipparchus*, nay even in *Ptolemy*'s Time, were in *Aries*, are now found to be in *Taurus*; and ſo on all round the Zodiack.

As to which, we muſt conſider that the *Terminus à quo*, or Point from whence this ſlow Motion is propagated, being the Vernal Equinoctial Point, or the Eaſtern Interſection of the Equinoctial and Ecliptick; till it can be determin'd whether this Point be fix'd or moveable, it cannot be known whether the Stars move from that, or that Point from them: And indeed the latter is much more probable, when we compare with this what certainly happens in other Inſtances in the Heavens. For 'tis well known now, that the *Nodes* of the Orbits of the ſecondary Planets, or the Points of their Interſection with the Ecliptick, do ſhift and change, and go a little backward, or move *in Antecedentia*; as is very evident in the *Nodes* of the Lunar Orbit: Why may it not be ſo then with the *Nodes* of the Earth's Orbit? The *Præceſſion* therefore of the Terreſtrial Equinoxes may ſerve to account for this Motion of the Fix'd Stars, ſince the Quantity will be found the ſame in both. For from the *Newtonian* Principles, it appears, the Terreſtrial *Nodes* ſhould go backward, after the Rate of about 50 Seconds every Year; and juſt ſo much the Fix'd Stars have been obſerv'd to move forward every Year.

3. It hath never been obſerv'd, that the Fix'd Stars have changed their Latitude, though, as before, they annually do their Longitude.

Which is a difficult Thing to account for without the New Aſtronomy. For allowing the former Motion of the Fix'd Stars, how can they all, and always, keep the ſame Diſtance from the Ecliptick? 'Tis true, the Celeſtial Orbits are all found to be in immovable Plains, but thoſe Plains are different, and do interſect each other with different Angles; nor is there any two of the Primary Planets, whoſe Orbits are in the ſame Plain. If therefore theſe Stars had any ſuch Motion, as that ſeeming one of Longitude, 'tis very likely that their Orbits would be poſited with reſpect to ſome one great and peculiar Plain, and which ſhould be inclin'd in a peculiar Manner to the Plains of the other Orbits, ſo as that their Orbits would interſect the Ecliptick, and the Orbits of the Planets; but ſince there is no ſuch Thing obſerv'd, 'tis likely, that Motion of Longitude belongs not to the Stars, but to the *Nodes* of the Earth's Orbit, as has before been ſhewn. But allowing that Receſſion of the Earth's *Nodes*, 'tis evident why the Stars ſhould have (or appear to have) a Motion in Longitude, but none in Latitude; becauſe that Receſſion of the Terreſtrial *Nodes* happens without any Change of the Earth's Annual Motion as to the Plain of the Ecliptick; for if the Stars themſelves are immovable, and the Earth's Orbit (or the Ecliptick) be always an immovable Plain, there can be no ſuch Thing as any Change in the Latitude of the Stars.

4. The Diameters of the Fix'd Stars are very ſmall, ſcarcely ſenſible even in the largeſt Teleſcopes, ſeen through which, they appear but like Lucid Points, and without any of thoſe adſcitious Rays which ſtrike the naked Eye.

5. The Fix'd Stars have no *Diurnal Parallax*, but, as hath lately been diſcover'd by Dr. *Hook* and Mr. *Flamſtead*, *a ſmall Annual one*; and conſequently their Diſtance muſt be immenſely great. In order to gueſs at which, Mr. *Hugens* ſuppoſes the Dog-Star, *Syrius*, to be about the Bigneſs of our Sun; and then conſiders how remote our Sun muſt be placed, before his Diameter would appear as little as that of *Syrius*: And on the whole, he concludes, that *Syrius* and the neareſt Fix'd Stars, cannot be leſs diſtant than 150000000000 of our Miles from the Earth, which is 27000 times as far off as our Sun is from us.

f And by that Annual Parallax which hath been ound to belong to the fix'd Stars, and is about 47 Seconds, they conclude, that they are diſtant from us about 9000 times the Radius of the *Magnus Orbis*, *i. e.* 9000 times as far off as the Sun; or about 500000000000 Miles.

6. The *Milky Way* is a circular Tract in the Heavens, extending over a very conſiderable Part of them; and is ſo call'd, becauſe it looks white and brighter than any other Part of the Sky. And this, by the Teleſcope is diſcover'd to be a Congeries of very ſmall Stars, which are ſingly inconſpicuous to the naked Eye.

7. There are above 1000 Stars which are viſible to the naked Eye; but the Teleſcope hath diſcover'd about 20 times as many more: And the larger and better thoſe Glaſſes are, the more are ſtill diſcover'd.

8. The Light of the Fix'd Stars is much more ſtrong and vivid than that of the Planets, tho' their apparent Diameters are much leſs; becauſe the Stars, like the Sun, ſhine by their own Native Light, but the Planets only by Reflection from the Sun.

9. The Fix'd Stars are obſerv'd to twinkle much more than the Planets: becauſe their apparent Diameters being very inſenſibly ſmall, the leaſt Atom or Particle of Matter floating in our Atmoſphere will hinder (for a Moment) the Stars being entirely viſible. As the groſs Smoak of a Chimney will do by the Planets themſelves, which in ſuch a Caſe will twinkle.

That there are Changes and Alterations among the Fix'd Stars, hath appear'd by the Obſervations of our Modern Aſtronomers.

In *Phil. Tranſ. N.* 73. there is an Account that *S. Montanari* found two Stars of the 2d Magnitude wanting in the *Navis*, in the Year 1668, *April* 10. which were certainly viſible before. And that he had made many ſuch Obſervations of Stars of leſs Note.

*Caſſini* hath diſcover'd alſo many new Stars: One of the 4th, and two of the 5th Light, in *Caſſiopæia*; two others in *Eridanus*; and four towards the *Arctick* Pole, which he is ſure were not viſible formerly. He takes Notice alſo of ſeveral in *Bayer's* Catalogue, which do now diſappear. *Hevelius*, in 1666, found a new Star *in Pectore Cygni*. And *Don. Anthelme*, a Carthuſian at *Dyon*, another in the Head of that Conſtellation. And this both he and Mr. *Caſſini* obſerv'd to be twice in great Splendor, and as often diminiſhing.

*Bullialdus* obſerv'd the new Star in the Neck of the *Whale*, to be very different in his Magnitudes at different Times. And *Hevelius* obſerves the ſame Thing of another Star in the ſame Conſtellation.

From all which Obſervations, and many others might be produc'd, 'tis plain, there are very great Changes and Alterations amongſt even the Fixed Stars themſelves.

And if that noble Conjecture of our Modern Aſtronomers be true, that each Fix'd Star is a Sun to ſome Syſtem of Planets moving round him, as we do round the Sun, there muſt needs be terrible Changes in thoſe Planetary Worlds; and thoſe probably both Conflagrations and Deluges. Of this, ſee more in *Whiſton's Aſtronomy*, p. 46.

Dr. *Hook*, *Op. Poſthum.* p. 109. gives very probable Reaſons why the Fix'd Stars ſhould be of the ſame Nature with the Sun; which are drawn from their *vaſt Diſtance*, and their affecting our Eyes with ſo ſtrong and vivid a Light; which they could not do, if they were not actually blazing Fires: And that they are ſo, the Diſappearance of ſome Stars, which have formerly been viſible, and the Appearance of new ones, doth much confirm.

And the incomparable Sir *Iſ. Newton*, in the Latin Edition of his Opticks by Mr. *Clark*, hath, to *p.* 83. added this Note; by which we may conclude the Fixed Stars to be at an immenſe Diſtance from us.

" That the Fixed Stars, by reaſon of their im-
" menſe Diſtance, are to be look'd upon as Points,
" (unleſs ſo far as their Light is dilated by Re-
" fraction) is plain from hence: That when by
" the Moon's Appulſes to them they are eclipſed
" or cover'd by her Body, their Light doth not,
" like that of the Planets in the like Caſe, va-
" niſh or diſappear gradually, but at once and
" all together; and when they emerge again out
" of the Eclipſe, they don't become viſible by de-
" grees, but, as it were, inſtantaneouſly, or at
" leaſt in the Space of 1 or 2 Seconds.

Beſides what hath been ſaid in the former *Vol.* and above, Dr. *Cheyne* adds this further Gueſs at the Immenſity of the Diſtance of the Fix'd Stars.

Tho' we on this Globe approach nearer to ſome of them about 24000 Diameters of the Earth, *i. e.* about 188304000 Miles (of 5000 Foot in a Mile) at one time of the Year than we do at another; yet their Parallax, if any at all, is ſcarcely then ſenſible, which it muſt be, if they were at an eſtimable Diſtance from us.

Mr. *Huygens* computes, that the Diſtance of the Sun, to that of the neareſt Fix'd Star, is as 1 to 27664. That is, (allowing the Diſtance of the Sun to be 12000 Diameters of the Earth, and a Diameter to be 7846 Miles, according to the beſt Calculations) the Diſtance of the neareſt Fix'd Star from us, is at leaſt 2404520928000 Miles; which is ſo great, that if a Cannon Ball (going all the Way with the ſame Velocity it hath when it parts from the Mouth of the Gun) would ſcarce arrive there in 700000 Years.

In *Philoſ. Tranſ. N.* 202. there is a Method of finding the Parallax of the Fix'd Stars, which Dr. *Wallis* acquaints Mr. *Molyneux* with; but both thoſe Perſons are ſince dead.

FIXITY. To the Production of this Property of Fixity, there is neceſſary chiefly a Suppoſition of the Particles *attracting* one another, within a certain Diſtance, with a very violent Force; or elſe they could never keep together, when preſs'd by a violent Heat; which yet we find the Particles of ſome fix'd Bodies will do. See *Coheſion.*

FLAME-*heat.* The ſame with a *White-heat*; which ſee.

FLAT-*pointed Nails*, are of two Sorts, the *longer* are uſed in Shipping, and are very proper to hold where you cannot clench; the *ſhorter* are fortified with Points to drive into Oak, and are uſed to draw Sheathing-Boards to, *&c.*

FLAW, at Sea, ſignifies a ſuddain Guſt of Wind, which ſometimes alſo the Seamen call a *Squale.*

FLEXION and *Retrogreſſion of Curves.* See *Contrary Flexion.*

FLIGHT. In melting the Lead-Oar in the Works in *Mendip*, there is a Subſtance flies away in the Smoak, which they call therefore the *Flight.* They find it ſweetiſh upon their Lips, if their Faces happen to be in the Way of the Smoak; which they

they avoid all they can. This falling on the Graſs, kills Cattle that feed there; and being gather'd and carried Home, kills Rats and Mice in their Houſes. That which falls on the Sand, they gather and melt (upon a *Flag-hearth*) into Shot and Sheet Lead.

FLORENS, were Gold Coins in the 18th of our *Edw.* III. of the Value of 6 Shillings. *Cambden* ſaith, they were ſo called, becauſe made by *Florentines*: And *Fabian* ſaith, they were not of ſo fine Gold as the Nobles and half Nobles of that Prince.

But what is moſt obſervable, is, that *Fabian* calls the *Floren* a Penny, val. 6 *s.* 8 *d.* the half *Floren* an Halfpenny, val. 3 *s.* 4 *d.* the Quarter *Floren* a Farthing, val. 1 *s.* 8 *d.* And theſe Words you will often meet with in old Hiſtories and Accounts, applied to ſeveral Coins, as Rials and Angels, *&c.* where you are to underſtand, by *Denarius* the whole, by *Obolus* the half, and by *Quadrans* the 4th Part or Farthing. *Chr. Preciosum*, p. 22.

By Indenture of the Mint, in 18 *Edw.* III. every Pound Weight of old Standard Gold was to be coined into 50 *Florences*, to be current at 6 Shillings a-piece; all which made, in Tale, fifteen Pounds: Or into a proportionable Number of half or quarter *Florences*. *Cowel's Interpreter.*

FLUIDITY. Beſides what hath been ſaid of this Quality in the former *Vol.* I muſt add here, That the Corpuſcular Philoſophy, before Sir *Iſ. Newton*'s wonderful Improvement of it, did not go to the Bottom of this Matter; for it gave no Account of the Cauſe of the chief Condition requiſite to conſtitute a Fluid Body, *viz. the various Motions and Agitations of its Particles.* But this may be in a good Meaſure accounted for, if you ſuppoſe it to be one of the Primary Laws of Nature, that as all Particles of Matter do *attract* one another when they come within a certain Diſtance, ſo, at all greater Diſtances from one another, they do fly away from, and avoid one another. For then, though their common *Gravity* may keep them together in a Maſs, together (it may be ſometimes) with the Preſſure of other Bodies upon them; yet their continual Endeavour to avoid one another *ſingly*, and the adventitious Impulſes of Light, Heat, or other external Cauſes, may make the Particles of Fluids continually move round about one another, and ſo produce this Quality. It is, indeed, a Difficulty I cannot yet get over, to account for the Particles of Fluids always keeping at ſuch a Diſtance from one another, as not to come within the Sphere of one another's Attraction. The Fabrick and Conſtitution of that fluid Body of Water is wonderful and amazing, that a Body ſo very rare as that is, and which has ſuch a vaſt Over-proportion of Pore, or interſperſed Vacuity, to ſolid Matter, ſhould yet be perfectly incompreſſible by the greateſt Force. And yet this Fluid is eaſily reducible into that firm, tranſparent, friable Body, which we call Ice; by being only expoſed to a certain Degree of Cold. One would think here, that though the Particles of Water cannot come near enough to attract each other, yet the intervening Frigorifick Matter doth, by being mingled *per minima* with them, ſtrongly attract them, and is itſelf alſo ſtrongly attracted by them, and ſowedges or fixes all the Maſs into a firm ſolid Body: Which ſolid Body loſes its Solidity again, when by Heat the Vinculum is ſolv'd, and theſe Frigorifick Particles are disjon'd from thoſe of the Water, and are forc'd to fly out of it. And perhaps juſt thus doth the Fumes of Lead fix Quickſilver.

When a firm ſolid Body, ſuch as a Metal, is by Heat reduc'd into a Fluid; doth not the Fire disjoin and ſeparate its conſtituent Particles, which *mutual Attraction* cauſed to *cohere* before, and keep them at ſuch a Diſtance from each other, as that they are without the Sphere of one another's Attraction as long as that violent Motion laſts? And don't they, when that is over, and the Heat is flown out, come nearer to, attract one another, and coaleſce again?

As therefore the Cauſe of Coheſion of the Parts of ſolid Bodies appears plainly to be their mutual Attraction; ſo the chief Cauſe of Fluidity ſeems to be a contrary Motion impreſſed on the Particles of Fluids, by which they avoid and fly one another as ſoon as they come at, and as long as they keep at ſuch a Diſtance from each other.

'Tis obſerv'd alſo in all Fluids, that the Direction of their Preſſure againſt the Veſſels that contain them, is in Lines perpendicular to the Sides of ſuch Veſſels; which Property being the neceſſary Reſult of the Particles of any Fluids being ſpherical, it ſhews that the Parts of all Fluids are ſo, or of a Figure very nearly approaching thereunto. For Fluids in an Animal Body, ſee *Glands* in *Vol.* II.

FLUTES, in Architecture, are the Hollows made in the Body of a Column or Pillar, and which then is ſaid to be *Fluted.* The Dorick, Ionick, Corinthian and Compoſite Columns, are uſually *fluted* all along the Body of the Pillar, from the Baſe to the Capital. Each Column hath 24 Flutes, and each Flute is hallowed in exactly a quarter of a Circle. In the Dorick Column the Flutes join together without any Interſpace; but in the Ionick, Corinthian and Compoſite Orders, there runs a Liſt between every two Flutes.

FLUXIONS. This general Method of finding the Fluxions of all Powers and Roots, I had from the Honourable *Fr. Robartes*, Eſquire.

If a Quantity gradually increaſes or decreaſes, its immediate Increment or Decrement is called its *Fluxion.*

Or the Fluxion of a Quantity is its Increaſe or Decreaſe indefinitely ſmall.

Let a Quantity $x$ be put into Fluxion, whereby it becomes $x \dot{x} \pm \dot{x}$ ($\dot{x}$ repreſenting an Increment or Decrement indefinitely little, being called the Fluxion of $x$).

Now the Fluxion of all the Powers, and of all the Roots of $x$, may be found by this general Rule:

As $x + \dot{x}$ contains the ſimple Quantity and its Fluxion; ſo the Square, Cube, *&c.* and the Square Root, Cube Root, *&c.* of $x + \dot{x}$ muſt contain the reſpective *Powers* or *Roots* of $x$ with its Fluxion reſpectively.

And conſequently, if the *Flowing Quantity* be reſpectively ſubſtracted, the *Fluxion* only muſt remain.

Thus the Fluxion of $x\,x$, is $x \mp \dot{x} \times x \mp \dot{x} = x\,x = 2\,x\,\dot{x} \mp \dot{x}\,\dot{x}$: And the

Fluxion of $x\,x\,x$ is $x \dot{+} \dot{x} \times 2\,x\,\dot{x} \dot{+} \dot{x}\,\dot{x} + x\,x$ $- x\,x\,x = 3\,x\,x\,\dot{x} \dot{+} 3\,\dot{x}\,\dot{x}\,x \dot{+} \dot{x}\,\dot{x}\,\dot{x}$.

But since $x\,x$, Part of the Fluxion of $x\,x$, is infinitely ſmaller than $2\,x\,\dot{x}$, whereby it can make no ſenſible Change in that Quantity, it may be laid aſide as of no Value.

And for the ſame Reaſon, $3\,x\,\dot{x}\,\ddot{x} + \ddot{x}\,x\,x$ may be left out of the Fluxion of $x\,x\,x$; ſo that their remains only

$\left.\begin{matrix} 2\,x\,\dot{x} \\ 3\,x\,x\,\dot{x} \end{matrix}\right\}$ for the Fluxion of $\left\{\begin{matrix} x\,x \\ x\,x\,x \end{matrix}\right.$

Thus alſo the Fluxion of $\sqrt{x}$ is $\sqrt{x} \dot{+} \dot{x}$ $- \sqrt{x} = \frac{\dot{x}}{2\sqrt{x}}$; which will be evident, by only extracting the ſquare Root of $x + \dot{x}$ according to the common Method, thus;

$$x + \dot{x} \left( \sqrt{x} + \frac{\dot{x}}{2\sqrt{x}} \right.$$

$$2\sqrt{x}) \overline{\begin{matrix} x \\ 0 \end{matrix}} + \dot{x}$$

$$\begin{matrix} \dot{x} \\ \hline 0 \end{matrix} \qquad \frac{\dot{x}\,\dot{x}}{4x}$$

The Fluxion of

$$\left.\begin{matrix} \sqrt[3]{x} \\ \sqrt[3]{x} \\ \sqrt{x\,x\,x} \end{matrix}\right\} = \left\{\begin{matrix} \frac{\dot{x}}{3\sqrt[3]{x\,x}} \\ \frac{2\,\dot{x}\,x}{3\sqrt[3]{x\,x\,x\,x}} \\ \frac{3\,x\,x\,\dot{x}}{2\sqrt{x\,x\,x}} \end{matrix}\right.$$

So that $\sqrt{x \dot{+} \dot{x}}$ is equal to $\sqrt{x} + \frac{\dot{x}}{2\sqrt{x}}$ $\sqrt{x}$, which is equal to $\frac{\dot{x}}{2\sqrt{x}}$ the Fluxion of $\sqrt{x}$, as above.

Indeed $\sqrt{x} + \frac{x}{2\sqrt{x}}$ is the true Root of $x + \dot{x} + \frac{\dot{x}\,\dot{x}}{4x}$ as the Operation ſhews, and conſequently ſomewhat bigger than the Root of $x + \dot{x}$. But $\frac{\dot{x}\,\dot{x}}{x\,4}$ being indefinitely leſs than what is annex'd to the Difference between $x + \dot{x} + \frac{\dot{x}\,\dot{x}}{4x}$ and $x + \dot{x}$, may be conſider'd as of no Value. Wherefore $\sqrt{x} + \frac{\dot{x}}{2\sqrt{x}}$ may be taken for the true Root of $x + \dot{x}$.

Authors Names who have written of Fluxions:

*D. Bernoulli Tractatus de Principiis Calculi Exponentialis.*

*Nieuwentyt's Analyſis Infinitorum. Amſter.* 1695.

Dr. *Cheyne's Fluxions*, with *Moivre's Animadverſions* on them; and the Doctor's Reply.

*Hays's Fluxions. Lond.* 1704.

*Analyſe des Infiniment Petits. Par l' Hoſpital Fr. Paris*, 1696.

*Le Calcule Integrale, par M. Carre. Paris*, 1700.

Mr. *Abraham de Moiver's* Uſe of *Fluxions*, in the Solution of Geometrick Problems. See *Philoſ. Tranſ.* N. 216.

Mr. *Humphrey Ditton's* Inſtitution of Fluxions.

FLYBOAT, is a large Veſſel with a broad Bow; uſed by Merchants in the Coaſting Trade. Some of theſe will carry 800 Tun of Goods.

FLYERS, is the Workmens Term in Architecture for Stairs that go ſtrait, and don't wind round; nor are the Steps tapering, but the fore and back Part of each Stair and the Ends are reſpectively parallel to one another. So that if one Flight don't carry you to your deſign'd Height, there is a broad half Space; and then you fly again with Steps every where of the ſame Breadth and Length, as before.

FLYING *Bridges*, in Fortification, are made of two ſmall Bridges laid one upon the other, ſo that the uppermoſt, by the means of Ropes and Pullies, is forc'd forwards 'till the End of it join to the Place deſign'd.

FOCUS. Dr. *Hook, Op. Poſthum. p.* 122, very well accounts for the Reaſon of the great Effect of Burning Glaſſes, thus: Suppoſe there be one, either Concave or Convex, of a Foot in Diameter; this will conſtipate or crowd together all the Rays of the Sun, which fell before on the Area of a Circle 12 Inches in Diameter, into the Compaſs of $\frac{1}{8}$ of an Inch. The Area's then of the two Circles will be as 9216 to 1; and conſequently, the Heat of the Leſſer, to the Heat of the Greater, will be reciprocally as 9216 to 1: That is, the Heat in the Focus will exceed the Sun's common Heat at that time 9216 Times. And this will have an Effect, as great as the direct Rays of the Sun would have on a Body plac'd at one 96th Part of the Diſtance of the Earth from the Sun, or on a Planet that ſhould move round the Sun, at but a very little more than a Diameter of the Sun's Diſtance from him, or that would never appear further from him than about 36 Minutes.

FODDER, or *Fother* of Lead, is a Weight containing eight Piggs; every Pigg three Stone and an half. In the Book of Rates, a Fodder of Lead is ſaid to be 2000 lb. Weight; at the Mines, it is $22\frac{1}{2}$ Hundred; and among the Plumbers, at *London*, it is but $19\frac{1}{2}$ Hundred.

FOETUS. The *Fœtus* is almoſt of an Oval Figure, whilſt it lies in the Womb: For its Head hangs down with its Chin on its Breaſt; its Back is round; with its Arms it embraceth its Knees, which are drawn up to its Belly; and its Heels are cloſe to its Buttocks; its Head is upwards, and its Face is towards the Mother's Belly. But about the 9th Month, in the Humane Fœtus, the Head, which was ſpecifically lighter than any other Part, becomes ſpecifically heavier; its Bulk bearing a much ſmaller Proportion to its Subſtance than it did before; and conſequently it muſt now tumble and ſink down in that Liquor in which it ſwam, as it were, before: So its Head falls down, its Feet get up, and its Face turns towards the Mother's Back. But becauſe 'tis then in an irkſom, tho' proper, Poſture for its Exit, the Motion it makes for Relief gives frequent and great Pains to the Mother; which cauſe a Contraction of the Womb, for the Expulſion of the *Fœtus*. When it happens to preſent it ſelf in any other Poſture, it ſhould be care-

carefully put back again; and, if poſſible, turn'd the right Way by the Midwife: But if that can't be done, it ſhould be drawn out by the Feet.

FOLIATE. In *Phil. Tranſ.* N. 245. there is a Way, communicated by Sir *Rob. Southwell*, of foliating the Globe Looking-glaſſes. The Mixture is of Quickſilver and Marchaſite of Silver, of each 3 Ounces; Tin and Lead, of each half an Ounce. Theſe two firſt thrown on the Marchaſite, and laſt of all the Quickſilver. Stir them well together over the Fire; but they muſt be taken off it, and be towards cooling, before the Quickſilver is put to them. When you uſe it, the Glaſs ſhould be well heated, and very dry: But it will do alſo when 'tis cold, but beſt when the Glaſs is heated.

This is a little odly expreſs'd: But I ſuppoſe 'tis meant, that the Marchaſite ſhould be powder'd, the Lead and Tin melted and poured upon it, and then all well ſtirred and mixed together while in Fuſion; and afterwards, when 'tis almoſt cold, the 3 Ounces of Mercury put to it to make the Amalgam.

FOLK-*Land*, was the *Terra vulgi*; the Land of the Common People who had no Eſtate therein; but held the ſame under ſuch Rents and Services as were accuſtomed or agreed, at the Will only of their Lord the *Thane*; and therefore their *Bargain was not put in Writing*, as that about the *Boc-Land* was, but was accounted *Prædium Ruſticum & Ignobile*.

FOLKMOTE, was the general Word for a Popular Convention of all the Inhabitants of any Place; which if it were of thoſe of a City or Town, it was called a *Burgh-mote*; but if of all the Free Tenants of a County, 'twas called a *Schire-mote*. In Towns and Burghs, this ſolemn Aſſembly was made by the Sound of a Bell call'd the *Motbell*. In the County *Folk-mote*, all Knights and Free Tenants did their Fealty to the King, and elected their annual Sheriff formerly, (on the 1ſt of *October*) before the King nominated. But after that, (about the Time of *Edward* II.) the City *Folk-mote* was changed into the Common-Council, and the County *Folk-mote* into the *Sheriffs Turn* and *Aſſiſes*. The Word *Folk-mote* had alſo ſometimes a leſs Extent, ſignifying only the Aſſembly of the Tenants to a *Court Leet* or *Baron* of their Lord.

FOOT-*Bank*, or a *Banquette*, in Fortification, is a ſmall Step of Earth on which the Soldiers ſtand to fire over the Parapet.

FOOT-*gelde*, was an antient Amerciament for not cutting out the Balls of the Feet of great Dogs in the Foreſt; which was done for preventing their running after the King's Deer; and was called *Expediation*.

FORAMEN *Arteriæ Duræ Matris*, is a Hole in the *Cranium*, which allows a Paſſage for the Artery belonging to the *Dura Mater*.

FORAMEN *Lacerum*, in the 3d Hole in the *Os Phæroides*, by which the 3d Pair of Nerves paſs out of the *Cranium*.

FORE-*Staff*, is an Inſtrument uſed at Sea to take the Sun's Altitude, or the Heighth of the Moon, or any Star in the Night; and 'tis ſo call'd, becauſe when 'tis uſed, your Face is to the Object: Whereas in the Uſe of the *Back-ſtaff*, or *David's Quadrant*, the Back of the Obſerver is towards the Sun. The Fore-ſtaff is the ſame with the Croſs-Staff: Which you will find fully deſcrib'd in this *Vol.* under that Word.

FORMELLA, was a Weight of Lead, which in 51 *H.* 3. *A. D.* 1267. is ſaid to contain ſix *Petræ*, except 2 lb. Each *Petra* contain'd 12 lb. and each Pound contain'd the Weight of 25 Shillings.

FORNICATION, is ſometimes uſed in Architecture, to ſignify Arching or Vaulting.

FORTIFICATION. Writers on this Subject.

Sir *Jonas Moor*'s Modern Fortification. *London*, 1673. 8*vo*.

*Nouvelle Maniere de Fortifier les Places, par M. Blondel. Hague*, 1684.

*La Grand Art d' Artillerie, par Caſimir Symyenwicks. Frankfort*, 1676.

*Les Fortifications d' Antoine de Ville. Lyon*, 1618.

*Fortificationi di Buono ajuto Lorini. Venet.* 1597.

*Corona Militari d' Artiglieria di Aleſſandro Capo. Ibid.* 1602.

*F. L. Vegetius & alii de Re Militari, cum Fig. Paris*, 1535.

*Coborn*'s Fortification, *Engl.* by Cap. *Savery*.

*Blondell's Art de Jetter des Bombes*.

*Anderſon*'s Gunnery.

Fortification and Military Diſcipline, by C. *John Steed*.

*Norwood*'s Fortification.

*L' Arte de Fortifier, par M. Dechales*.

*L' Arte de Fortification, par M. Ozanam*.

FORTINGLES, the ſame with *Farthingdell*; *i. e.* the 5th Part of an *Acre*, *Penny*, &c.

FORTITUDE, is that Virtue which enables us to perſevere in doing well, notwithſtanding any Dangers, Obſtacles or Difficulties we may meet with in the Performance of what we know to be our Duty.

FOSSA, is, according to ſome Anatomiſts, the Term for the Middle Part of the *Corvix*, or Hinder Part of an Humane Neck. The Upper Part being called *Lophia*, and the Lower *Epimis*.

FOSSATORUM *Operatio*, was antiently the Service of Work and Labour done by Inhabitants and adjoining Tenants for Repair and Maintenance of the Ditches round the City or Town, for which ſome compounded, paying a Duty called *Foſſagium*.

FOTMEL, in Old Times, was a Weight of Lead containing Ten Stone, or, at that time, Seventy Pounds; as appears from the *Cartul. St. Albani, MS.* in the *Cotton* Library.

FOUCADE, the ſame with *Fougade*.

FOUNDAY, is a Word uſed in the Iron Works, for the Space of ſix Days; in which time they uſually make about 8 Tun of Iron.

FOURNEAU, is the *Powder Chamber*, or the *Chamber of a Mine*, which holds the Powder in Barrels or Sacks, (uſually about 1000 lb. Weight) which by means of the *Saucidge* is fired, and ſo the Mine is ſprung.

FRACTIONS. Beſides the common one, given in *Vol.* I. there is alſo another Notion of a Fraction; which is very neceſſary to be underſtood, beauſe it will be of uſe to ſhew the Reaſon of many of the vulgar Rules and Operations in Fractions. Thus ſuppoſe $\frac{3}{4}$ of 20 *s.* or of a Pound Sterling, were the Fraction; this Fraction, inſtead of three quarters of one Pound, may be conſider'd as a fourth Part of three Pounds: That is, by taking as many of the Integers as the Numerator expreſſes, (*viz.* 3.) and dividing them by 4, the Denominator; for then a Quotient of the ſame Value will ariſe, (for 4) 60 *s.* (15 *s.*) And this ſhews you the Reaſon of that manner

manner of Expreſſion which is uſed by Geometers and Algebraiſts about Fractions; who read $\frac{a}{b}$, thus, *a* divided by *b*.

FRACTIONS *Decimal.* See *Decimal.*

FRACTIONS *Sexageſimal.* See *Sexageſimal.*

FRACTIONS *in Algebra.* A *Fraction* is a broken Number or Quantity, expreſſing the Parts of ſome Integer. It conſiſts of two Parts, with a Line of Separation placed between them. Of which, that above the Line is called the *Numerator*, becauſe it *Enumerates* or tells you how many of the Parts of the Integer the Fraction contains: And that below the Line is call'd the *Denominator*; becauſe it *Denominates* or expreſſes the Nature of the Parts the Integer is ſuppoſed to be divided into. Thus,

Suppoſe $a = 3$ and $b = 4$, then will $\frac{a}{b}$ or $\frac{3}{4}$ be a Fraction, expreſſing, that ſome Interger being divided into 4 Parts or *Quarters*, there is taken 3 of them, or 3 Quarters.

A Fraction is either *Proper*, when the *Numerator* is leſs than the *Denominator*, as $\frac{3}{4}$: Or *Improper*, when the *Numerator* is equal to it, or greater: As $\frac{4}{4}$ or $\frac{4}{3}$ are Improper Fractions; becauſe one expreſſes the whole *Integer*, and the other more than the *Integer*; however 'tis often of good Uſe to expreſs Quantities after this Way.

The Operations about Algebraick Fractions, or Fractions expreſt by Letters, are much of the ſame Nature with thoſe in common Arithmetick.

I. All Fractions ought firſt to be reduc'd to their loweſt Terms; which is done by dividing both Numerator and Denominator, by their *greateſt common Deviſor*; that is, the *greateſt* Quantity which can divide both. For then the Quotient will be a Fraction of the ſame Value as the former, but in the ſmalleſt Terms that can be. Thus, $\frac{3aa}{6a}$, by dividing both Parts by $3a$, will be brought down to $\frac{a}{2}$ or $\frac{1}{2}a$. And $\frac{4a^3}{6a^4}$ being divided by its greateſt Common Diviſor $2a^4$, will be reduc'd to $\frac{2aa}{3}$

$$4z) 36zz \quad (9z$$
$$4z) 4bz + 16dz \quad (b + 4d$$

And this may moſt times be done by Inſpection, by caſting out of both *Numerator* and *Denominator* ſuch Letters as are multiplied into both of them; as in theſe Examples.

But ſuch greateſt Common Deviſor may be found in all Caſes where the Eye cannot readily diſcover it, by dividing the Denominator by the Numerator, and the laſt Deviſor by the Remainder, if any be; and ſo on, 'till there come to remain nothing: And then that laſt Deviſor is the greateſt Common Meaſure. But if Unity, or 1, remain at laſt, then the Fraction was in its loweſt Terms at firſt, and cannot be reduc'd to any ſmaller Terms. This Practice is the ſame as in Vulgar Fractions; and you have an Example of it in *Species* in *Ward's* Algebra, *Chap.* 4.

II. To reduce any Integer, as *b* or $a + c$, to the Form of an Improper Fraction, draw the Line of Separation, and under it write 1, then it will ſtand $\frac{b}{1}$ or $\frac{a+c}{1}$, which, tho' in the Form of Fractions, are not alter'd, becauſe 1 neither Multiplies nor Divides.

If a *Denominator*, as *d*, were given: Firſt Multiply the given Integer by ſuch Denominator, and then write the Denominator under the Product. Thus,

$$\frac{db}{d} = b, \text{ and } \frac{da + dc}{d} = a + c.$$

III. To reduce Fractions of different Denominators, to others of the ſame Value that ſhall have a Common Denominator; (*which Operation muſt always precede Addition and Subſtraction in Fractions.*) You muſt firſt bring the Fractions down as low as you can; (by *Rule* 1.) then Multiply a-croſs the Numerator of the firſt into the Denominator of the ſecond, for a new Numerator of the firſt Fraction; then the Numerator of the ſecond into the Denominator of the firſt, for a new Numerator for the ſecond Fraction; and laſtly, Multiply the Denominators one into another, for a Common Denominator. Thus, let $\frac{a+b}{d}$ and $\frac{bb}{f}$ be given, and they will by this Rule be reduced to $\frac{fa+fb}{df}$, and $\frac{dbb}{df}$; Fractions in Value equal to the former.

The Reaſon of which is plain; for each Fraction is Multiplied and Divided by the ſame Quantity or Letter, and therefore muſt retain the ſame Value as before, tho' reduc'd to another Form:

$$\frac{4}{6} \quad \frac{3}{4}$$
$$\frac{16}{24} \quad \frac{18}{24}$$

For every Fraction being Multiplied by Multiplying its Numerator, but Divided by Dividing it; and being alſo Multiplied by Dividing the Denominator, and divided by Multiplying it:

It follows, That each Fraction will gain as much by the Multiplication of its Numerator, as it loſes by the Multiplication of its Denominator. And, *Vice verſa*, in caſe of Diviſion, by one and the ſame Quantity.

If there are more than two Fractions, every Numerator muſt be Multiplied continually into all the Denominators but its own; and the Denominators one into another continually for a new Denominator. *E. gr.* $\frac{a}{x}, \frac{b}{y}, \frac{c}{z}$, will be reduc'd to this Form $\frac{ayz}{xyz}, \frac{bzx}{yzx}, \frac{cyx}{zyx}$, which are Fractions of the ſame Value as the former (as is apparent by ejecting the Common Letters) but reduc'd to a Common Denominator.

IV. And when this is once underſtood, *Addition* and *Subſtraction in Fractions* are perform'd by only Adding or Subſtracting the *Numerators*, and

and Subscribing the *Common Denominator* before found. Thus,

If the Fractions $\frac{a+b}{d}$ $\frac{bb}{f}$, were to be *Added* or *Substracted*; they will stand, when reduc'd (by *Rule* 3.) in this form, $\frac{fa+fb+fbb}{df}$, or $\frac{fa+fb-fbb}{df}$: The former of which is the *Sum*, the latter the *Difference*, of the two given *Fractions*.

V. *Multiplication in Fractions*, is perform'd by Multiplying the Numerators into one another for a new Numerator, and the Denominators for a new Denominator, the Fractions having been first reduced to their lowest Terms. Thus,

$\frac{a}{b} \times \frac{d}{c} = \frac{da}{bc}$, and $\frac{a+b}{c} \times \frac{a-b}{d} = \frac{aa-bb}{cd}$.

Hence, if any Fraction be Multiplied by the Denominator, or by some Integer the same with it, the Numerator is the Product. As $\frac{aa}{b} \times b = aa$, for $\frac{aa}{b} \times \frac{b}{1} = \frac{aab}{b}$; which, casting off the Common Letters in both Parts, leaves $aa$.

Also, if any Fraction be to be Multiplied by some Letter or Letters that are found in every Member of the Denominator, the Multiplication may be made only by ejecting such Letters out of the Denominator: As $\frac{ab}{cd}$ Multiplied by $d =$ to $\frac{ab}{c}$.

VI. *Division in Fractions*, is perform'd (after Reduction, according to *Rule* 3.) by Multiplying the Numerator of the Dividend by the Denominator of the Devisor, for a *Numerator*; and the Denominator of the Dividend by the Numerator of the Divisor, for a new *Denominator*: As in *Vulgar Fractions*. Thus,

$$\frac{a}{b} ) \frac{d}{c} ( \frac{bd}{ac}$$

The Reason of which is plain, from what was said above, That a Fraction is Divided by Multiplying its Denominator. Thus,

$$\frac{3}{4} ) \frac{12}{16} ( \frac{48}{48} = 1.$$

For to divide $\frac{12}{16}$ by $\frac{3}{4}$, is to seek how often 3, the Numerator of the Devisor, is in $\frac{12}{16}$; which is done by Multiplying 16 by 3, and the Answer is $\frac{12}{48}$: But then again, because $\frac{3}{4}$ is but $\frac{1}{4}$ of 3, it will be contain'd in $\frac{12}{16}$ 4 times oftner than 3 is; and therefore, in order to bring it to a *Par*, Divide the Value of that Fraction by Multiplying its Denominator by 12, and the Product 48 will be the Numerator of the Quotient.

But if it happen that the Fractions have a Common Denominator, then cast off that, and divide one Numerator by the other. Thus,

$\frac{a}{b} ) \frac{c}{b} ( = \frac{c}{a}$, and $\frac{b}{a} ) \frac{bb}{a} ( = b.$

For Fractions having a Common Denominator, are as their Numerators.

VII. A Mixt Quantity or Number, is that which is part Integer, and part Fraction. As $aa + \frac{b}{c}$: Such Quantities are reduc'd to the form of improper Fractions, by first Multiplying the Integral Part by the Denominator of the Fractional Part; then adding the Numerator to it, and subscribing the Denominator under all. Thus, the former Quantity $aa + \frac{b}{c}$ is Reduc'd to this improper Fraction $\frac{caa+b}{c}$.

Every improper Fraction is Reduc'd back again into its equivalent Mixt Number or Integer, by dividing the Numerator by the Denominator. Thus, $\frac{caa+b}{c}$ divided by $c$, quotes $aa + \frac{b}{c}$; and $\frac{aa}{1}$ divided by 1, makes $aa$.

FRAISING *of a Batallion*, is to line the Musketiers all round with Pikes, in case of their being charg'd by a Body of Horse.

FRANKPLEDGE, *Franciplegium visus Franciplegii*, was the Antient Custom for the Freemen of *England*, at 14 Years of Age, to find Surety for their Truth and Fidelity to the King, and good Behaviour to their Fellow Subjects. This Surety, among the *Saxons*, was taken in their *Friborg*, *Lath*, or *Tithing-Court*; and after the *Norman Conquest*, it was call'd *Frankpledge*, and was continu'd in the *Court-Leet* of Royal Jurisdiction to be held annually on the Feast of St. *Michael* by *Magna Charta*.

So that to have *Visum Franciplegii*, View of *Frankpledge*, was no more than to have the Privilege of holding a *Court Leet*; and this Power was determin'd by Stat. 8 of *Edw.* II. and 1 of *Edw.* III. The Place of holding such Courts was, if it were fair Weather, on some open Green; but if it was bad Weather, they adjourn'd to the Mannor House, or to that of some adjoyning Tenant. *Kennet P. Antiq.*

FREEZING. The true Cause of the Congelation of Water into Ice, seems plainly to be the Introduction of the Frigorifick Particles into the Pores or Interstices between the Particles of the Water; and by that means, getting so near to them, as to be just within the Sphere of one another's *Attracting Force*, (see *Attraction*) and then they must cohere into one solid or firm Body. But Heat afterwards separating them, and putting them into various Motions, breaks this Union, and separates the Particles so far from one another, that they get out of the Distance of the *Attracting Force*, and into the Verge of the *Repelling Force*, and then the Water reassumes its Fluid Form.

Now that Cold and Freezing do arise from some Substance of a *Saline* Nature floating in the Air, it seems probable from hence, That all *Salts*, and more eminently some particular ones, when mix'd with Snow or Ice, do prodigiously encrease the Force and Effects of Cold: We see also, that all *Saline* Bodies do produce a Stiffness and Rigidity in the Parts of those Bodies into which they enter. Microscopical Observations upon *Salts* inform us, That the Figures of some Salts, before they shoot into Masses, are thin double-wedg'd like Particles, which have abundance of Surface in Respect to their Solidity, (which is the Reason why

why they ſwim in Water when once raiſed in it, tho' ſpecifically heavier). Theſe ſmall Points or the Salt getting into the Pores of the Water, whereby alſo they are in ſome meaſure ſuſpended in the Winter Time (when the Heat of the Sun is not ordinarily ſtrong enough to diſſolve the Salts into a Fluid, to break their Points, and to keep them in perpetual Motion) being leſs diſturb'd, are more at Liberty to approach one another, and by ſhooting into Chryſtals of the Form abovementioned, do, by both their Extremities, inſinuate themſelves into the Pores of Water, and by that Means freeze it into a ſolid Form. And we ſee, that the Dimenſions of Water are increas'd by Freezing, its Particles being kept at ſome Diſtance one from another by the Intervention of the Frigorific Matter.

But beſides this, there are many little *Volumes*, or ſmall Parcels of Air, included at ſeveral Diſtances, both in the Pores of the Watry Particles, and in the Interſtices formed by their Spherical Figures. Now by the Inſinuation of theſe Chryſtals, the *Volumes* of Air are driven out of the Watry Particles, and many of them uniting, form larger *Volumes*, which thereby have a greater Force to expand themſelves than when diſpers'd, and ſo both enlarge the Dimenſions, and leſſen the ſpecifick Gravity, of Water thus congeal'd into Ice. And hence, ſaith Dr. *Cheyne*, (from whom this laſt Account) we may gueſs at the Manner, how Water, impregnated with *Salts*, *Sulphers*, or *Earths*, which are not eaſily diſſolvable, may form itſelf into *Metals*, *Minerals*, *Gums*, and other Foſſils; the Parts of theſe Mixtures becoming a Cement to the Particles, of Water, or getting into their Pores, change them into theſe different Subſtances. *Phil. Prin. of Nat. Rel. p.* 66.

FRESCO. Painting in *Freſco* is thus perform'd: The Colours are ground with Lime-Water, Milk, or Whey, and temper'd or mix'd together in Pots, as in Size Colouring. The Plaiſter is made of the Powder of old rubbiſh Stones mixt with burnt Flints or Lime, and Water; but the Salt of the Lime muſt be waſh'd out, by often pouring on freſh Water; and to make the Plaiſter ſtick the better, they drive in Stumps of Horſe-nails, about 6 Inches aſunder. With this Plaiſter the Wall is to be laid thick, and then it muſt be let dry; and afterwards a new Layer of Plaiſter is put of the Thickneſs of an Half-Crown; and the Colours muſt be wrought with a quick free Hand whilſt it is wet, for there is no altering of it after it is dry. This Way of Painting was in moſt antient Uſe among the *Greeks*, and from them came to the *Romans*, with whom it was famous. *Raphael Urbin*, and *Julio Romano*, were eminent this Way: There being three Chambers in the Vatican of their doing, yet in being.

FRICTION, is a Word uſed often among Mechanicians, or the Writers on Mechanicks, for the Reſiſtance which ariſes to the Motion of the Parts of any Engine from the Matter of the Wheels, *&c.* rubbing againſt one another, or againſt any other Body.

Of the Reſiſtance ariſing from Friction of the Parts of any Engine one againſt another, Mr. *Amontons* hath a large Diſcourſe, which is printed in the *Memoires de l'Academ. Royale des Sciences*, for the Year 1699. where he makes ſeveral Experiments, gives Rules to find and calculate Tables of this Reſiſtance ariſing from Friction, and of that which is the Reſult of the Rigidity of Chords uſed in Pulleys, *&c.*

FRIGAT, is a Ship of War, uſually of two Decks, light built, and deſign'd for ſwift Sailing. When it hath but one Deck, and conſequently is of a ſmaller Size, they call her a *Light Frigat.*

FRIGATOON, is a *Venetian* Veſſel, commonly uſed in the *Adriatick*: She is built with a ſquare Stern, without any Fore-maſt; having only a Main-maſt, Miſſen-maſt, and Bow-ſprit.

FRUGIVOROUS *Birds*, according to Mr. *Willoughby*, are the *Parrot-Kind*, which tho' they have a crooked Beak and Talons, and therefore do belong in general to the *Birds of Prey*, being Rapacious and *Cornivorous*; yet becauſe they eat *Fruit* too, I ſuppoſe, he diſtinguiſhes them from the reſt by this Title. See *Birds.*

FRUMGYLD, was the old *Saxon* Term for the firſt Payment made to the Kindred of a ſlain Perſon, in Recompence of his Murder.

FURNACE *Almond.* In the ſmelting of Silver Oar, and clearing it from the Lead, they uſe a Furnace which they call an *Almond Furnace*; in which they melt the Slaggs or Refuſe of the Litharge, without pounding or ſtamping it, and with Charcoal only.

FURNACE *of Aſſay*, is uſed in the Smelting-Houſes of Silver Oar; and is to try the Value of the Silver, or what Proportion it bears to the Lead: Which they know by weighing the Pieces cut off from every Bar, and then melting them anew, and after the Lead is ſeparated, weighing the remaining Silver. See *Silver*, in this Vol.

FURNITURE *of Dials.* As on all Sorts of Dial Plains, *Strait Lines* may be deſcrib'd, which by the Shadow of a *Stile*, or a Line parallel to the Earth's Axis, will ſhew the true Hour of the Day: So by the Shadow of an *Apex*, *Nodus*, or one determinate Point in that Axis or Stile, on the Plane of the Dial, may many uſeful and curious Aſtronomical Concluſions be deſcrib'd or ſhewn: And all theſe taken together, are call'd the *Furniture of Dials.*

Such as,

1. *The Parallels of the Sun's Diurnal Motion*; ſhewing every Day what Degree of the Ecliptic the Sun is in; or, if leſs Accuracy be thought enough, what Sight of the Zodiac.

2. *The Length of the Day and Night*; or, *The Proportion of the Sun's Diurnal to his Nocturnal Arch, throughout the Year.*

3. *The Time of the Year*; ſhewing, by the Shadow of the Axis, both the Month and Day.

4. *The Sun's Almacanters*, or, *Parallels of Altitude*; ſhewing the Sun's Altitude above the Horizon, and the Proportion of Shadows.

5. *The Azimuths*, or *Vertical Circles*; ſhewing what Azimuth or Point of the Compaſs the Sun is upon it all Times of the Day.

6. *The Babyloniſh, Italian, Jewiſh* (or *Unequal*) *Hours*; together with the Meridians or Horizons of any Particular and Remote Places; and many other Things, *&c.* I purpoſely omit to mention the Planetary Hours, the Circles of Poſition, *&c.* in order to Aſtrological Fooleries; becauſe, I hope, at this Time of Day, they are of no Eſteem with any Perſons of Mathematical Skill, or indeed of common Senſe and Underſtanding.

Now of theſe Circles of the Sphere, whoſe Projection conſtitutes this Furniture; ſome are *Great*, as

as the Azimuths or Vertical Circles, the Meridians or Hour Circles, and the Circles of Longitude of the Sun or Stars; and these on all Sorts of Dial-Planes will be ſtrait Lines: And if the Planes on which ſuch great Circles are deſcrib'd, are parallel to ſuch great Circles in the Heavens as they are deſign'd to repreſent, then will thoſe ſtraight Lines be all parallel to one another.

But if the Dial-Plane be perpendicular to any of thoſe correſponding great Circles in the Heavens, then the ſtraight Lines ſo projected on the Plane, will meet in the Centre at *Equal* Angles.

But if the Plane lie oblique to any of thoſe great Circles in the Heavens, the projected ſtraight Lines will ſtill meet in one Centre upon the Plane, but at *Unequal* Angles.

All leſſer Circles of the Sphere, (ſuch as are, *the Parallels of the Sun's Declination or Courſe*, and all *Almacanters, or Parallels of Altitude*) being projected on a Plane, become *Conick Sections*, *i. e.* either *Ellipſes*, *Parabola's*, or *Hyperbola's*; except when theſe leſſer Circles are projected on ſuch Planes as do lie parallel to thoſe leſſer Circles in the Heavens; as Parallels of Declination, when they happen to be drawn on a Plane, lying parallel to the Equinoctial, for then they will be perfect Circles, which are Sections of a Cone parallel to its Baſe. So alſo, if the Almacanters, or Parallels of Altitude, be deſcrib'd on a Plane parallel to the Horizon, they will become perfect Circles.

It may be of Uſe to remark alſo, That all Dial-Planes in any Latitude, and however poſited in that Latitude, whether Direct, Declining, Inclining, or Reclining, or both Declining and Inclining, or Declining together, are, in ſome Part or other of the Earth, *Horizontal Planes*: and the *Height* of the *Stile* is equal to the *Latitude* of the Place wherein it is an *Horizontal Plane*; and the *Subſtile* of the Dial is the *Meridian* of that Place; and the *Difference of Longitude* of that Plane, ſhews how much to the *Eaſt* or *Weſt* the Place lies from *that* wherein it is an *Horizontal Plane*.

Whence it muſt follow, that if you draw, for any Declining-Reclining Plane, or any other Dial-Plane, a good Dial with Hours and Quarters; and much more if you draw it to Minutes, *&c.* and then, on the ſame Plane, with Red Ink, *&c.* draw an Horizontal Dial for the Latitude of that Place, which is equal to the Stile's Height in the former Declining-Reclining, *&c.* Plane; and letting the Subſtile be the Hour-Line of 12 to it, draw all the other Hours, Quarters, *&c.* from thence; and then on that Horizontal Dial draw alſo the proper Furniture: When you have done this, I ſay, if you can expunge the Hour-Lines of the Horizontal Dial, the Furniture of that Horizontal Dial will be the true Furniture for the Declining-Reclining, *&c.* be it never ſo irregular, ſuppoſing it have but a Centre.

As to the Deſcription of this Furniture on all Kinds of Dial-Planes, you will find large and full Directions in *Wells's Art of Shadows*, *Hollwell's* and *Leybourn's Dialling*, &c. And the full Demonſtration of the whole Matter, *Chriſtopher Cluvius* gives us in his *Gnomonicks*. See alſo *Gaſpar Schottus's Curſus Mathematicus*, Book 14. of *Horography*.

FURRING, in Architecture, is making good the Rafters-Feet in the Corniſh: That is, when Rafters are cut with a Knee, theſe *Furrings*, or *Furrs*, are Pieces that go ſtraight along with the Rafter from the Top of the Knee to the Corniſh. Alſo when Rafters are rotten, or ſunk hollow in the Middle, there are Pieces cut thickeſt in the middle, and tapering towards each End, which are nailed upon them to make them ſtraight; and ſuch Pieces are call'd *Furrs*, and the putting them on, *Furring* the Rafters.

FUST, is a Term in Architecture for the Shaft of a Column, from the *Aſtragal* to the *Capital*.

GABELL, *Gabella*, *Gabellum*, the ſame with *Vectigal* in old Writers, hath the ſame Signification as *Gabelle* in *French*: And for the better underſtanding of Antient Records, Statutes, Charters *&c.* you ſhould know, that *Gabel*, or *Gavel*, *Gablum*, *Gabellum*, *Gabellettum*, *Galbellettum*, and *Gavillettum*, do all ſignify a Rent, Cuſtom, Duty, or Service, yielded or done to the King, or ſome other Lord: and Dr. *Cowell* ſeems to have judg'd right, that *Gablum* is to be diſtinguiſh'd from a Rent or Payment made, or a Contract or Bargain; and hath only Relation to ſuch a Payment or Service as was impoſed by the Power and will of the Lord.

GABEL-*End* of a Houſe, is the Upright Triangular End, from the Corniſh or Eaves, to the Top of its Roof.

GAGE, in Joinery, is an Inſtrument made to ſtrike a Line truly parallel to the ſtraight Side of any Board or Piece of Stuff. Its chief Uſe is for gaging of Tenents true to fit into Mortiſſes, and for gaging Stuff of an equal Thickneſs. It is made of an oval piece of Wood, fitted on upon a ſquare Stick, to ſlide up and down ſtiffly thereon, and with a Tooth in the End of a Staff, to ſcore or ſtrike a Line upon the Stuff at any Diſtance, according to the Diſtance of the Oval from it.

GAGE-*Point*. See *Gauge-Point*.

GAGER *Deliverance*. See *Wage*.

GAIN, in Architecture, is the Workmen's Term for the Bevilling Shoulder of the Joiſt or other Timber. 'Tis uſed alſo for the lapping off the End of the Joiſt, *&c.* upon a Trimmer or Girder; when the Thickneſs of the Shoulder is cut into the Trimmer alſo, and bevilling upwards that it may juſt receive the *Gain*; and ſo the Joiſt and Trimmer lie even and level with their Surface. This way of working is uſed in Floors and Hearths.

GAINAGIUM, or *Wainagium*, ſignifies all manner of Plough-Tackle, or Inſtruments uſed in Husbandry, without any Reſpect to *Gain*, or *Profit*. For as *Magna Charta* provides, That the Knight and Freeholder ſhall be amerced *Salvo Contenemento ſuo*, and the Merchant *Salvâ Mercandisâ ſuâ*; ſo the Villain Countryman, or Plowman, was to be fined or amerced for his Offences, but ſtill *Salvo Guinagio ſuo*, *i. e. Saving all his Plow-Geers, and neceſſary Implements of Husbandry*: For he was not to be fined ſo as to be ruined and undone, by taking from him the neceſſary Means of Life.

GALEASSE, is a large low-built heavy Veſſel, uſing Sails and Oars: It hath three Maſts, and thoſe not to be lowered, as they are in a Galley. They have three Tire of Guns in the Head, and uſually two Tire in the Stern. In two *Dutch* Prints that I have of a Galeaſſe, there are 25 Oars of a Side; and I'm told, there is about 6 or 7 Men to an Oar.

GALEONS, were formerly the *French* Ships of War; but now the Word is only uſed amongſt the *Spaniards* and *Italians*. And the *Spaniards* do now call only thoſe Ships *Galeons*, which are ſent annually to *La Vera Cruſe*, or other Places in the *Weſt-Indies*, to fetch home Bullion.

GALL. Dr. *Keil* ſhews, *An. Secret. p.* 36. That the Gall or Bile, being to be mixed with the Chyle, as it comes out of the Stomach into the Duodenum, could be no where ſo conveniently ſecerned from the Blood, as where the Liver is placed, had alſo all the Branches of the Celiack Arteries, carry'd all the Blood to the Liver, from which the Gall was to be ſeparated: It is evident, conſidering the Nearneſs of the Liver to the Heart, and the Inteſtine Motion of the Blood, that ſo viſcid a Secretion, as the Gall is, could never have been ſeparated by any Gland in that Place. In this Caſe therefore, Nature is forced to alter her conſtant Method of ſending the Blood to all Parts of the Body by the Arteries; and here ſhe forms a Vein, (which is no Branch of the *Cava*, as all other Veins are) and by it ſhe ſends the Blood from the Branches of the Meſenterick and Celiack Arteries, (after having paſſed through all the Inteſtines, Stomach, Spleen, Caul, and Pancreas) to the Liver. By which extraordinary Contrivance, the Blood is brought a great way about, before it arrive at the Liver; and its Celerity is extremely diminiſh'd: So that all the Corpuſcles which are to form the Gall, may have ſufficient Time to *attract* one another, and to *unite*, before they come to their ſecerning Veſſel. And thus the Uſe of the *Vena Porta* is found out.

And moreover he computes, that ſince a Branch of the Meſenterick Artery is to its correſponding Branch of the *Porta*, as 9 to 25; therefore the Blood in the Branches of the *Porta* moves above 177 times ſlower than it does in the Trunk of the Meſenterick Artery; and this only on the Account of the Increaſe of the Diameters of the Veſſels.

Thus Nature provides for the forming of the Gall, in that Blood which paſſes through the Meſenterick Artery. Next he enquires what Care is taken about that which is convey'd by the Celiack Artery to the Liver. For it ſeems it was neceſſary to ſend a larger Quantity of Blood thither, than could be diſpoſed of through the Inteſtines. Part of the Blood of the Celiack Artery is ſpread upon the Stomach and Caul, and its Velocity diminiſhed, as we have ſeen in the Inteſtines: But ſtill all the Blood which thoſe Parts could receive, was not ſufficient for the Liver; and there was no room for the Diviſion and Expiating of the Veſſels through ſuch a large Space as the Meſentery, and the long Tract of the Guts. And therefore here Nature hath a new Contrivance to abate the Velocity of the Blood, (to which the Inteſtine Motion is always proportional); which is, by empting the Blood entirely out of the Veſſels, into a large ſpongy Bowel, *the Spleen*; which ſeems to be a Ciſtern produced for that very Intent and Purpoſe. And the Circumference of the Celiack Artery being half an Inch, or .5 its Square is .25: And therefore the Square of the Splenick, which is a Branch of it, cannot be above .18. Now the Dimenſions of the Spleen are ſix Inches long, 3 or 4 in Breadth, and 2 in Thickneſs. He makes therefore this eaſy Suppoſition, That it is a Cylinder of 2 Inches Diameter. Wherefore the Square of its Circumference being 36, the Blood muſt move above 200 Times ſlower in it, than in the Beginning of the Splenick Artery; and is longer before it gets to the Liver, than that which paſſes through all the Inteſtines.

From

From all this Art and Contrivance, it is an evident Demonſtration, that the Intent of Nature was to diminiſh the Velocity of the Blood; and that ſuch a ſlow Motion is abſolutely neceſſary for the ſecerning of the Bile in the Liver.

The Particles which compoſe the Gall, he ſhews, bear a very ſmall Proportion to the reſt of the Blood; as is evident from that great Quantity of Blood which is carry'd to the Liver, and the ſmall Quantity of Bile which is ſeparated from it. In a large Dog, whoſe *Ductus Choledoctius* was near as big as a Man's, I could never gather above two Drams in an Hour. Now there is thrown into the *Aorta* every Hour about 4000 Ounces of Blood; and it appears by the Proportions of the Arteries, that the Meſenterick and Celiack are to the reſt, as 1 to 8. And therefore 500 Ounces of Blood are carry'd every Hour to the Liver. And ſince only two Drams of Gall are ſeparated from it, the Blood muſt be to the Blood, at leaſt as 2000 is to 1.

'Tis by Reaſon of this ſmall Proportion of the Bile to the Blood, that it was ſo neceſſary to allow ſo much Time for the Attraction of the Particles which form the Bile.

From this Contrivance alſo of the *Aorta*, the Bile receives another Advantage, not leſs conſiderable than the Diminution of the Velocity of the Blood: And that is, the Blood paſſing thro' ſo many different Parts before it comes to the Liver, parts with the greateſt Share of its *Lympha*. By which means, the Particles compoſing the Bile approaching nearer towards one another, are by their mutual Attraction ſooner united.

And the Conſideration of theſe two Contrivances does highly (he thinks) confirm the Truth of his Theory of *Animal Secretion*. For the Diminution of the Velocity of the Blood, and the Subſtraction of the *Lympha*, can agree in no other End, than the uniting the Particles of the Bile.

GALLEHALPENS, were formerly a *Genoa* Coin, brought into *England* by the Merchants of that City; who trading hither in Galleys, lived commonly in a Lane near *Tower-ſtreet*, call'd from them *Galley-Lane*; and they landed their Goods at a Place in *Thames-ſtreet*, call'd *Galley-Key*; and they traded with their own ſmall Silver Coin, which our People call'd *Gallehalpence*. But theſe, together with two kinds of Coin, call'd *Suskins* and *Dotkins*, were forbidden by the Statute of 3 *H.* V. 1. See *Stow's Survey of London*. p. 137.

GALLERY *of a Mine*, is any Branch of it carried on towards any Place. For the Beſiegers, and the Beſieged, do carry each of them Galleries or Branches under Ground, in ſearch of one another's Mines, which often meet and deſtroy one another.

GALLEY, is a low-built Ship, uſing both Sails and Oars. Uſually they have only a Main-maſt and a Fore-maſt, which may be ſtruck or lowered at pleaſure. 'Tis ſaid, their Length is uſually about 130 Feet, and their middle Breadth about 18, and the Length of the Oar is about 36 Feet, and about 4 or 5 Men to an Oar. They are of Service only in the Mediterranean, and ſuch ſtill quiet Seas. Theſe were like the *Roman Liburnicæ*. See my *Introduction to the Bibliotheca Navigantium & Itinerantium*, about the *Antient Shipping*.

GALLIOT, is a ſmall Galley, or a Sort of *Brigantine*, built very ſlight, and deſign'd for Chaſe. She hath but one Maſt, and can both ſail and row. She uſually carries two or three Pedrero's, and hath 16 or 20 Oars. Some call the Bomb-Ketches *Galliots*.

GAMING. For the Laws of Chance in Games. See *Play*.

GARBLER *of Spices*, is an Officer of great Antiquity in the City of *London*, who may enter into any Shop, Warehouſe, *&c.* to view and ſearch Drugs, Spices, *&c.* and to *Garble* the ſame, that is, to make them clean from any *Garbles* or Duſt. See 21 *Jac.* I. *c.* 19.

GARSUMME, (*Gerſuma, a Spelm. Gloſſ.*) a Fine or Amerciament often uſed in Doomſday Book.

GARTER. The moſt Noble Order of the Garter, is an Order of Knighthood firſt inſtituted by our famous King *Edward* III. 1350. and inferior to none in the World; conſiſting of 26 Nobles, or Perſons of even yet higher Degree; *i. e.* Sovereign Princes, Kings, and Emperors; whereof the King or Queen of *England* is the Sovereign; and the reſt are ſtiled, The Companions of the Order. See *Cambden, Aſhmole*, &c.

GARTER, is alſo the Title of the Principal King at Arms among our *Engliſh* Heralds. The Office was created by *Hen.* V. See *Stow, p.* 581. and *Stat.* 14. *Car.* II. *c.* 33.

GAVELL-BREAD, Corn-Rent, or Proviſion of Bread, referred from the Tenant to be paid in Kind.

GAVELCESTER, *Sextarius Vectigalis*, was a certain Meaſure of Ale, to be paid by way of Rent: It appears to be the ſame with *Tokeſter*, which hath ſometimes been corruptly written *Colceſter*; as perhaps in *Selden's Deſertation*, annexed to *Fleta*, *c.* 8.

GAVELLERTH, *Gavelhert*. The Duty or Work of plowing ſo much Earth or Ground, done by the Cuſtomary Tenant for his Lord: As,

GAVEL-MEDE, was the Duty of mowing Graſs, or cutting Meadow Land, required by the Lord from his Cuſtomary Tenant: So,

GAVEL-REP, or *Bedreap*, was the Duty of *Reaping* at the *Bid* or *Command* of the Lord.

GAVELLING-*Men*. Tenants which paid a reſerved Rent, beſides ſome Cuſtomary Duties to be done by them.

GAUGE-*Point* of a ſolid Meaſure, is the Diameter of a Circle, whoſe *Area* is equal to the ſolid Content of the ſame Meaſure. Thus the Solidity of a Wine Gallon being 231 Cubick Inches, (according to *Wincheſter* Meaſure;) If you conceive a Circle to contain ſo many Inches, the Diameter of it will be 17.15; and that will be the Gauge-Point of Wine-Meaſure. And an Ale-Gallon containing 288 Cubick Inches; by the ſame Rule, the Gauge-Point of Ale Meaſure will be found to be 19.15.

And after the ſame manner may the Gauge-Point of any Foreign Meaſure be diſcover'd.

And from hence may be deduced, by way of Conſequence, that when the Diameter of a Cylinder in Inches is equal to the Gauge-Point of any Meaſure (given likewiſe in Inches;) every Inch, in Length thereof, will contain an Integer of the ſame Meaſure, *V. gr.* In a Cylinder whoſe Diameter is 17.15 Inches, every Inch in Height contains one entire Gallon in Wine Meaſure;

and in another, whoſe Diameter is 19.15, every Inch in Length contains one Ale Gallon.

GAUGER, is an Officer of the King's Exciſe, whoſe Buſineſs it is to examine all Casks of Beer, Wine, Oil, Honey, Butter, *&c.* and to give them a Mark of Allowance, (which is a Circle burnt with an Iron) before they be ſold in any Place of this Office. See 27 *E.* III. *c.* 8. 4 *R.* II. *c.* 1. 18 *H.* VI. 17. 23 *H.* VI. 10. 1 *R.* III. 13. 28 *H.* VIII. 14. and laſt of all, 12 *Car.* II. *c.* 4.

GAUGING. On this Subject, the following Authors may be conſulted:

*Stereometrical Propoſitions*, variouſly applicable, but particularly intended for *Gauging*: By *Robert Anderſon*. *Lond.* 1668. 8*vo*.

*Gauging Promoted*; being an Appendix to the former Book. *Lond.* 1669.

*Smith's Practical Gauging.*
*Jones's Guide to the young Gauger.*
*Kepleri Stereometria Nova.*
*Mayne's Practical Gauger.*
*Hunt's Practical Gauging.*
*Newton's Gauging.*
*Everard's Gauging.*

GELD, the ſame with *Gild*, or *Guild*.

GEMOTE, is an old *Saxon* Term for what we now call a Court: 'Tis often uſed in the Laws of *Edward the Confeſſor*.

GENERAL. When an Army is preparing to march, the Drums beat a peculiar Sound, in order to acquaint the whole Army, that they ſhould all get ready to march: And this Notice by the Drum, they call *Beating the General*.

GENERALE, the Single Commons, or Ordinary Proviſion, of the Religious in Convents, was formerly call'd by this Term *Generale*, as being their *General Allowance*; and ſo diſtinguiſh'd from their *Pictantiæ*, or *Pittances*, which, on extraordinary Occaſions, were added as Over Commons.

GENERAL *Iſſue*. See *Iſſue*.

GENERATION. As to what the Moderns, from their Diſcoveries by Microſcopes, have advanc'd on this Subject, you will find by comparing the Obſervations and Diſcoveries of Dr. *Harvey*, *S. Malpighii*, Dr. *de Graaf*, and *M. Leeuwenhoek*, with one another: And theſe *Three* Things ſeem to me very probable. 1. That *Animals* are *ex Animalculo*. 2. That the *Animalcules* are originally *in Semine Marium*, *& non in Fœminis*. 3. That they can never come *Forward*, nor be *Formed* into *Animals* of the reſpective *Kind*, without the *Ova in Fœminis*.

The *Firſt* of theſe ſeems probable from theſe 3 Obſervations; 1. That ſome ſuch Thing has been ſo often obſerv'd by *Malpighius* in the *Cicatricula* of an *Egg* before *Incubation*, as the Rudiments of an *Animal* in the Shape of a *Tadpole*; as may be ſeen in his *Firſt*, and in his repeated Obſervations *de Formatione Pulli in Ovo*. 2. The ſudden Appearance and Diſplaying of all the Parts, after *Incubation*, makes it probable, that they are not then actually *formed* out of a *Fluid*, but that the *Stamina* of them have been formerly there Exiſtent, and are now expanded. The firſt Part of the *Chick* which is diſcover'd with the *Naked Eye* is, you know, the *Punctum Saliens*, and that not till *Three Days* and *Nights* of *Incubation* be paſt: And then on the *Fifth Day* the Rudiments of the *Head* and *Body* do appear. This made Dr. *Harvey* conclude, that the *Blood* had a Being before any other Part of the Body, and that from it all the *Organs* of the *Fœtus* were both *formed* and *nouriſhed*; but by *Malpighius's* Obſervations, we find that the Parts are then only ſo far extended, as to be made viſible to the *Naked Eye*, and that they were actually Exiſtent before, and diſcernable by *Glaſſes*. After an *Incubation* of 30 *Hours*, are to be ſeen the *Head*, the *Eyes*, and the *Carina*, with the *Vertebra*, diſtinct, and the *Heart*. After 40 *Hours* its *Pulſe* is viſible, and all the other Parts more diſtinct, which cannot be diſcern'd by the *Naked Eye* before the Beginning of the *Fifth Day*; from whence it ſeems very probable that even the ſo early Diſcovery of thoſe Parts of the *Fœtus* by the *Microſcope*, is not the diſcerning of Parts newly form'd, but only more dilated and extended by receiving of *Nutriment* from the *Colliquamentum*; ſo that they ſeem all to have been actually exiſtent before the *Incubation* of the *Hen*. And what *Swammardam* has diſcover'd in the *Tranſmutation* of *Inſects*, gives no ſmall Light to this, whilſt he makes appear in the *Explanation* of the 13*th Table* of the *General Hiſtory of Inſects*, that in thoſe large *Eruca's* which feed upon *Cabbage*, if they be taken about the Time they retire to be *transform'd* into *Aurelia's*, and plunged often in warm Water to make a Rupture of the *Outer Skin*, you will diſcern, through the Tranſparency of their *Second Membrane*, all the *Parts* of the *Butterfly*, the *Trunk*, *Wings*, *Feelers*, &c. folded up: But, that after the *Eruca* is *changed* into an *Aurelia*, none of theſe *Parts* can be diſcern'd, they are ſo drench'd with Moiſture, though they be there actually *formed*.

Another Conſideration is from the *Analogy*, which we may ſuppoſe between *Plants* and *Animals*. All *Vegetables*, we ſee, do proceed *ex Plantula*, the *Seeds* of *Vegetables* being nothing elſe but *little Plants* of the ſame *kind* folded up in *Coats* and *Membranes*; and from hence we may probably conjecture, that ſo curiouſly an *organized* Creature, as an *Animal*, is not the ſudden Product of a *Fluid*, or *Colliquamentum*, but does much rather proceed from an *Animalcule* of the *ſame kind*, and has all its little Members folded up according to their ſeveral *Joints* and *Plicatures*, which are afterwards enlarg'd and diſtended, as we ſee in *Plants*. Now though this Conſideration alone may ſeem not to bear much Weight, yet being join'd to the two former, they do mutually ſtrengthen each other. And indeed all the *Laws* of *Motion* which are as yet diſcover'd, can give but a very lame Account of the *forming* of a *Plant* or *Animal*. We ſee how wretchedly *Des Cartes* came off, when he began to apply them to this Subject. They are *formed* by *Laws* yet unknown to Mankind; and it ſeems moſt probable, that the *Stamina* of all the *Plants* and *Animals* that have been, or ever ſhall be in the World, have been *formed ab Origine Mundi*, by the *Almighty Creator* within the *Firſt* of each reſpective *Kind*. And he who conſiders the Nature of *Viſion*, that it does not give us the true *Magnitude*, but the *Proportion* of Things, and that what ſeems to our *Naked Eye* but a *Point*, may truly be made up of as many Parts as ſeem to us be in the whole viſible World, will not think this an abſurd or impoſſible Thing.

But the *Second* Thing which later Diſcoveries have made probable is, that theſe *Animalcules* are

originally *in Semine Marium, & non in Fœminis* : And this I collect from these Considerations :

1. That there are innumerable *Animalcula in Semine Masculino Omnium Animalium.* M. *Leeuwenhoek* has made this so evident by so many Observations, that I do not in the least question the Truth of the Thing.

2. The Observing of the *Rudiments* of the *Fœtus* in *Eggs*, which have been *Fœcundated* by the *Male*, and the seeing no such Thing in those which are not *Fœcundated*, as appears from *Malpighius* his Observations, makes it very probable, that these *Rudiments* proceeded originally from the *Male*, and not from the *Female*.

3. The Resemblance between the *Rudiments* of the *Fœtus in Ova*, both Before and After *Incubation*, and the *Animalcule*, makes it very probable, that they are One and the Same. The same Shape and Figure which M. *Leeuwenhoek* gives us of the *Animalcule*, *Malpighius* likewise gives us of the *Rudiments* of the *Fœtus*, both before and after *Incubation*; yea, and even the *Fœtus's* of *Animals* do appear so at *first* to the *Naked Eye*; so that Dr. *Harvey* does acknowledge, that all *Animals*, even the *most Perfect*, are Begotten of a *Worm*.

4. This gives a Rational Account of *Many Fœtus's* at *One Birth*, especially that of the Countess of *Holland*; and how, at least, a Whole *Cluster* of *Eggs* in a *Hen* are *Fœcundated* by *One Coition* of the *Male*.

5. This gives a New Light, as it were, to the *First Prophecy* concerning the *Messiah*, that the *Seed of the Woman shall bruise the Head of the Serpent* : All the rest of *Mankind* being thus most properly and truly the *Seed of the Man*.

6. The *Analogy* I have already mention'd, which we may rationally suppose between the Manner of the *Propagation* of *Plants* and *Animals*, does likewise make this probable. Every *Herb* and *Tree* bears its *Seed after its Kind*; which *Seed* is nothing else but a *Little Plant* of the same Kind, which being thrown into the *Earth*, as into its *Uterus*, spreads forth its *Roots*, and receives its Nourishment, but has its *Form within it self*; and we may rationally conjecture some such *Analogy* in the *Propagation of Animals*.

The *Third* Particular, which later Discoveries make propable, is, That *Animals* cannot be *Formed* of these *Animalcula* without the *Ova* in *Fœminis*, which are necessary for supplying them with proper *Nutriment*; and this, these Considerations seem to evince. 1. It is probable that an *Animalcule* cannot come forward if it do not fall into a proper *Nidus*. This we see in the *Cicatricula* in *Eggs*, and tho' a *Million* of them should fall into *One Egg*, none of them would *come forward*, but what were in the *Centre* of the *Cicatricula*; and perhaps the *Nidus*, necessary for their Formation, is so proportioned to their Bulk, that it can hardly contain more than *One Animalcule*; and this may be the Reason why there are so few *Monsters*. This we see is absolutely necessary *in Oviparis*; and the only Difference which seems to be between them and the *Vivipara* in this Matter, is in this, That in the latter the *Ova* are properly nothing more but the *Cicatricula*, with its *Colliquamentum*, so that the *Fœtus* must spread forth its Roots into the *Uterus* to receive its *Nourishment*; but the *Eggs* in *Oviparis* may be properly termed an *Uterus* in relation to the *Fœtus*; for they contain not only the *Cicatricula* with its *Amnion* and *Colliquamentum*, which is the immediate *Nourishment* of the *Fœtus*, but also the Materials which are to be converted into that *Colliquamentum*; so that the *Fœtus* spreads forth its *Roots* no farther than into the *White* and *Yolk* of the *Egg*, from whence it derives all its *Nourishment*. Now that an *Animalcule* cannot *come forward* without some such proper *Nidus*, M. *Leeuwenhoek* will not readily deny; for if there were nothing needful but their being thrown into the *Uterus*, I do not see why *many Hundreds* of them should not *come forward* at *once*, at least whilst scatter'd in so large a Field.

Now, 2. That this *Cicatricula* is not originally in *Utero*, seems evident from the frequent *Conceptions* which have been found *extra Uterum*: Such as the *Child* which continued 26 *Years* in the Woman of *Tholouse's* Belly; and the *Little Fœtus* found in the *Abdomen* of *Mad. de S. Mere*, together with the *Testicle* torn, and full of Clotted Blood; such also seem to be the *Fœtus* in the *Abdomen* of the Woman of *Copenhagen*, mentioned in the *Nouvelles des Lettres*, for *Sept.* 85. all the *Members* of which were easily to be felt thro' the Skin of the *Belly*, and which she had carried in her *Belly* for four *Years*: And the seven *Years Gravidation* related by Dr. *Cole*. Now granting once the Necessity of a *Proper Nidus*, for the *Formation* of an *Animalcule* into the *Animal* of its respective Kind, these Observations make it probable, that the *Testes* are the *Ovaria* appropriated for this Use; for though the *Animalcules* coming thither in such Cases, may seem to be extraordinary, and that usually the *Impregnation* is *in Utero*, yet it may be collected from hence, that the *Cicatriculæ* or *Ova* to be *Impregnated*, are in *Testibus Fœmineis*; for if it were not so, the accidental coming of *Animalcules* thither, could not make them *come forward* more than in any other Part of the Body, since they cannot be *Formed* and *Nourished* without a *Proper Nidus*.

But, 3. It is acknowledg'd by all, that the *Fœtus in Utero*, for some considerable Time after *Conception*, has no *Connexion* with the *Womb*; that it sits wholly loose to it, and is perfectly a Little Round *Egg* with the *Fœtus* in the Midst, which sends forth its *Umbilical Vessels* by Degrees, and at last lays hold on the *Uterus*. Now from hence it seems evident, that the *Cicatricula*, which is the Fountain of the *Animalcule's Nourishment*, does not sprout from the *Uterus*, but has its Origine elsewhere, and falls in thither as into a fit Soil, from whence it may draw *Nutriment* for the *Growth* of the *Fœtus*; else it cannot be easily imagined how it should not have an *Immediate Connexion* with the *Uterus* from the Time of *Conception*.

If you joyn all these *Three* Considerations together, *viz.* that an *Animalcule* cannot *come forward* without a *Proper Nidus*, or *Cicatricula*; that there have been frequent *Fœtus's extra Uterum*; and that they have no *Adhesion* to the *Uterus* for a considerable Time after *Conception*; they seem to make it evident, that *Animals* cannot be Formed *ex Animalculis* without the *Ova in Fœminis*. To all these I shall subjoyn the Proposal of an *Experimentum Crucis*, which may seem to determine whether the *Testes Fœmineæ* be truly the *Ovaria : viz.* Open the *Abdomen* of the *Females* of some Kinds, and cut out these *Testicles*, and this

this will determine whether they be absolutely neceſſary for the *Formation* of *Animals*.

It is indeed difficult to conceive, how theſe *Eggs* ſhould be *Impregnated per Semen Maris*, both becauſe there is no *Connexion* between the *Tube* and the *Ovary* for its Tranſmiſſion; and for that Dr. *Harvey* could never diſcover any thing of it *in Utero*. But as to the laſt, M. *Leeuwenhoek* has cleared that Difficulty, by the Diſcovery of innumerable *Animalcula Seminis Maris in Cornutus Uteri*, and thoſe living a conſiderable time after *Coition*. And as to the former, we may either ſuppoſe that there is ſuch an *Inflation* of the *Tubæ*, or *Cornua Uteri*, *tempore Coitionis*, as makes them *Embrace* the *Ovaria*, and ſuch an *Approach* of the *Uterus* and its *Cornua*, as that it may eaſily tranſmit the *Seed* into the *Ovary*: Or elſe, that the *Ova* are *Impregnated* by the *Animalcules* after they deſcend into the *Uterus*, and not in the *Ovary*. The former ſeems probable for this Reaſon, that at leaſt a whole *Cluſter* of *Eggs* in a *Hen* will be *Fœcundated* by *One Tread* of the *Cock*; now this *Fœcundation* ſeems to be in the *Vitellary*, and not in the *Uterus*, as the *Eggs* paſs along from Day to Day: For it can hardly be ſuppoſed that the *Animalcules* ſhould ſubſiſt ſo long, being ſcatter'd looſely in the *Uterus*, as to wait there, for many Days, for the *Fœcundation* of the *Eggs* as they paſs along. The latter Conjecture has this to ſtrengthen it; That the *Animalcules* are found to *live* a conſiderable Time in the *Uterus*, and that if they ſhould *Impregnate* the *Ova* in the *Ovary* it ſelf, the *Fœtus* would encreaſe ſo faſt, that the *Ova* could not paſs through the *Tubæ Uteri*, but would either burſt the *Ovary*, or fall down into the *Abdomen* from the Orifices of the *Tubæ*; and that from hence proceed thoſe extraordinary *Conceptions*, *in Abdomine extra Uterum*.

But M. *Leeuwenhoek*, to weaken this Conſideration about the *Conception*'s being like unto an *Ovum* in the *Womb*, propoſes a Parallel between theſe *Animalcules* and *Inſects*, and inſinuates, that as the Latter caſt their Skins, and appear of another Shape, ſo the Other, which at firſt ſeem like *Tadpoles*, may caſt their Outer Skin, and then be *Round*; and that this may be the Occaſion of the *Round Figure* of the *Conception* in the *Womb*. To this it may be replied, That according to M. *Leeuwenhoek*'s own Sentiment, the *Animalcules* cannot *come forward*, if they do not find the *Punctum* or proper Place for their *Nouriſhment*, to which it ſeems they muſt have ſome *Adheſion*. Now the *Conception* in *Viviparis* is not *faſtened* unto the *Womb* for many *Days*, nor does *Adhere* to any Point of it; ſo that it ſeems this *Roundiſh Body* is not the *Animalcule* thus changed after having caſt an outer Skin, but is rather the *Cicatricula*, or little *Egg*, into which the *Animalcle* has enter'd as its *Punctum*, or Place of *Nouriſhment*; elſe I do not ſee why they ſhould not be *Adhering* to the *Womb* from the *Firſt Conception*; or why (as I have ſaid) many Hundreds of them are not *Conceived* and *Formed* together.

GENITURA. See *Seed*.

GENTLEMAN, is derived from the *French Gentil*, *i. e. Honeſtus*, *vel Honeſto loco natus*; and the *Saxon* Word *Man*: So that it ſignifies a Man well born. So the *Italians* call ſuch Perſons *Gentil Huomoni*: And the *Spaniards* keep the Meaning, when they call a Gentleman *Hidalgo*, or *Hijo d'algo*; *i. e.* the Son of *ſome Man*, or of *ſome Man of Note or Reckoning*. Under this Name with us are compriſed all above *Yeomen*; ſo that Noblemen may truly be call'd *Gentlemen*. But by the Courſe and Cuſtom of *England*, Nobility is either *Greater* or *Leſs*, *Upper* or *Lower*. The *Greater* contains all from Knights upwards; the *Leſſer* all from Barons downwards: As *Smith* ſaith, *Cap.* 21. *de Republ. Anglic.*

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GEOMETRY *Abstruse.* See *Transcendentals.*

GEORGE Noble, was a Piece of Gold, current in 1 *Hen.* VIII. at Six Shillings and Eightpence. At which Time, by Indenture with the Mint, one Pound of Gold (in Weight) was to be coined into Eighty one *George Nobles.*

GIRDERS, in Architecture, are the largest Pieces of Timber in a Floor: Their Ends are usually fastened into the *Summers* or *Brest-Summers*, and the Joists are framed in at one End to the *Girders.* No *Girder* should lie less than 10 Inches into the Wall, and their Ends should be laid in *Lome, &c.*

GLANDS. All Secretions in an Animal Body are made by *Glands*, and a *Gland* is nothing but the Convolution or various Folding of the small Arteries, whose last Branch must be Cylindrical. This Cylindrical Artery, in its Windings, sends out several little Ducts or Secretory Vessels of equal Diameters, which sometimes unite in one common Pore, sometimes run into a common Bason. This Structure is evident in all the larger Glands, such as the *Intestines*, with their Secretory Ducts, the *Lacteals*, the *Testicles*, and some of the *Conglobate Glands*, and may be seen in all the rest, if they happen to be *Obstructed*, and so swell to become visible; and therefore the same may reasonably be concluded of all Glands in general. There are small Branchings of Nerves passing all over the Coats of the Arteries, and seem to be designed principally for their Spiral Contortion, that the Blood may be the more easily propagated through them.

A Conglobate Gland is a little smooth Body wrapt up in a fine Skin, by which it is separated from all other Parts, only admitting a Nerve and Artery to pass in, and giving way to a Vein and Excretory Canal to pass out: Of this Sort, are the Glands of the Brain, the Labial Glands, and the *Testes.*

A Conglomerate Gland is composed of many little Conglobate Glands all tied together, and wrapt up in one common Tunicle or Membrane. Sometimes all their Execretory Ducts unite and make up one common Pipe, thro' which the Liquor of all of them runs, as the *Pancreas* and the *Parotides* do. Sometimes the Ducts uniting, form several Pipes, which only communicate with one another by cross Channels; and such are the *Breasts.* Others again have several Pipes without any Communication with one another, of which Sort are the *Glandulæ Lachrymales*, and the *Prostata.* And a fourth Sort is, when each little Gland hath its own Excretory Duct, thro' which it transmits its Liquor to a common Bason, as in the *Kidneys.*

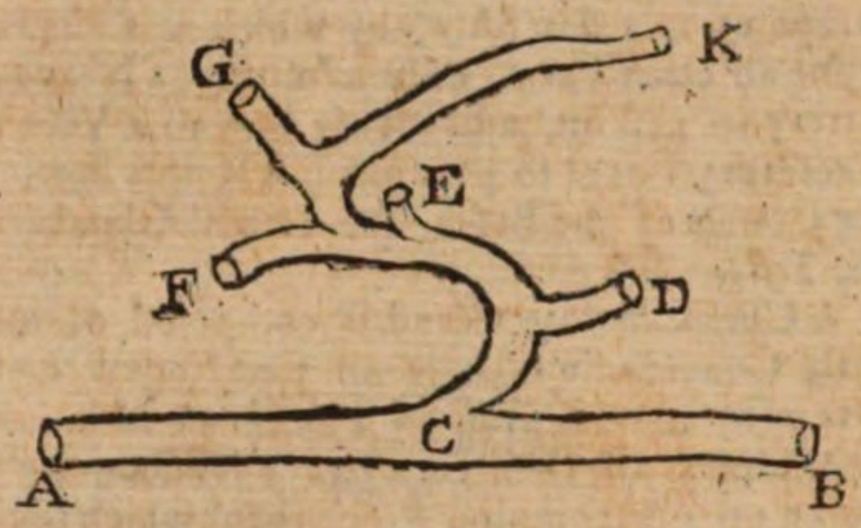
As to the Manner how the several Fluids, after they are form'd in the Blood, are separated from it in the Glands; it depends (as Dr. *Keil* shews, *An. Secret, p.* 82.) entirely on the Figure and Structure of the Glands, which therefore must first be determined. As *Truth, when plain and evident, doth of itself dispel all false Opinions*; So *the true Structure of the Glands being once demonstrated, there will be no Occasion to refute the Doctrine of Ferments*, nor *the Hypothesis of Tubes differing as to the Figures of their Orifices*; both which have several Times been demonstrated to be false.

That the Glands are nothing but Convolutions of small Arteries, the greatest and most accurate Anatomists of this Age, *Malpighi*, *Bellini*, and *Nuch*, have discover'd. And indeed, that all the Vessels of the Body, in which the Liquors are continually moving, can have no other than a *Cylindrical* or *Conical* Form, is demonstrable from the Nature of Fluids, whose Pressure is always prependicular to the Sides of the Vessel containing them, and equal at equal Heights of the Fluid. If therefore the Sides of the Vessels are soft, and equally yielding every where, (as are all the Tubes in the Body of a *Fœtus*) they must, by the Pressure of their contained Fluid, be equally every where distended; and consequently the Section of such a Vessel, perpendicular to its Axis, must be a Circle; and therefore the Vessel must be either a Concave Cone or Cylinder, or at least such a Figure whose Transverse Section, normal to the Axis, must be a Circle.

The *Circular Orifices* therefore of the Glands can only *differ in Magnitude*; and all Sorts of Particles, of a lesser Diameter than that of the Orifice

Orifice of the Gland, may enter it: So that without ſome further Contrivance, that Fluid which contains the biggeſt Particles, muſt likewiſe conſiſt of all the Particles of all the other Secretions; neither could any Fluid thicker than the Blood be ſeparated from it, becauſe of the great Proportion of the Aqueous Fluid, whoſe Particles being vaſtly ſmaller than any other, and inviſible to the beſt Microſcopes, muſt enter all the Glands, and be mix'd with the ſecerned Fluid.

Now how this Inconvenience may be prevented, and how the Particles of any Size may either be ſeparated by themſelves, or with any aſſigned Portion of the Aqueous Fluid, or of other leſſer Particles, I ſhall endeavour to ſhew.




Suppoſe then *A B* to be a ſmall evaneſcent Artery, and that the Particles of the leaſt Size were to be ſeparated from the reſt.

From the Side of the Artery muſt ariſe the Gland or Tube *C K*, whoſe Orifice at *C* is ſuch as is capable of admitting only Particles of the leaſt Size, together with the Aqueous Fluid: Theſe therefore will be ſeparated from all the other Particles of the Blood, and the Tube *C K* being a Cylinder, they will paſs to its further End *K*, which is ſuppoſed to be the Excretory Duct of the Gland.

If the Quantity of the Aqueous Fluid, ſeparated with the leaſt Particles, muſt be diminiſh'd, that ſuch a Fluid as is requiſite may paſs through the Excretory Duct *K*, from the Tube *C K*; you muſt imagine, that ſeveral other ſmaller Canals go out, as at *D*, *E*, *F*, and *G*, whoſe Orifices are ſo ſmall, that they admit no other Particles, beſides thoſe of the Aqueous Fluid, to paſs through them; and therefore as the leaſt Particles, together with the Aqueous Fluid, paſs along the Tube *C K*, the Aqueous Fluid muſt conſtantly be diminiſhed; and the Quantity of the leaſt Particles ſtill remaining, they can paſs no where but through the Excretory Duct at *K*: And this Diminution of the Aqueous Fluid will always be according to the Number of the Canals, *D*, *E*, *F*, *G*, that is, in Proportion to the Length of the Tube *C K*. And therefore, according as the Gland is longer or ſhorter, ſo the more or leſs Aqueous Fluid will paſs through the Orifice of the Excretory Duct at *K*; and conſequently, the ſecreted Fluid, on this Account, be *Thicker* or *Thinner*.

If the Particles of a middle Size, between the biggeſt and the leaſt, are to be drawn off from the reſt of the Blood: Let the Orifice at the Gland *C* be juſt ſo big as to admit thoſe Particles, and not any other of a larger Size. Theſe Particles therefore, with the Aqueous Fluid, and all better Particles, will paſs through the Orifice *C*; but if the Canals *D*, *E*, *F*, *G*, are big enough to receive all the other Particles, and too little to admit thoſe that are to be ſeparated, it is evident, that thoſe Particles muſt arrive at the Excretory Duct *K*, with what Proportion of *Leſſer* Particles is required.

And thus we ſee how any Sort of Particles may be drawn off, either by themſelves, or mixed with any others, in any Proportion: And this is done in the moſt ſimple manner, only by Arteries; for *C K* is only a ſmaller Artery, either Straight, Spiral, or otherwiſe contorted, and *D*, *E*, *F*, and *G*, are again Arteries ſmaller than it; and if any of theſe are ſo ſmall as only to admit Particles of *Serum*, they will conſtitute *Lymphatick Veſſels*. From whence it is, that we find *Lymphæducts* ariſing in great Numbers from thoſe Glands that ſeparate thick Humours; as from the *Teſticles*, *Liver*, &c.

GLANDULÆ *Miliares*. See *Miliares*, and *Skin*.

GLANDULÆ *Myrtiformes*, are the Contractions of the Fibres of the broken *Hymen*, upon the firſt *Coition*.

GLANDULÆ *Sebaceæ*, are a large Number of Glands which lie under the Skin of the *Auricula* of the Ear; and which, becauſe they ſeparate a greaſy Matter, like *Tallow* or *Sebum*, their firſt Diſcoverer *Valſalva*, in his Book of the Ear, calls by this Name. This *Sebum* being carried to the Surface of the Skin, he ſaith, hardens there, and turns into a ſcaly greaſy Subſtance, not unlike that of Bran. Perhaps they are ſuch Glands as thoſe that ſecrete the Scurf and Dandruff that ariſes from combing the Head.

GLASS *Drops*, or *Bubbles*, ſometimes called *Prince Rupert's Drops*; are ſmall Parcels of coarſe green Glaſs, taken out of the Pot in Fuſion at the End of an Iron Pipe; and being exceeding hot, are let fall or dropt from thence into a Veſſel of Cold Water, and ſo lie there 'till they are ſenſibly cold. Theſe exhibit a very ſurpriſing Phænomenon, *viz.* as ſoon as you break off the leaſt Bit from the Stem of it, or pecked End, the whole Bulk of the Drop flies to pieces with a brisk Noiſe, and ſome of the Pieces will be as ſmall as Duſt. Dr. *Hook*, in his *Micrographia*, hath a particular Diſſertation upon this Subject.

GLOBULES, are ſuch ſmall Particles of Matter as are of a Globular or Spherical Figure: As the Red Particles of the Blood which ſwim in the tranſparent *Serum*, which are eaſily diſcoverable by the Microſcope; and 'tis pleaſant to ſee how theſe Blood-Globules, whenever they come within a due Diſtance, do *attract* one another, and unite like Spheres of Quickſilver; and by this Means the Blood ſeparates into two Parts; one of which is the Coagulation this Way of the Red Parts of it, and the other is the *Serum*. Now the *Serum* conſiſts of a great Number of Corpuſcles or ſmall Particles (but they are not all Spherical nor Globular, like the Red Globules of the Blood) and theſe of various Figures and Magnitudes, and ſwimming in a Limpid Fluid. And theſe *Serous* Particles don't unite with, nor attract one another as the former did, 'till ſome Part of the Fluid in which they ſwim hath been evaporated by Heat; but then they do (and form a Coagulum) as the Blood Globules did. So that the Power of Attraction is greater in the Red Globules, than in the Particles of the *Serum*.

GLYPHICE, is a Part of Sculpture, being the Art of Cutting, Carving, or Caſting, the Images and Reſemblances of natural Things in Metals.

GOLD *Mines.* In *Phil. Tranſ.* N. 58. Dr. *Edw. Brown* gives the following Account of the *Gold Mines* in *Hungary.* Among the 7 *Mine Towns* in *Hungary*, (which are not far from one another, *viz. Chremnitz*, *Schemnitz*, *Newſol*, *Coningsberg*, *Bochantz*, *Libeten*, and *Tiln*) *Chremnizt* is the richeſt in *Gold.* They have alſo at preſent, *Gold Mines* at *Bochantz* and *Coningsberg*; and they report in that Country, that there hath been formerly a rich *Gold Mine* at *Glaſs-Hitten*, but loſt ſince that *Bethlem Gabor* over-ran thoſe Parts, when the Undertakers ſtopped up the *Mine* and fled.

They have worked in the *Gold Mine* at *Chremnitz* 900 *Years.* This *Mine* is divers *Engliſh Miles* in Length, and about 160 *Fathoms* Deep. Many *Veins* of the *Ore* run to the *North*, and to the *Eaſt.* They work alſo towards *One*, *Two*, and *Three* of the Clock, as they ſpeak; for the *Miners* direct themſelves under Ground by a *Compaſs*, not of 32 *Points* (ſuch as is uſed at *Sea*), but by one of 24; which they divide, as we do the *Hours* of the Day, into twice Twelve. Of the *Gold Ore*, ſome is *White*, and ſome *Black*, *Red*, or *Yellow*: That with *Black Spots* in *White* is eſteem'd the beſt, as alſo the *Ore* which lieth next to the *Black Veins.* This *Ore* is not rich enough to ſuffer any Proof in ſmall Parcels, like that in other *Mines*, whereby to know what Proportion of *Metal* is contain'd in it; but they pound a very great Quantity thereof, and waſh it in a little River, which runs nigh the Town. The whole River being divided, and admitted into divers Cuts, runs over the *Ore* continually, and ſo waſheth away the Earthy Parts from the Metalline: And from a clear River above the Town, by its running through ſo many Works, and over ſo much pounded *Ore*, it becomes below the Town a Dark-yellow Stream, of the Colour of the Earth of thoſe Hills.

There have been Pieces of *pure Gold* found in the *Mine*; ſome of which I have ſeen in the *Emperor's Treaſury*, and in the *Elector* of *Saxony's Repoſitory*; one Piece as broad as the Palm of my Hand, and others leſs, and upon a White Stone many Pieces of *pure Gold*; but theſe are very rare.

The common Yellow Earth of the Country near *Chremnitz*, although it be not eſteem'd *Ore*, affords ſome *Gold:* And in one Place I ſaw a great Part of an Hill digg'd away, which hath been caſt into the Works, waſhed and wrought in the ſame Manner as pounded *Ore* with conſiderable Profit.

Some Paſſages in this *Mine*, cut through the *Rock*, and long diſuſed, have grown up again; and I obſerv'd the Sides of ſome, which had been formerly wide enough to carry their *Ore* through, to approach each other, ſo as we paſſed with difficulty. This happens in moiſt Places. The Paſſages unite not from the Top to the Bottom, but from one Side to another.

There is *Vitriol* in this *Mine*, *White*, *Red*, *Blue*, and *Green*; and alſo *Vitriol Waters.* There is a Subſtance found which ſticks to the *Gold Ore*, of ſmall pointed Parts like *Needles*, called by them *Antimony* of *Gold.* There are *Chryſtals* found here, and ſome tinctured *Yellow.*

The *Miners* will not allow any *Quickſilver* or *Brimſtone* to have been found here; yet in the lately mention'd *Antimony* of *Gold*, there is evidently *Sulphur*, as I perceiv'd by burning. The *Quickſilver Mine*, mentioned in the Anſwer to *Kercher's Inquiries, Mund. Subter.* is an *Hungarian Mile*, or 7 *Engliſh Miles* diſtant from *Chremnitz*, and is not wrought in at preſent.

There is a *Vitriol Mine* in theſe Hills near the *Gold Mine*; the *Earth* or *Ore* of it is *Reddiſh*, and ſometimes *Greeniſh.* This Earth is infuſed in Water, and after 3 *Days*, the Water is poured off, and boiled 7 *Days* in a *Leaden Veſſel*, till it comes to a thick granulated whitiſh Subſtance, which is afterwards reduced to a *Calx* in an *Oven*, and ſerveth in the making *Aquæfortis*, or the *Separating Water* uſed at *Schemnitz.*

They have divers Ways of taking the *Gold* out of its *Ore*; by burning the *Ore*; by melting; by adding *Silver Ore*, and other *Minerals*, *Sand*, and *Lead*, as they find the *Ore* fluid or fix'd.

But without *Lead* they proceed thus:

They break and pound the *Ore* in Water, very fine; they waſh it often, and lay it in Powder upon Cloths, and by the gentle oblique deſcending of the Water over it, and their continual ſtirring it, the earthy, clayiſh, and lighter Parts, are waſhed away, while the heavier and *metalline* remain in the Cloths; theſe Cloths are afterwards waſhed clean in ſeveral *Tubs*, and the Water, after ſome ſettling, poured off from its Sediment; which Sediment is again waſh'd, and ſtirred up in ſeveral Veſſels and Troughs, 'till at length they ſprinkle *Quickſilver* upon it, and knead it well together for an Hour, and then waſhing it again in a wooden Veſſel, after the ſeparating of much of it which the *Quickſilver* touches not; by ſtriking this Veſſel againſt their Leg, they bring the *Gold* and *Quickſilver* together, in an *Amalgama*, to one Corner of it. From this *Amalgama* they ſtrain as much of the *Quickſilver* as they can through coarſe Cloths firſt, and then through fine; then they put the Maſs remaining upon a perforated Plate, which they ſet over a deep Pan placed in the Earth, in the Bottom of which Pan they alſo put *Quick-ſilver*: This Pan they cover, and *lute* the Cover well, and then making a *Charcoal Fire* upon it, they drive down the *Quick-ſilver*, yet remaining in the *Gold*, to the reſt in the Bottom of the Pan; then taking out the *Gold*, they caſt it into the *Fire*, that it may become purer.

Concerning *Cranach-Gold*, I cannot learn that there is any ſuch *Gold*, or Place where *Gold* is digg'd in *Hungary*; but in *Germany* I think there is, for *Agrigola* mentions ſuch a Place as *Golde-Cranacum*, and another called *Golde-Crona.*

For the exceeding Minuteneſs of the Conſtituent Particles of *Gold*, ſee *Ductility.*

GOTHICK *Manner of Building*, was unhappily brought into Uſe, after the Irruption of thoſe barbarous Nations, the *Goths* and *Vandals*, *&c.* from the *North*, and the *Moors* and *Arabs*, from the *South* and *Eaſt*, into the civiliz'd World. Theſe rude People demoliſh'd what they could of the antient *Greek* and *Roman* Architecture, and inſtead of thoſe admirable and regular Orders and Manner of Building, introduced a licentious and fantaſtical Manner, which, tho' ſometimes adorn'd with expenſive Carvings, and coſtly, tho' lamentable, Imagery, is without any of that auguſt Beauty, and juſt Symmetry, which the Fabricks of the Antients entertain us with.

GRAMMAR, is thus very juſtly defined by Mr. *Johnſon*, in his Grammatical Commentaries:

*That it is the Art of expreſſing the Relations of Things in Conſtruction, with due Accent in Speaking, and Orthography in Writing, according to the Cuſtom of thoſe whoſe Language we learn.*

GRAND *Days*, are thoſe in every Term ſolemnly kept in the Inns of Court and Chancery; *viz.* In *Eaſter* Term, *Aſcenſion Day*; in *Trinity* Term, *St. John Baptiſt's Day*; In *Michaelmas* Term, *All-Saints Day* (and of late, *All-Souls Day*); and in *Hillary* Term, the Feaſt of the *Purification of our Lady*, commonly called *Candlemas Day*. Theſe are *Dies non Juridici*, no *Court Days*.

GRAND *Guſto*, is a Term uſed by Painters, to expreſs, that in a Picture there is ſomething very great and extraordinary, to ſurpriſe, pleaſe, and inſtruct. Where this is found, they ſay the Painter was a Man of the *Grand Guſto*, or *Goût*: And they uſe the Words *Sublime* and *Marvellous*, when they ſpeak of a Picture, in much the ſame Senſe.

GRAPPLINGS. The ſame with *Grapnels*. See that Word in *Vol.* I.

GRAS-*Hearth*, was formerly the Cuſtomary Service for all the inferior Tenants to bring their Plows, and do one Day's Work for the Lord, within four Days after *Michaelmas*.

GRAVITY. Dr. *Gregory*, in the Preface to his Excellent Aſtronomy, ſhews, that the ancient Aſtronomers knew that the Heavenly Bodies gravitated towards one another, and were kept in their Orbits by the Force of Gravity. And that when *Democritus*, *Metrodorus*, and *Diogenes*, and afterwards *Anaxagoras*, *Archelaus*, and *Eurypides*, maintain'd the Sun and Stars to be great Globes of Stone or Metal heated red hot; they meant by it, that they were heavy Bodies of ſuch a Denſity, and heated to ſuch a Degree, as to enable them to retain their Fire and Heat for the Purpoſes they were deſigned.

*Anaximenes* ſaid, the Fix'd Stars were of a Fiery Nature, but had Bodies of an Earthy Nature moving round them, which we can't ſee as we can them. And this Opinion he had from *Anaximander*, and he from *Thales Mileſius*; who was the firſt of the *Ionick* Sect of Philoſophers; among whom this was a received Notion. It got alſo into the *Italian* Philoſophy; for thoſe of that Sect maintain'd each Star to be a World, and to have Earths or Planets moving round it, in the infinite Mundum Space; and in particular, that the Moon was an Earth like ours, and inhabited by ſome fine Sorts of living Creatures.

In the *Leipſick Acts* of *May*, 1690. there is a Diſcourſe about the Cauſe of Gravity, by Mr. *Leibnitz*, together with a Defence of his Opinion of the *true Laws of Nature* againſt the *Carteſians*.

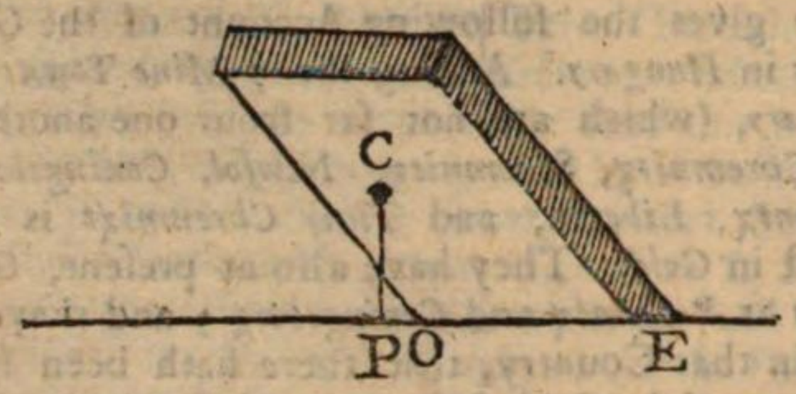
GRAVITY, its *Center*, is a Point in every heavy Body, through which any Plane whatever being drawn, will divide the Body into two Parts of equal Weight.

And the Plane ſo dividing the Body into two Parts, equal in Weight to each other, is call'd the *Plane of Gravity*.

And every Line in this Plane which paſſes thro' the Centre of Gravity, is call'd the *Diameter*, or *Line of Gravitation*, *Propenſion*, and (by ſome) *Innition*.

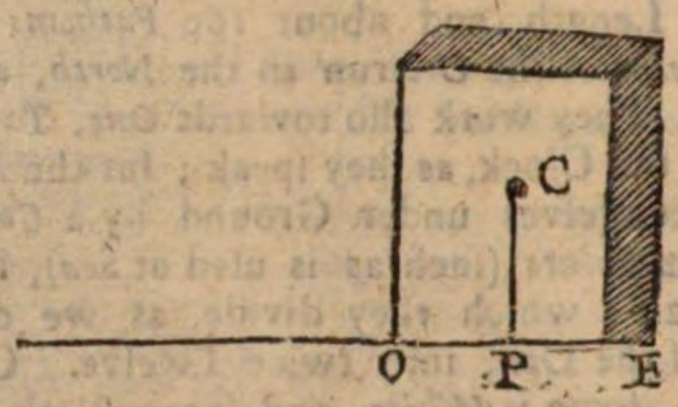
*The Line of Direction of Gravity*, or *Line of Gravity*, is perpendicular from the Center of Gravity to the Horizon.

If a Body, being placed upon an Horizontal Plane, have its *Line of Gravity C P* falling with-



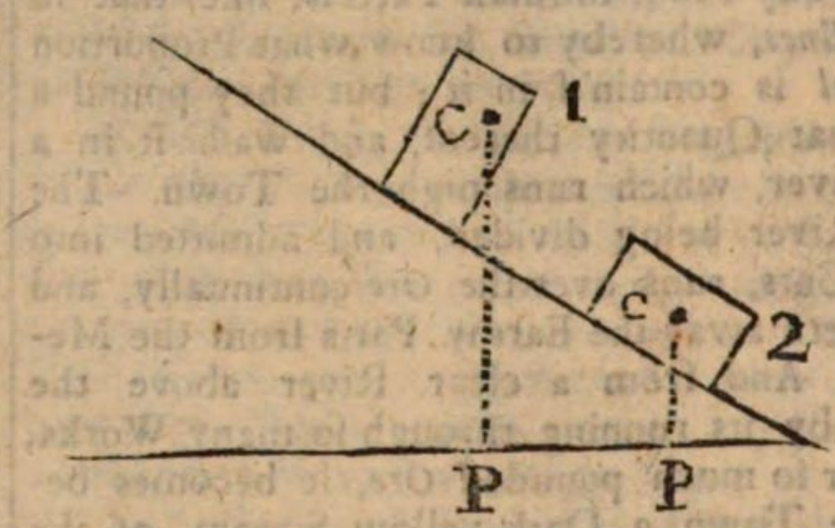

out its Baſe *O E*; then that Body muſt fall down, and will fall on that Side where the Perpendicular *C P* falls.

But if that Line *C P* falls any where within *O E*, the Baſe or Foot on which the Body ſtands,




the Body will reſt there without Danger of falling.

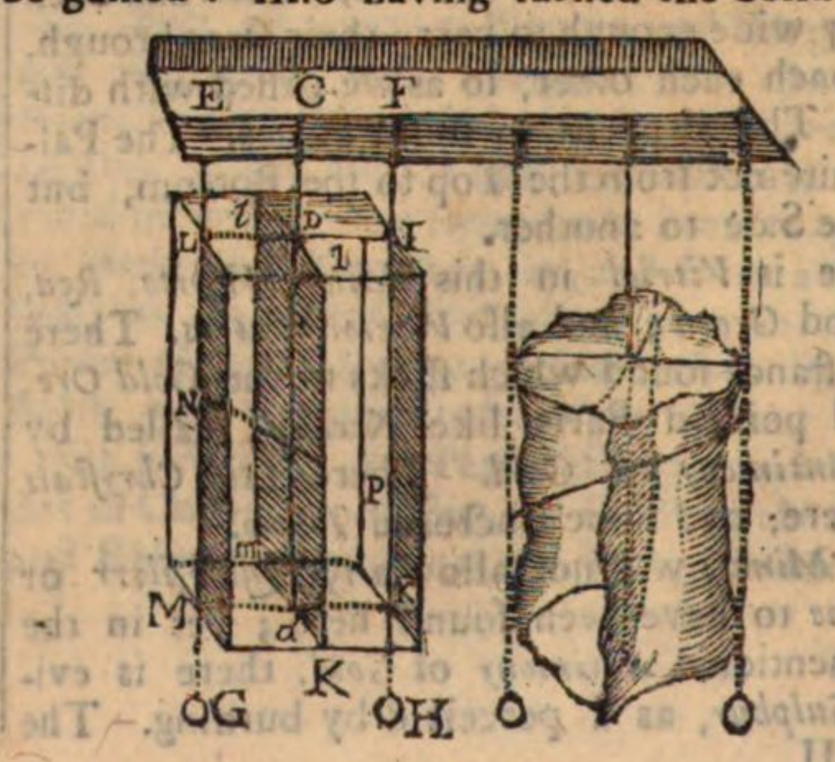
And if a Body be placed on an Inclined Plane, and *C P* the Line of Gravity, as in N. 1. falls




without the Baſe, it will tumble over; but when it falls within, as in N. 2. it will only ſlide down.

Of the Mathematical Way of finding Centers of Gravity. See *Centers of Gravity*, in *Vol.* II.

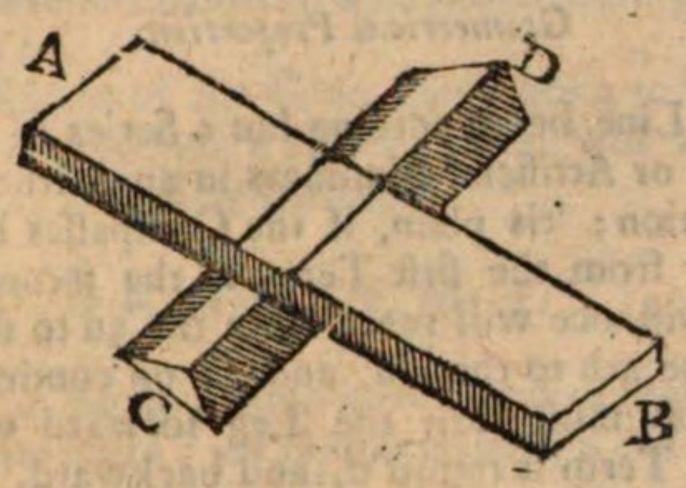
I ſhall here, from *Sturmius*, give you a good Mechanical or Practical Way for finding the Center of Gravity of Regular or Irregular Solids; by which alſo the Plane of Gravity, and the Diameter of Gravity, may be determined. Apply to the Solid ſuſpended by a Rope, as *C D*, on both Sides of it, the Perpendiculars *E G*, and *F H*, ſo that they may touch in the Lines *I K*, *L M*, which ſhould be mark'd out with Chalk, *&c.* and then be joined above and below by the Tranſverſe Perpendiculars *I L*, *K M*, ſo that one of the Planes of Gravity, *I K*, *M L*, may be gained: Alſo having turned the Solid about,




find

find out, after the ſame Manner, another ſuch Plane of Gravity, *l i*, *k m*, which will cut the former above in *D*, and below in *d*; and then the Diameter of Gravity *D d* will be had. Then hang the Solid tranſverſly, and the ſame Way find another Diameter of Gravity *N P*, which will cut the former in *O*, the Centre of *Gravity* ſought.

And in ſome Caſes, there may be yet uſed a more Compendious Way; *viz.* Lay the given Solid *A B* on the fine Edge *C D*, of any *Hypomochlion*, turning and moving it about 'till it will reſt there in *Equilibria*; then will that Plane, in the Body or Solid which anſwers perpendicularly to the Edge of the *Hypomochlion*, be one of the *Planes of Gravity*: Then find out *ſuch another*,




by poiſing the Solid another Way oblique to the former, ſo will their common Section be one of the Diameters of Gravity: Laſtly, roll the Solid into another Poſition, and then repeat the former Way of finding another Plane and Diameter of Gravity; ſo ſhall the Interſection of this Diameter of Gravity with the former be the Centre of Gravity ſought.

GREAT *Circle-Sailing*, is conducting a Ship (if it be poſſible) in the Arch of a great Circle, which paſſes thro' the Zenith of the two Places from whence and to which ſhe is bound. But this from Method is not practicable at Sea, tho' the nearer a Ship can keep to it, the better. See Sir *Jonas Moor*'s *Navigation*.

GREE, from the *French* Word *Gre*, ſignifies in our Law, Contentment or *Satisfaction*. Thus in 2 *R.* II. *c.* 15. to make *Gree* to the Parties, is to give them Contentment or Satisfaction for an Offence done to them. So in 25 *E.* III. *c.* 19. 'Tis appointed that Judgment ſhall be put in Diſpenſe, 'till *Gree* be made to the King of his Debt. Hence *Agree*, *Agreement*, *&c.*

GREGARIOUS *Birds*, are ſuch as do not live ſolitarily, but aſſociate in Flights or Coveys, a great many together in Company.

GREUT, is the Miners Word for the Earthy Part of what they dig up, and which hath no Mine or Oar in it, but is peculiar to each particular *Load*, *i. e.* ſuch a *Load* hath ſuch a coloured *Greut*. The common Earth, which is the looſe Mold above the Shelf, in which find the *Shoad*, they call *Deads*.

GROOVE, is the Shaft or Paſſage into the Lead Mines, and by which they draw up their Oar.

GROSSE. Formerly a Villain *in Groſs*, was ſuch a ſervile Perſon as was not appendant or annex'd to the Land or Mannor, and to go along with the Tenure as an Appurtenance of it; but was, like the other Perſonal Goods and Chattles of his Lord, at his Lord's free Pleaſure and Diſpoſal. And thus *Advouſon in Groſs*, is diſtinguiſh'd from *Advouſon Appendant*.

GROTESQUE, or *Groteſca* Work, is the ſame with what is ſometimes call'd *Antick*; being a confus'd Compoſure of Figures of different Natures, Sexes, *&c.* and uſually of ſuch Fancies as are not any where really exiſting in *Rerum Natura*.

GROUND *Plates*, in Architecture, are the outermoſt Pieces of Timber lying on or near the Ground, and framed into one another with Morteſſes and Tennons: In theſe alſo are Morteſſes made to receive the Tennons of the *Joiſts*, the *Summer*, and *Girders*; and ſometimes the *Trimmers* for the Stair-Caſe and Chimney-Way, and the Binding Joiſts.

GROUPPE, in Painting or Sculpture, is a Knot or ſeparate Collection of Figures, which appear to have ſome plain Connexion with, or Relation to one another, by the Deſign of the Piece.

GUARD, in the Military Art, ſignifies a Duty or Service paid by the Soldiers, to ſecure the Army or Place from the Surprizes and Efforts of the Enemy; and of this there are ſeveral Kinds: As, 1. *The Main Guard*; which is that from whence all other Guards are detatch'd: Thoſe who are to mount the Guard, meet at the reſpective Captains Quarters, and are carried from thence to the *Parade*; where, after the Whole Guard is drawn up, the Small Guards are detach'd for the *Poſts* and *Magazines*; and then the Subaltern Officers throw Lots for their Guards; and are commanded by the Captain of the *Main Guard*. 2. *Advance Guard*, is that Party of Horſe or Foot which march before a Body, to give Notice of approaching Danger. When an Army is upon their March, the *Grand Guards* which ſhould mount that Day, ſerve as *Advance Guards* to the Army. That ſmall Body alſo of 12 or 16 Horſe, which are poſted under a Corporal or Quarter-maſter before the Grand Guard of a Camp, are called the *Advance Guard*. 3. *Grand Guard*, are 3 or 4 Squadrons of Horſe commanded by a Field Officer, and poſted before the Camp, on the Right and Left Wing, towards the Enemy, for the Security of the Camp. 4. In a Camp alſo every Battalion poſts a ſmall Guard, commanded by a Subaltern Officer, about 100 Yards before its Front; and this is called the *Quarter Guard*. As, 5. That ſmall Guard of Foot which a Regiment of Horſe mounts in the Front of the Regiment, under a Corporal, is call'd the *Standard Guard*. There is alſo, 6. The *Picquet Guard*, which is a good Number of Horſe and Foot, which keep themſelves always in a Readineſs in a caſe of an Alarm: The Horſe are ſaddled, and the Riders booted, all the while; and the Foot draw up at the Head of the Battalion at the Beating of the *Tattou*; but afterwards return to their Tents, where they are in a readineſs to march upon any ſudden *Alarm*. This Guard is to make Reſiſtance, in caſe of an Attack, 'till the Army can get ready.

GUARDIAN *of the Spiritualities*, is he that collects the *Spiritualities* of any Biſhoprick during the Vacancy of that See. The Dean and Chapter of *Canterbury* are *Guardians of the Spiritualities* for the whole Dioceſe and Province, during the Vacancy of that Archbiſhoprick.

GUERITE, in Fortification, is a ſmall Tower of Wood or Stone, plac'd uſually on the Point of a Baſtion, or on the Angles of the Shoulder, to hold a Centinel, who is to take care of the Ditch. and to watch out againſt Surprizes.

GULE *of Auguſt*, is the Day of St. *Peter ad Vincules*, celebrated formerly and now on the firſt of *Auguſt*. See *Hoſpinion de Origine Feſtorum*, *Fol.* 85.

GUN-*Powder*. The wonderful Exploſion of this miſchievous Compoſition (when it is kindled) ſeems to ariſe from hence: That the Sulphur and Coal-duſt being Bodies very quickly ſet on Fire, they do very ſwiftly accend the Nitre; whoſe Spirit being thereby rarified, breaks out with a violent Exploſion, like the heated Vapour of Water out of an Æolipile. The Sulphur alſo being of a volatile Nature, is itſelf alſo converted into Vapour, and ſo encreaſes the Exploſion; and that Part of it which is of an Acid Nature, (as that Spirit which they call Oil of Sulphur *per Campanam*) upon the Accention, breaks out, and entring into the fix'd Body of the Nitre, looſens and lets out its latent Spirit alſo, hereby producing a yet much greater Fermentation and Heat.

And if you mingle Salt of Tartar with Gun-Powder, and let that Mixture be gradually heated 'till it come to take Fire, the Exploſion will become much more quick and violent; and this can ariſe from no other Cauſe than from the Action of the Vapour of the Gun-Powder on the Salt of Tartar. By what Means the ſmall Particles of Bodies do act upon one another with this Immenſe Violence, you will find under the Word *Attraction*.

GUN-*Room*, in a Ship, is the Appartment under the Great Cabin; where the Maſter Gunner and his Crew rendezvous, get ready their Cartridges, *&c.* and do all Things belonging to their Buſineſs.

GUNTERS *Line*. Deſigning in this Volume, the Deſcription and Uſe of the common Scales, Rules and other Mathematical Inſtruments; I ſhall now give you the Conſtitution and Uſe of this Famous Line. Provide a Ruler of any Metal, Wood, *&c.* that is proper, of any Length, (the larger the better) and according to the deſigned Length of your Line of Numbers, divide a Line of the ſame Length into 10000 equal Parts; and then having Recourſe to a Table of Logarithms, take off from the ſaid Scale the Artificial or Logarithmic Numbers anſwering to the Diviſion of your intended Line, (omitting the Index or Characteriſtick) and theſe Diſtances will graduate your Line of Numbers, and divide it into its *Primes*, *Tenths*, *Centeſms*, *&c.*

For the firſt eminent Nine unequal Parts, which have the Nine Digits annex'd, are call'd *Primes*; and the Subdiviſions of thoſe into Ten leſſer Parts are called *Tenths*; each *Tenth* is divided, or ſuppoſed to be ſo, into *Centeſms*; and thoſe *Centeſms* into *Millains*, as Mr. *Wingate* calls them. *Numeration* therefore, as they call it, on the Line will be very eaſy; and you may know readily how to find the Point expreſſing any Number of not above 4 Places on it. Suppoſe the Number were 4867; The Figure 4, on the Line, expreſſes the Place of 4000; thence accounting 8 Tenths further to the Right Hand, you will have the Place of 4800; and in the next Tenth, reckoning forward ſix Subdiviſions, you will have the proper Point for 4860; and then in the next *Centeſm*, taking or gueſſing at 7, (and Practice will make this eaſy) you will find the Point (nearly) for 4867.

But if your Number had been but of 3 Places, as 486; then the Digit Figure 4 on the Line would only have repreſented 400. And if it had been but of two Places, or a ſingle Figure, the Figure 4 on the Line would have been 40, or barely 4 Unites accordingly. 'Tis plain alſo, that any Decimal Fractions and Unfixt Numbers will be repreſented on the Line as eaſy as Whole Numbers, Regard being only had to the Point or Line of Separation.

## PROBLEM I.

*Two Numbers being given, to find a Third or Fourth Geometrical Proportion.*

The Line being nothing but a Series of Logarithms or Artificial Numbers in an Arithmetical Proportion; 'tis plain, if the Compaſſes be extended from the firſt Term to the ſecond, the ſame Diſtance will reach from the 3d to the 4th, from the 4th to the 5th, and ſo on continually; only you muſt turn the Leg forward when a greater Term is requir'd, and backward, or towards the Left Hand, when the proportional Term required is to be leſs; as common Senſe will direct. Thus if the Two Numbers had been 10 and 12, the Third Proportional forward would be 14.4, and backward 8.3, *&c.* So that all Queſtions in any Practical Art, where ſuch kind of Proportionals are requir'd, may, you ſee eaſily, be wrought by the *Gunters Line*.

## PROBLEM II.

*To multiply or divide one Number by another.*

Since in all Multiplication, As 1 is to the One Factor :: So is the Other, to the Product. And ſince in all Diviſion, as the Deviſor is to Unity :: So is the Dividend to the Quotient. Either of theſe Rules may be eaſily wrought by the Line of Numbers, ſince 'tis only finding a 4th Proportional to Three Terms given. The Extent of the Compaſſes therefore, from 1 to the Multiplier, will reach forward in Whole Numbers from the Multiplicand to the Product: And the Extent from the Diviſor to Unity, will reach from the Dividend to the Quotient. If either or both Numbers be Decimal Fractions, the Nature of the Product or Quotient muſt be determined by the Rules given about managing of ſuch Fractions; but the ſame Figures will be found by the Line, let the Nature or Value of the Numbers be what it will. *N. B.* How many Places muſt be in the Product or in the Quotient, may be diſcovered eaſily by the Rules of Common Arithmetick, and conſequently to what Exactneſs you muſt endeavour to go in the Line.

## PROBLEM III.

*Three Numbers being given, to find a Fourth in a Duplicate Ratio or Proportion.*

This relates to the Proportion of Surfaces and Area's, which, when Similar Figures, are in a Duplicate

Duplicate Ratio of their Homologous Sides. Let the Diameter of a Circle be 14 Inches, and its Area 154; What is the Area of a Circle, whose Diameter is 28?

Extend the Compasses from 14 to 28; that Extent will reach from 154 to 308, and thence to 616, the Area requir'd.

## PROBLEM IV.

*To three Numbers given, to find a Fourth in a Triplicate Proportion.*

This relates to Solids, and their Proportion to Lines.

Let the Diameter of an Iron Bullet be 4 Inches, and its Weight 9 lb. What will a Bullet weigh, whose Diameter is as much more; *viz.* 8 Inches?

The Extent of the Compasses from 4 to 8, applied to 9, and turn'd three Times, will at last fall on 72, the Weight sought.

## PROBLEM V.

*To find a Mean Proportional between any Two Numbers given: As suppose between 8 and 32.*

Extend the Compasses from 8 in the Left Hand Part of the Line, to 32 in the Right, and then bisect that Distance; the half shall reach either from 8 to 16 forward, or from 32 to 16 backward.

## PROBLEM VI.

*To find Two or more Mean Proportionals between two Numbers given.*

Divide the Distance between the two Numbers into a Number of equal Parts, which shall exceed the *Means* required by one; (as if 2 are required into 3, if 3 are required into 4, *&c.*) So shall the Feet of the Compasses, when turned from either of the Numbers towards the other, mark out the middle Proportionals required.

## PROBLEM VII.

*To Extract the Square Root of any Number.*

Bisect the Distance between 1 on the Scale, and the Point which represents the Number; and the Half being set from 1, will give the Point representing the Root.

## PROBLEM VIII.

*For the Cubick Root, or that of any Higher Power.*

You must Divide the Distance on the Line between 1 and the given Number, into as many equal Parts as the Index of the Power expresses; and one of those Parts set from 1, on the Line, will find the Point representing the Root requir'd. Thus if the Cubick Root of 1728 were requir'd: Divide the Distance between 1 and 1728 into three equal Parts, (3 being the Index of the Cube or Third Power) and one of those set from 1 forward, will find 12 the Root sought.

*N. B.* Only observe to *Point the Number* whose Root is to be Extracted (as in Extraction of Roots in Common Arithmetick) and then, if the last Point fall on the first Figure of the Number, the former Way of accounting on the Line will do: But if the last Point fall on the second Figure or Place in the Number (reckoning from the Left Hand towards the Right;) then account the whole Length of the first Line of Numbers in, and carry the Account on in the Second: As suppose the Root of 36 were requir'd; begin to take the 36 from the first 1 on the Left Hand in the Line, and account the 36 on in the second Line; and then half that Distance being sent from the first 1, will reach to 6, the Root in either the first or second Line. So also if the Square Root of 1440 had been sought: Account the whole first Line for your first 1000; and then the 440 on in the Tenths between the second 1 and 2: So will half the Distance between the first 1 and that Point, reach from 1 to near 38 in either Line.

## PROBLEM IX.

*For the Use of the Line in* Trigonometry; *See that Word.*

*The Use in Superficial Measure.*

## PROBLEM X.

*Having the Diameter of a Circle, to find the Circumference.*

Extend the Compasses from 1 to the Number expressing the Diameter; and then the same Extent will reach from 3.142 to the Circumference.

## PROBLEM XI.

*Having the Diameter, to find the Superficial Content.*

The Extent, as before, from 1 to the Diameter being found, set it twice from the Point of .7854 on the Line, and then it will reach to the Number expressing the Area.

## PROBLEM XII.

*The Breadth of a Rectangle being given in Inch-Measure, and the Length in Foot-Measure, to find the Area in Feet.*

Extend the Compasses from 12 on the Line to the Breadth in Inches; and that will reach from the Length in Feet, to the Area in Square Feet.

## PROBLEM XIII.

*The Length and Breadth being given in Foot-Measure, to find the Area in Yards.*

The Extent from 9 to the *Breadth*, will reach from the *Length* to the *Area* in *Yards*.

PRO-

## PROBLEM XIV.

*To find the Area in ſingle Perches.*

The Extent from 16.5, to the *Breadth*, will reach from the *Length* to the *Content* in *Perches*: And the Extent from 160 to the *Breadth*, will reach from the *Length* to the *Content* in *Acres*, &c.

*The Uſe in Solid Meaſure.*

## PROBLEM XV.

*The Depth and Breadth of a Right-angled Parallelopiped being given in Inch-Meaſure, and the Length in Foot-Meaſure, to find the Content in Feet.*

The Extent from 12 to the *Breadth* and *Depth* in Inches, being twice repeated from the *Length* in Feet, will reach to the Content in Feet. If the Parallelopiped be Oblique-angled, you muſt find a Mean Proportional between the *Breadth* and *Depth*: And then the *Extent* from 12 to the Mean Proportional being twice repeated from the *Length* in Feet, will reach to the *Contents* in Feet.

## PROBLEM XVI.

*To find the Solidity of a Cylinder, whoſe Baſe and Length is given.*

The Extent from 1 to the Baſe, will reach from the *Length* to the *Solid Content*.

## PROBLEM XVII.

*Having the Diameter of a Sphere, to find its Surface and Solidity.*

The Extent from 1 to the Diameter, repeat twice from the Point of 3.142, and that will reach to the Number expreſſing the Surface: And if you repeat the Extent from 1 to the Diameter, three times from .5238 on the Line, that will reach to the *Solid Content* requir'd.

*Its Uſe in Intereſt and Annuities.*

## PROBLEM XVIII.

*To find what any Sum will encreaſe at* 6 per Cent. *Intereſt upon Intereſt, if forborn a certain Time. Suppoſe* 273 l. *for* 5 *Years.*

Extend the Compaſſes from 100 to 106, and then repeat that Diſtance five times from 273, ſo will the Point at laſt fall on 402.1, or 402 *l.* 2 *s.* which is the Principal and Intereſt requir'd.

## PROBLEM XIX.

*A Sum of Money being due for a Time to come, to know what 'tis worth in ready Money.*

This is the Reverſe of the Laſt.

## PROBLEM XX.

*A Yearly Rent or Annuity being forborn for a Term of Years, to find what the Arrears will amount to, at the Rate propoſed.*

As ſuppoſe a Rent or Annuity of 12 *l. per Ann.* were forborn ſixteen Years; What will the Arrears amount to at the Rate of 8 *l. per Cent.* Intereſt?

Firſt find the Principal anſwering to 12 *l.* by ſaying, If 8 *l.* hath 100 *l.* for its Principal, what will 12 *l.* have? Anſwer, 150 *l.* Then I find (by *Probl.* 18.) that 150 *l.* being forborn ſixteen Years, amounts, at 8 *l. per Cent.* to 513.9, or 513 *l.* 18 *s.* Out of which deducting 150 *l.* the Principal anſwering to the Annuity given, there remains 363 *l.* 18 *s.* the Sum of all the Arrears requir'd.

## PROBLEM XXI.

*To know what Annual Rent or Annuity is worth in Ready Money.*

Find (by the Precedent) the Value of the Arrears at the End of the Term propoſed; and then (by *Probl.* 19.) what thoſe Arrears are worth in Ready Money; and that will be the requir'd Price or Value of the propoſed Rent or Annuity; *v. gr.* I find the Arrears of 12 *l. per Ann.* at ſixteen Years end, and at 8 *l. per Cent.* amount to 363 *l.* 18 *s.* And I find (by the 19th *Probl.*) that the ſaid Sum is worth in Ready Money 106 *l.* 4 *s.* and conſequently I conclude, that the Leaſe or Annuity propoſed is worth in ready Money (after 8 *l. per Cent.*) 106 *l.* 4 *s.*

If the Term of the Annuity don't commence preſently, but ſuppoſe at five Years hence or to come, then you muſt find what the Arrears for all that Time are worth in ready Money; that is, what they are worth, when forborn in this Inſtance for twenty one Years. The Anſwer is, 72 *l.* 6 *s.*

GUTS: See *Inteſtines.*

GUY *Rope*: See *Guy*, in Vol. I.

GWAIF, the ſame with *Waif*; *i. e.* ſuch Goods as Felons when purſued, caſt down and leave in the High-Way; which become a Forfeiture to the King or Lord of the Mannor, unleſs the Right Owner legally claim them within a Year and a Day.

HABENTES *Homines*, *Fæsting-Men*; as they are call'd in a Charter of *Cenulph* King of the *Mercians*, *Anno* 821. *Du Freſne* will have theſe to be no more than *Divites*, Rich Men: But no doubt the Word implies a ſtricter Sence; and ſignified either the King's Guard or Retinue, which were at the King's Pleaſure to be *Feaſting-Men*, or plentifully entertained at the Houſes of his Tenants: Or rather, thoſe Old Servants which were commended to the Religious by the King; and ſo *faſtned* on them for *Corrodies*, or Maintenance for Life. Some think that they were only *Pledges* and *Sureties*, or *Friburghs*; which under their Chief or Principal Tything Man, were to keep the King's Peace, and to be accountable for the Breach of it.

HABITATION, in the Civil Law, is the Term for one of the Perſonal Services, by which a Man hath a Right to live in the Houſe of another without Prejudice to the Propriety.

HADBOTE, was a Recompence made for the Violation of Holy Orders, or Violence offer'd to Perſons in them.

HAIL. Dr. *Wallis* in a Letter from *Oxon* to the Secretary of the Royal Society, and printed in the *Tranſactions*, obſerves that *Hail* is very often an Attendant on Thunder and Lightning; (of which, ſee *Thunder* in this Volume.) And 'tis well known, that in our artificial Congelations, a mixture of Snow and Nitre, or even common Salt, will cauſe a very ſudden Congelation of Water. Now the ſame in the Clouds may cauſe *Hail-Stones*; and the rather, becauſe not only in ſome prodigiouſly great, but alſo in common *Hail-Stones* there ſeems ſomewhat like Snow rather than Ice, in the midſt of them. And as to thoſe very large *Hail-Stones*, weighing $\frac{1}{2}$ or $\frac{3}{4}$ of a Pound; by the violence of their Fall 'tis manifeſt they muſt have deſcended from a great Height: And tho' perhaps in their firſt Concretion, or Congelation, their Bulk might be but of the moderate Size of common *Hail*, yet in their long Deſcent, if the *Medium*, through which they fell were alike inclined to Congelation, they might receive a great Acceſſion to their Bulk, by, perhaps, many of them coaleſcing and incorporating into one; as in that ſtrange Shower of *Hail* in *December* 1672. whereof their hung on the Trees a great deal in the form of Icicles, of a Foot or more in length.

HAIL WORKFOLK; *i. e.* Holy Work-folk, or People who hold Lands for the Service of Repairing or Defending ſome Church or Sepulchre: For which pious Labours they were excuſed formerly from Feudal and Military Services.

HALF-*Bloom*, is the Term for a round Maſs of Metal, which comes out of the *Finery* in all Iron-work: See *Iron*.

HALF-*Tangent-Lines*: See *Scale*.

HALF-*Tongue*, or *Party-Jury*, is a Jury empanell'd in a Cauſe where a Stranger is a Party; whereof the one Part conſiſts of Denizens, the other Half of Strangers: And the ſame is uſed in Pleas, where one Party is a Denizen, the other a Stranger. This way of Tryal was firſt Enacted by a Statute of *Edward* III.

HALLAGE, is a Fee due for Cloths brought for ſale to *Blackwell-Hall* in *London*; and alſo the Toll that is due to the Lord of a Fair or Market, for ſuch goods as are vended in the Common Hall of the Place.

HALO. Mr. *Huygens* (*vid. Philoſoph. Tranſ.* N. 60.) endeavours to account for the Appearance of *Halo's*, or Circles round the Sun, thus: That they are formed by ſmall round Grains of a kind of Hail made up of two parts; one of which is opake and incloſed in the other, which is tranſparent; and the ſame way he accounts for the *Parhelia*; only there he imagines that the Icy Grains are of an oblong Figure, and rounding at the Ends like Cylinders with round convex Tops. Where ſome of theſe Cylinders are in an erect Poſition, the Circle they form will be white, and is cauſed by the Reflexion of the Rays of the Sun on the Surface of theſe Cylinders. He proceeds afterwards to account for the colour'd *Halo's* and *Parhelia* from the ſame Hypotheſis, and produces an Experiment of a Glaſs Cylinder of a Foot long, and having within an Opake Kernel (which was a Cylinder of Wood) and the ambient Space was filled with Water: Which Cylinder being expoſed to the Sun, and the Eye diſpoſed in proper places, the ſeveral ſucceſſive Reflexions and Refractions neceſſary to produce ſuch Effects did plainly appear.

HALY-MOTE (*alias Healge-mote*) a Word retain'd in *Herefordſhire* to this Day for a Court-Warren. It may ſignifie a Convention of Citizens in their Court-Hall; or, a *Holy* or Eccleſiaſtical Court. *Cowel's Interpr.*

HAMBLING, or *Hamelling* of Dogs, is the ſame, in the Laws of the Foreſt, as Expeditating: And *Manwood* ſaith, *Canutus*, in Can. 1. calls the Lawing of Dogs, *Genuſciſſio*, *Ham-ſtringing*.

HAMMER. Beſides the *Sledges*, or large *Hammers* uſed by Smiths, there is, 1. The *Hand-Hammer*, which is us'd by the Smith at the Forge with one Hand. Its edge is call'd the *Pen*; and the other part of the Head the *Face*; and the Hole for the Handle is call'd the *Eye*. 2. The *Rivetting-Hammer*, chiefly us'd for rivetting or ſetting ſtraight cold Iron; or for crooking of ſmall Work; but 'tis ſeldom us'd at the Forge. For the Smith's larger *Hammers*, ſee *Sledge*.

HAMPER: See *Hanaper*.

HAMSOKEN, *Haimſuken*, *Homeſoken*, is the Term in *Scotland* for the Crime of him that violently Aſſaulteth a Man in his own Houſe: And our antient Records call Burglary *Hamſocne*.

HANAPER: See *Clerk* of the *Hanaper*.

HANCES (in a Ship) are Falls or Deſcents of the Fife-Rails, which are placed on Baniſters on the Poop, Quarter-Deck, *&c.* down to the Gangway.

HANCES in Architecture are the Ends of Elliptical Arches; and theſe are the Arks of ſmaller Circles than the *Scheme* or middle Part of the Arch.

HANDBOROW, is a Surety, a Manual Pledge; *i. e.* an *Inferior* Undertaker; as *Headborow* is a *Superior* or Chief Inſtrument. *Spelman.*

HANDGRITH, was antiently the Word for Peace or Protection given by the King with his own Hand.

HAND-HABEND, is a Thief taken with the Goods in his Hand, or upon him, as we ſay.

HANGWITE, according to *Raſtal*, was a Liberty granted to a Man whereby he was quit of a Felon or Thief, hang'd without Judgment, or eſcap'd out of Cuſtody.

HANSE, is an old *Gothick* Word, ſignifying a Society of Merchants combin'd together for the good Uſage and ſafe Paſſage of Merchandize from Kingdom to Kingdom. This Society was, and in part is yet, endow'd with many large Privileges of Princes reſpectively within their Territories. It had four principal Seats or States, where the *Almain* or *German* Merchants, being the Erectors of this Society, had an eſpecial Houſe; One of which was here in *London*; and call'd *Gild-Hald a Teutonicorum*, or among us vulgarly the *Steel-Yard*, or *Still-Yard*.

HAPPE, from the *French Happer*, to Snatch or Catch, is a Term uſed in our Law. As to *Happe* the Poſſeſſion of a Deed Pole. *Littleton*, Fol. 8. To *Happe* the Rents; as if Partition be made between two Parcenors, and more Land be allow'd to one than to the other: And ſhe that hath moſt of the Land charges it to the other, and ſhe *Happeth* a Rent, ſhe ſhall remain an Aſſize without Specialty. *Cowel.*

HARMONY. Dr. *Holder* in his Diſcourſe on this Subject, ſaith, That when the Sonorous Body is conſtituted of Parts ſolid or tenſe, regular and fit to receive and expreſs the Tremulous Motion of Sound, *equally* and ſwiftly, it will then render a certain even *Harmonical Tone* or *Tune*.

The Tune of any Note is conſtituted by the Meaſure and Proportion of the Vibrations of the Sonorous Body; *i. e.* of the *Velocity* of thoſe Vibrations in their Recourſes.

For the *more frequent* the Vibrations are, the *acuter* will be the Tune; and the *ſlower* or *fewer* they are in *the ſame Time*, the *graver* is the Tune.

So that *any given Note of a Tune is made by one certain Meaſure of Velocity of Vibration; viz.* Such a certain Number of *Courſes* and *Recourſes* (*i. e.* forward or backward Vibrations) of any Chord or String in ſuch a certain Space of Time, doth conſtitute ſuch a determinate Tune: And all ſuch Sounds as are *Uniſons*, let them come from *Voice*, *Bell*, *Pipe*, or *String*, are made with Vibrations all equal to one another.

The *Continuance* alſo of the Sound in the *ſame Tune*, *to the End*, (as in Strings of Wire, which being once ſtruck will hold their Sound long in the ſame Note) depends upon the Equality of Time of the Vibrations from the greateſt Range till they come to ceaſe: As is the known Property of *Pendulums*: And a Muſical String ſtruck, is like a Double *Pendulum*, moving upon two Centres, the *Nut* and the *Bridge*, and vibrating with its greateſt Range in the middle of its Length, and the Vibrations equal, even to the laſt; which muſt make it keep the ſame Tune as long as it ſounds. And becauſe it doth plainly keep the ſame Tune to the laſt, the Vibrations are equal.

The Meaſures of Swiftneſs of Vibrations of the String or Chord, as hath been ſaid above, conſtitutes and determines the Tune, as to the *Acuteneſs* and *Graveneſs* of the *Note* which it ſounds: and the lengthning or ſhortning of the String under the ſame Tenſion, determines the Meaſure of the Vibrations which it makes. And thus *Harmony* comes under Mathematical Calculations of Proportions; as to the Length of the Chords, the Meaſure of the Time in Vibrations, and of the Interval of tuned Sounds. As the Length of one String is to another (if of the ſame Matter, Thickneſs and Tenſion) ſo is the Meaſure of the Time of their Vibrations. As the Time of the Vibration of one String to another, ſo is the *Interval* or Space of Acuteneſs or Graveneſs of the Tune of that one, to the Tune of the other: And conſequently, as the Length is, ſo is the determinate Time, *cæteris paribus*. Theſe Vibrations impreſs a Motion of Undulation or Trembling in the Air, as far as the Motion extends, of the ſame Meaſure with the Vibrations.

And if the Motions made by different Chords are ſo commenſurate that they mix and unite, and bear the ſame Courſe altogether, alternately or frequently: Then the Sounds of theſe different Chords, thus mixing, will calmly paſs the *Medium*, and arrive at the Ear as *one Sound*, or nearly the ſame; and ſo do evenly, ſmoothly, and with pleaſure ſtrike the Ear; which produces what they call a *Conſonancy*; and from the Want of ſuch an agreeable Mixture, *Diſſonances* do ariſe.

And as the more frequent Mixture or Coincidence of Vibrations render the *Concords* generally ſo much the more perfect; ſo the leſs there is of Mixture, the greater and more harſh will the *Diſcord* be.

From all which 'tis eaſie to ſee the Reaſon why Concords are agreeable and pleaſing to the Ear; which is becauſe they unite in their Motions often; at leaſt in every ſixth Courſe of Vibration; as is apparent from the Muſical *Ratio*'s by which they are conſtituted, which are all contain'd within that Number of 6.

Thus the Agreement between two or more *Uniſons* or Chords of the ſame Length, *&c.* is becauſe the Vibrations of ſuch Sounds are equal to *Time* and *Meaſure*, and do joyn and unite in every *Courſe* and *Recourſe*.

If the String *A* be double in length to *B* (I proceed according to the uſual Diviſion of the Monochord) *i. e.* as to 2 to 1. Then the Vibrations of *B* will be duple to thoſe of *A*, or twice as ſwift: And conſequently if theſe Strings are ſtruck together, their Vibrations will unite alternately; *viz.* at every *Courſe* croſſing at the Recourſe, and give the Sound of the *Octave* to one another.

If the Length of *A* to that of *B*, be as 3 to 2: Then reciprocally their Vibrations will be as 2 to 3; and their Sounds will *concord* in a *Fifth*; their Motions uniting after every ſecond *Recourſe*; *i. e.* at every other, or third Courſe.

If *A* be to *B*, as 4 to 3, they ſound a *Fourth* together, and their Vibrations unite after every third Recourſe, or at every fourth Courſe.

If the Length of *A* be to that of *B*, as 5 to 4, they ſound a *Ditone* or *Third Major*; and their Motions unite after every fourth Recourſe, or at every fifth Courſe.

If *A* be to *B*, as 6 to 5, then they ſound a *Trihemitone* or *Third Minor*; uniting their Vibrations after every fifth Recourſe, and at every ſixth Courſe, *&c.*

And thus by the frequency of their being mix'd and united, the *Harmony* of joyn'd Concords in Muſick is found ſo very ſweet and pleaſing; the Remoter being alſo combined by their Relation to other Concords beſides the *Uniſon*. The *ſixth Major*, which is 5 to 3, is within the compaſs of *Ratio's* between 1 and 6. But the *leſſer Sixth* (8 to 5) is beyond it; but is the Complement of 6 to 5, to an Octave; and makes a better Concord by its Combinations with the Octave and Fourth from the Uniſon; having the Relation of a *Third Minor* to one, and of a *Third Major* to the other, and their Vibrations uniting accordingly. The *Sixth Major* hath the ſame Advantage.

HARO, *Harron*, is an *Outcry*, or a Hue-and-Cry after Felons and Malefactors: See the Original of this *Cuſtom*; *de Haro* among the *Normans in La Couſtume de Normandie par Mr. H. Baſnage*, Vol. 1. p. 104. Perhaps, hence our *Engliſh* Word to be *Har'd*, *i. e.* Frighted; and *Haraſs'd*, Tired, *&c.*

HATCH, a Term in Mining: See *Eſſay-Hatch*. *Hatch* is alſo us'd for a Croſs-Board that lies a-thwart the *Paſs*, [to hinder the *Ore* from tumbling all at once into the *Coffer* of a *Stamping-Mill*.

HATCHING, is a Term us'd in the Art of Drawing or Deſigning in Black and White; and by it is underſtood a manner of Shadowing by a continual *Series*, or Succeſſion of many Lines ſhorter, or longer; cloſer or more ſeparate; oblique, or direct, according as the Work requires, to render it more or leſs enlighten'd.

HAW, is a ſmall Quantity of Land, and uſually ſuch as lies near a Houſe: As a *Hemp-Haw* or Plat, a *Bean-Haw*: And ſome old Manuſcripts ſay that *Haw* is the ſame with *Manſio*, a Dwelling-Houſe, as in *Doomſday-Book*, *&c.*

HEADS, is a Term us'd by Builders for thoſe kind of Tiles which they uſe to lay at the Eaves of a Houſe; being the full breadth of a Common Tile, and but half a Tile in length.

HEAD-BOROW, ſignifies him that is Chief of the *Frank-Pledge*, and him that had the principal Government of them within his own *Pledge*. And as he was call'd *Head-Borow*, ſo he was alſo call'd *Burrow-Head*, Burſholder (now *Boſholder.*) *Third-Borow*, *Tything-Man*, *Chief-Pledge*, and *Borow-Elder*, according to the diverſity of Speech in divers places. This Officer is now uſually call'd a *Conſtable*.

HEAD-PENCE, or *Head-Silver*, was formerly an Exaction of 40 *l.* or more, collected by the Sheriff of *Northumberland* of the Inhabitants of that County every Third and Fourth Years; without any Account made to the King. But by 23 *H.* VI. c. 7. this was clearly aboliſh'd for ever.

HEART. Authors which have treated about this Muſcle are chiefly *Lower de Corde*, *Bellini de Motu Cordis*, and *Borelli de Motu Animalium*; who accounts that the Force of the Compreſſion of the *Heart* to ſqueeze out the Blood into the Arteries, is equal to that of 3000 Pound weight; and that 350 Pound weight of Blood paſſes thro' the *Heart* every Hour: See Dr. *Keil's Animal Secretion*, p. 88. where you have a good Attempt to eſtimate the Quantity of the Blood in an Human Body, its Velocity, *&c.*

HEAT. Great Bodies are capable of preſerving *Heat* for a long while; their Parts mutually increaſing one another's *Heat*. And it may be, that a very great denſe and fix'd Body, when heated beyond ſuch a degree, may emit Light ſo copiouſly, that by ſuch Emiſſion, and by the Reaction of its Light, and by the Reflexions and Refraction of the Rays within its hidden *Meatus*, it may come to grow ſtill hotter and hotter, as deriving more *Degrees of Heat* by thoſe ways, than it can of *Cold* by any other: And by this means it may come to attain a *Heat*, like that of the Sun: For the Sun and the fix'd Stars ſeem only vaſt Globes of Earth vehemently heated; and whoſe *Heat* is preſerved by their great Magnitude, and by the mutual Action and Re-action that there is between them and the Light which they emit.

And their Parts are preſerved from evaporating in Flame and Fume, not only by the great Fixity of their Nature; but alſo by the mighty Weight and Denſity of the Atmoſphere which environ them, which *preſs* them every way with a great *Niſus*, and condenſe their Vapours and Exhalations, whenever they are emitted.

For we ſee that *Water*, but moderately heated, will boil with violence when the Preſſure of our Atmoſphere is taken off in the Exhauſted Receiver.

And a Mixture of Tin and Lead, being plac'd on a red-hot Iron *in vacuo*, will emit copious Fumes, and even ſome Flame, which yet in our Air will ſcarce viſibly ſmoke. *Vid. Qu.* 11. *Newton. Opt.* p. 296. Edit. Lat.

*Heat* conduces very much to the Fluidity of Bodies, by leſſening the Tenacity of their Parts; for it renders many Bodies fluid, which otherwiſe are not ſo; and increaſes the Fluidity of Tenacious Liquors, as of Oyl, Balſam, Honey, *&c.* and by the ſame reaſons leſſens their Reſiſting Force: And yet it doth not much leſſen the Reſiſting Force of Water; which it muſt do, if that Force ariſe chiefly from the Attrition or Tenacity of its Parts; and conſequently it doth not ariſe from thence, but from the *Vis Inertiæ Materiæ*.

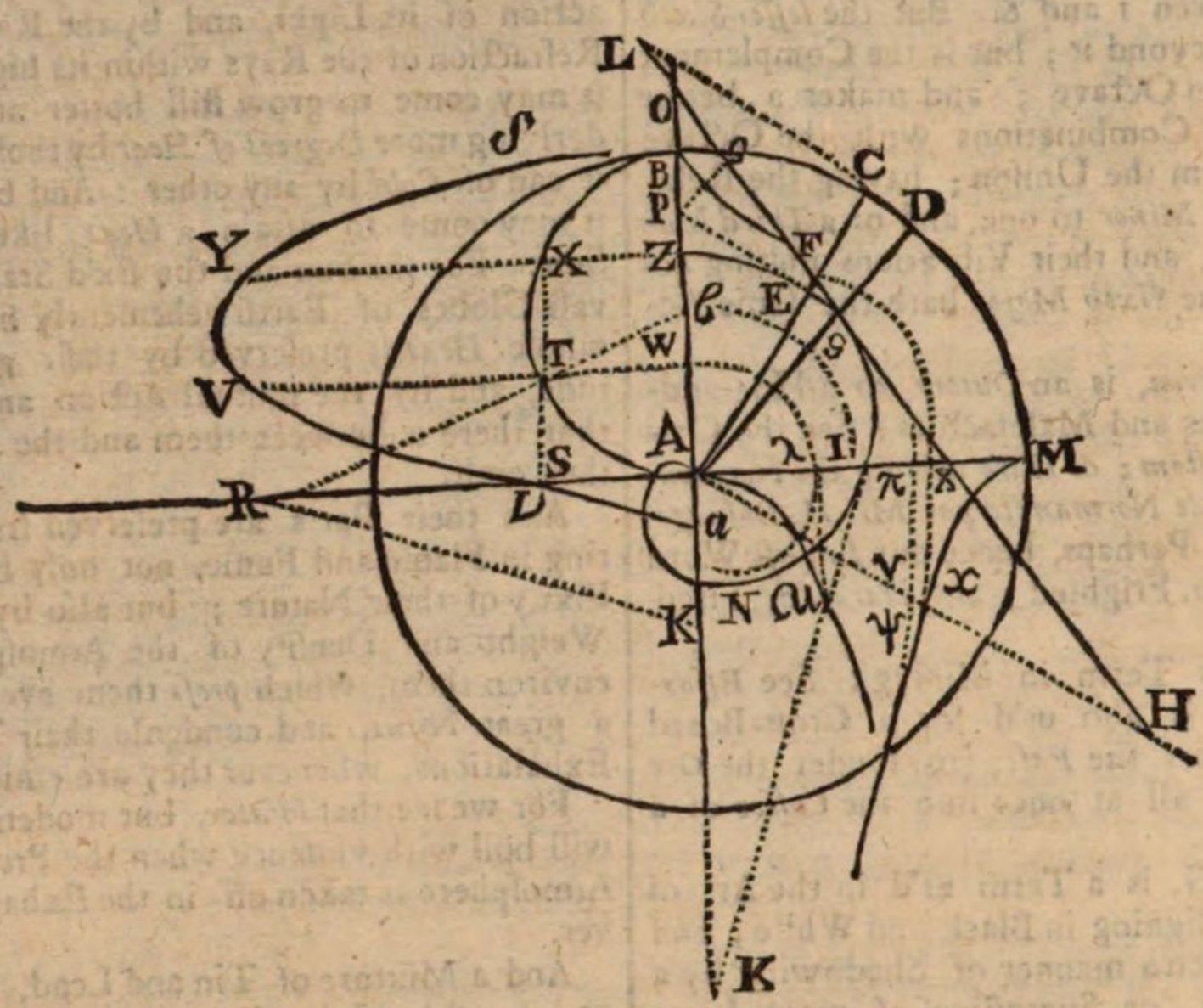
HEBBER-THEF, was formerly the Privilege of having the Goods of a Thief, and the Tryal of him within ſuch a Liberty.

HEBDOMADIUS, was formerly that Canon or Prebendary in a Cathedral Church, which had the peculiar Care of the Choir, and the Officers of it, for his own Week.

HEDAGIUM, from *Heda*, a *Hythe*, Port or Wharf; was formerly the Term for the Toll or Cuſtom paid at the *Hythe* or Wharf, *&c.* for Landing Merchandize, Goods, *&c.* From which Toll or Cuſtomary Duties, Exemptions were ſometimes granted by the Sovereign to ſome particular Perſons and Societies.

HEIGHT, or *Altitude* of the Eye in Perſpective, is its *Height* or Elevation above the Horizontal Plane; and it is meaſured by a Perpendicular let fall from the Eye to that Plane.

HELICOLD *Parabola*, or the *Parabolick Spiral*, is a Curve which ariſes from the Suppoſition of the Axis of the common *Apollonian Parabola's*, being bent round into the Periphery of a Circle, and is a Line then paſſing through the Extremities of the Ordinates, which do now converge towards the Centre of the ſaid Circle. The *Tangent*, *Area*, *Length*, and *Flexure* of this *Spiral Curve* is inveſtigated by Mr. *J. Bernoulli*, according to the Method of the *Differential Calculus*, in a Diſcourſe on that Method on the *Act. Lipſ.* for *Jan.* 1691. Thus,




Suppoſe the *Axis* of the common *Parabola* to be bent into the Periphery of the Circle *B D M* (in *Fig.* above;) Then the Curve *B F G N A*, which paſſes through the Extremities of the Ordinates *C F*, *D G* (which converge towards the Centre of the Circle *A*) is what is called the *Helicoid*, or *Spiral Parabola*, or the *Parabolick Spiral*. And in order to the Inveſtigation of its Tangent, Area, Length, and Flexure; He ſuppoſes $AB = r$, $BDMB = c$. The Arch $BC = x$, $CF = y$. Let alſo *C L*, *A H*, be drawn perpendicular to *A C*; and let *C D* be an infinitely ſmall Arch on part of the Circumference, ſimilar to, and concentrick with, the little Arch *G E*.

The Nature of the Curve is $l x = yy$ (where $l$ ſtands for the Parameter of the Parabola.) Whence, in this *Calculus*, $dx$ being the Fluxion of $x$, and $dy$ the Fluxion of $y$, &c. (*See the Marquis l' Hoſpital Analyt. des Infiniment petits.*) $l\,dx = 2y\,dy$; and $dy : dx :: l : 2y$.

$AD : AG :: DC : GE$

Firſt then for the *Tangent*. It will be $r : r-y :: dx : \frac{r\,dx - y\,dx}{r}$;

$FE : EG \quad FA \quad AH \quad FC \quad CL$

And $dy : \frac{r\,dx - y\,dx}{r} :: r-y : \frac{dx \times \overline{r-y}^2}{r\,dy} :: y : \frac{ry\,dx - yy\,dx}{r\,dy}$

To make a particular Application of the General Expreſſion to the Curve propoſed; inſtead of $dy$ and $dx$, ſubſtitute their Proportionall and $2y$; Then will $AH = \frac{2y^3 - ryy + 2rry}{lr} =$ (ſubſtituting $lx$ for $yy$) $\frac{2xy}{r} + \frac{2ry}{l} - 4x$; and $CL = \frac{2ryy - 2y^3}{lr} = 2x \frac{-2xy}{r}$. The greateſt $AH$ ($CL$) will be found, if its Differentials $\frac{6yy\,dy - 8ry\,dy + 2rr\,dy}{lr}$ (or $\frac{4ry\,dy - 6yy\,dy}{lr}$ the Differentials of $CL$) be put $= o$: Whence ariſes $y = \frac{1}{2}r$ ($\frac{2}{3}r$;) and conſequently the greateſt $AH$ ($CL$) $= \frac{8rr}{2yl}$ either of them.

## COROLLARY.

If the Parameter $\frac{l = rr}{c}$, *viz.* that the Applicate anſwering to the whole Circumference be the Radius it ſelf (as in the preſent *Fig.*) then the greateſt $AH$ or $CL$ will $= \frac{8}{2y}c$.

*The greateſt Angle made by the Ordinate and Tangent*, viz. $AFH$, or $CFL$, is found, by putting the *Ratio* $\frac{CL}{CF}$, or $\frac{2ry - 2yy}{lr}$ equal a *Maximum*; that is, its *Differential* $\frac{2r\,dy - yy\,dy}{lr} = o$. Whence we have $y = \frac{1}{2}r$; and conſequently $\frac{CL}{CF} = \frac{r}{2l}$. But more particularly in

the

the Hypothesis of $l = \frac{rr}{c}$, we have $x\ (= \frac{yy}{l} = \frac{cyy}{rr}) = \frac{1}{4}c$, and $\frac{CL}{CF} = \frac{c}{2r}$

COROLLARY.

If $IK$ touches the Curve in the Point $I$ (where it intersects the Radius $AM$) and cuts the Diameter $BAK$ produced in $K$; then shall $AK = \frac{1}{4}$ the Periphery.

Next,

2. *For the Area*: 'Tis $DC + GE \times \frac{1}{2} DG = CDGE$: Or $\frac{2r\,dx - y\,dx}{r} \times \frac{1}{2} y = \frac{2ry\,dx - yy\,dx}{2r}$ = (substituting $\frac{2y\,dy}{l}$ instead of $dx$) $\frac{2yy\,dy}{l} - \frac{y^3\,dy}{lr}$. The *Integral* of which is $2\frac{y^3}{3l} - \frac{y^4}{4l3}$, or $\frac{2}{3}xy - \frac{lxx}{4r}$; which is equal to the Curvilineal Space $BFGDCB$. Wherefore putting $y = r$, we shall find the whole Space $BANGFBCDMB = \frac{5r^3}{12l}$; that is, in the Case of $l = \frac{rr}{c}$, 'tis $= \frac{5}{12}rc$. And since the whole Circle $BDMB$ is $= \frac{1}{2}rc = \frac{6}{12}rc$; the aforesaid Space shall be to the Circle as 5 : 6: And therefore the remaining Space $BANGBA$ will $= \frac{1}{6}$ of the Circle.

Again, *Thirdly*, *For the Length of the Curve*. $FG^q = FE^q + EG^q = dy^q + dx^q \times \frac{rr - 2rq - yy}{rr} =$ (substituting $\frac{2y\,dy}{l}$, instead of $dx$) $\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll} dy^q$.

Hence

$$FG = dy \times \sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll}};$$

The Integral of which, could it be exhibited, would give the Length of the Curve $BFG$: Which Rectification may yet be thus expres'd. On the Diameter $AB$ describe the Semi-circle $ATXB$, and let $A\alpha$ be cut off $= l$; then drawing any indefinite Perpendiculars $WV$, $\zeta\upsilon$, equidistant from $A$ and $B$, and cutting the Periphery of the Semi-circle in $T$ and $X$, let the Right Line $XTS$ be drawn, and joining $S\alpha$, take $AK = AS$, and let $KR$ be parallel to $S\alpha$, and the Right Line $R\beta$ be drawn to the Centre of the Semi-circle; equal to which cut off the Right Lines $WV$, $\zeta\upsilon$; Then shall the Points $V$, $\Upsilon$, be at the Curve $\gamma V \Upsilon \delta$; which is of such a Nature, that the *Abscissa* $B\zeta = DG$, and the Space $B\zeta\Upsilon\delta B$ divided by $A\beta$ $(= \frac{1}{2}AB)$ gives a Right Line = the Curve $BFG$.

*Demonstration.*

$AK = AS = WT = \zeta X = \sqrt{B\zeta \times \zeta A} = \sqrt{y \times r - y} = \sqrt{ry - yy}$; and $A\alpha\ (= l) : AS\ (= \sqrt{ry - yy}) :: AK\ (= \sqrt{ry - yy}) : AR = \frac{ry - yy}{l}$.

Wherefore,

$\zeta\Upsilon\ (= WV = R\beta = \sqrt{A\beta^q + AR^q} = \sqrt{\frac{1}{4}rr + \frac{rryy - 2ry^3 + y^4}{ll}}$: Whence a Portion of the Space $\zeta\gamma\delta B$, of the Breadth $dy = dy\sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{ll}}$;

And this divided by $A\beta = \frac{1}{2}r$, gives $dy\sqrt{\frac{rrll + 4rryy - 8ry^3 + 4y^4}{rrll}} = FG$.

And consequently the whole Space $\zeta\Upsilon\delta B$ divided by $\frac{1}{2}r$ is equal the Portion of the Curve-Line $BFG$. Q.E.D.

COROLLARY.

Taking $B\zeta$, $AW$, equal to one another; if on the Centre $A$, and with the Radii $A\zeta$, $A\beta$, $AW$, we describe Arches cutting the Curve in the Points $G$, $I$, $N$, (*Note here, The middle Intersection* I, *in the Case of the present Figure, falls in the Radius* A M) the Portions of the Curve $BG$ and $AN$, $GI$ and $NI$, as also $BGI$ and $ANI$, are equal to one another. Whence 'tis plain, that even those Curves that don't admit of a Rectification, yet some times have *Dissimilar* Parts equal to one another.

When I had signified this to my *Brother*, he presently observ'd, That the Nature of almost any *Spiral* being expres'd by an *Algebraical* Equation, another *Geometrical* Curve may be assign'd equal to it. For on the Centre $A$, with the Radia $AF$ and $AG$; describing the Arches $F\rho$, $G\pi$, if the Curve $M\downarrow$ be imagin'd such, that $\nu\downarrow$, the Difference of the Ordinates $\rho x$, $\pi\downarrow$, be equal to the Arch $EG$: Then, because of $\nu\varkappa = \pi\rho = EF$, and $\nu\downarrow = EG$, and the Angles $\downarrow\nu x$, $FEG$, Right ones; also $\downarrow x$ shall be equal $FG$; and compounding, the whole Portion of the Curve $M\downarrow$ = the whole Portion of the Spiral $BG$. Now to find the Nature of the Curve $M\downarrow$, we need only substitute (in the Quantity $\frac{r\,dx - y\,dx}{r}$, which always expresses $EG$ or $\nu\downarrow$) the Value of $dx$, which in our Curve is $\frac{2y\,dy}{l}$; which produces $\frac{2y\,dy}{l} - \frac{2yy\,dy}{rl}$, the *Integral* of which $\frac{yy}{l} - \frac{2y^3}{3rl}$, gives the Length of the Ordinate $\pi\downarrow$. Then putting $\pi\downarrow = z$, we have no Equation between $z$ and $\frac{yy}{l} - \frac{2y^3}{3rl}$, or $3rlz + 2y^3$, or $3rlz + 2y^3 - 3ryy = 0$; which expresses the Relation between the *Abscissa* $M\pi = y$, and the Ordinate $\pi\downarrow = z$. But in *General*, A *Parabolical Spiral*, of any Degree, is by this means transmuted into another Geometrical *Paraboloid*, of one Degree higher. This also is to be observed; That if the Curve $ANIGB$ be the *Archimedean* Spiral, and a Common Parabola $A\mu$ be described

described at the Centre *A*, and upon the Axis *AK*; whose Parameter is a Fourth Proportional to the Periphery, Diameter, and Radius of the Circle *B D M*, then shall both the Curve Lines, and the Spaces comprehended under them, be equal, *viz.* Taking any Point λ in the Right Line *AM*; if to this be applied the Right Line λ μ, cutting the Parabola in μ, and the Arch λ *N* concentrical to the Periphery of the Circle *B M*, be drawn cutting the *Spiral* in *N*; then the Portion of the *Spiral* Line *A N* shall ever be equal the Portion of the *Parabolick* Line *A* μ; and the Space *A N* comprehended between the Right Line *A N* and the *Spiral*, shall equal the *Parabolick* Space *A* λ μ *A*. Which wonderful Agreement of the *Spiral* and *Parabola* we afterwards found Dr. *Willis* had observed before; who relates, that *Roberval* and *Hobbs* contended about the first Discovery of it; as if two Persons, at a distance both in point of Place and Time, might not be led by their own Genius's to one and the same Invention.

4. *For the Flexure of the Curve.* That the Curve must have a Point of contrary Flexion, is evident; for because the Periphery *B C* differs but insensibly from a Right Line, for some space beyond the Vertex *B*, it follows from the Nature of the Parabola, that the Curve must be concave towards the Circumference in the Parts next the Vertex, and concave towards the Centre in the rest. If *G*, *e. gr.* be the Point of contrary Flexion, then *A O*, the Segment of the Radius, intercepted between the Centre and the Tangent, shall be a *Minimum*, which put = *M*. Produce *G E* in *P*, and draw *P* ℚ parallel to *E F*; and let the *Secant* of the Arch *B D* = *s*, and the Tangent = *t*: Then we have the following Proportions; *Viz.* $r : r - y\ (= AG) :: t : \frac{tr - ry}{r}\ (= GP) :: s : \frac{sr - sy}{r}\ (= AP.)$

Again, $GE : EF :: PG : P\mathbb{Q}$

$$\frac{r\,dx - y\,dx}{r} : dy :: \frac{tr - ty}{r} : \frac{t\,dy}{dx}.$$

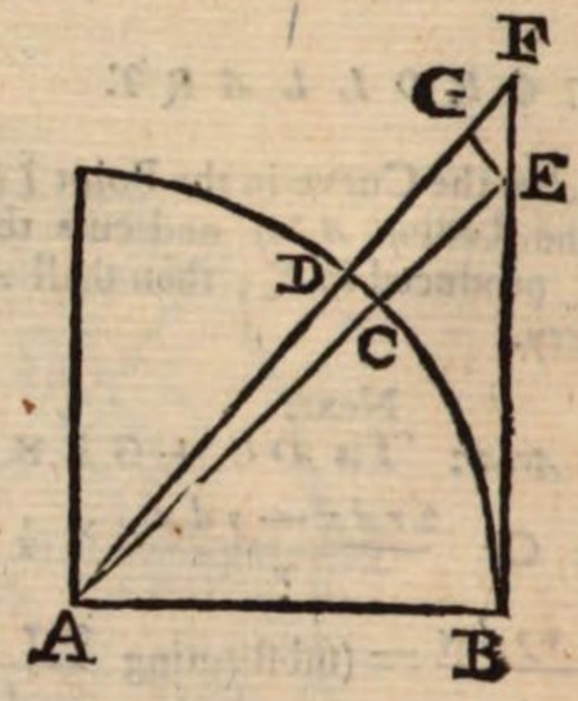
Lastly; $AF : P\mathbb{Q} :: AO : PO\ (= AO - AP)$

$$r - y : \frac{t\,dy}{dx} :: M : M - \frac{sr - sy}{r}.$$

Whence we shall find

$$M = \frac{rr\,s\,dx - 2r\,sy\,dx + s\,sy\,dx}{rr\,dx - ry\,dx - rt\,dy};$$ and

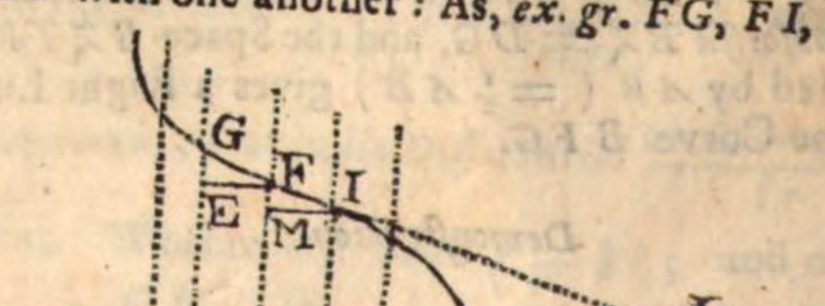
Substituting $\frac{l\,dx}{2y}$ for $dy$, and dividing by $dx$, we have $M = \frac{2rr\,sy - 4r\,syy + 2sy^3}{2rr\,y - 2r\,yy - rl\,t}$. And therefore the *Differential* of this is to be equal to nothing; but the *Differential* of a Fraction is = o, when its Terms, multiplied into the Alternate *Differentials*, are equal: For the *Differential* of the Fraction $\frac{y}{z}$ is $\frac{\mp z\,dy \mp y\,dz}{zz}$; and consequently if it be = o; then also shall $\mp z\,dy \mp y\,dz = o$; that is, $z\,dy = y\,dz$. By the help of which Rule we shall come to an Equation of sixteen Members; in order to the Reduction of which, let it be observed, *viz.* That the *Differential* of an *Arch* is in a given Ratio to the *Differential* of the *Tangent* and *Secant*; for It is to the *Differential* of the *Tangent*, As the Square of the Radius To the Square of the *Secant*: And It is to the *Differential* of the *Secant*, As the Square of the Radius to the Rectangle under the Tangent and Secant. For in the Quadrant *A B D*,




$dx : dt :: DC : EF :: DC : GE + GF$; $GE + GF : EF :: AD\ (= AB) : AG + AB$; $AG + AB : AF :: AB^q\ (= rr) : AF^q\ (= ss.)$ Wherefore, $dt = \frac{s\,s\,dx}{rr} =$ (in the present Case) $\frac{2\,s\,sy\,dy}{lrr}$.

Again, $dx : ds :: DC : GF :: DC : GE + EF$; $GE + GF : GF :: AD\ (= AB) : AG + AB$; $AG + AB : BF :: AB^q\ (= rr) : AF \times FB\ (= st.)$ Wherefore $ds = \frac{st\,dx}{rr} = \frac{2\,sty\,dy}{lrr}$: And substituting these Values in the Equation instead of $ds$ and $dt$, as also $ss - rr$ instead of $tt$, there will come forth another Equation, which may be divided by $st\,dy$; so that the Symbols $s, t, d, y$, will be quite out, and only the Powers of the unknown $y$ remain. The Equation then will be $y^6 - 3ry^5 + 3rry^4 - r^3y^3 + \frac{3}{4}rrllyy - r^3ly + \frac{1}{4}r^4ll = o$; which may be still further divided by $r - y$, and so the Equation be reduc'd to this, $y^5 - 2ry^4 + rry^3 * + \frac{3}{4}rrly - \frac{1}{4}r^3ll = o$: The Root of which will shew the Point of *Contrary Flexure*; which in the Case of $l = \frac{rr}{c}$, is very nearly obtain'd by drawing the Ray *AC*, so that the Applicate *C F* be $\frac{1}{6}r$, or the Arch *B C* = $\frac{1}{24}$ *c* = 10 *Gr.*

This Method for finding the Points of *Contrary Flexure* in Curves, seeming very tedious, and not so natural, in that it makes use of Symbols that are superfluous, and do afterwards vanish out of the Equation; gave us occasion to find a shorter and easier Way for doing the same, and that thus: I conceive the Point of *Contrary Flexion* as falling in that Point of the Curve, where two contiguous infinitely small Particles are imagin'd to lie *in directum* with one another: As, *ex. gr. F G*, *F I*, the



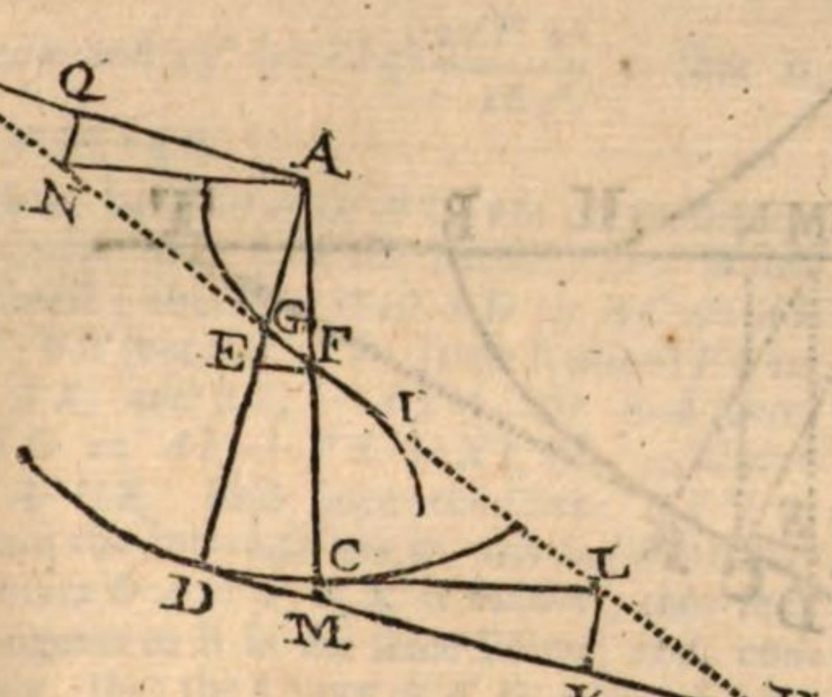

rest

reſt being bent upwards on one hand, and downwards on the other. It follows from hence,

1. That in Curves whoſe Axes are perpendicular, and whoſe Ordinates are parallel to one another, the Acute Angles $EGF$, $MFI$, or $DGL$, $CFL$, are *equal*, and either the *greateſt* or the *leaſt* of all thoſe that the Ordinates make with the Curve on the one ſide and the other, according as the Portion of the Curve (that is) at the Parts of theſe Angles, falls either with or without them. From whence the Ratio $\frac{DG}{DL} (= \frac{y}{t})$ is either a *Maximum* or *Mininum*; and conſequently (by what was ſhewn above) $y\,t\,d = t\,dy$. But ſince every where $t\,dy = y\,dx$ (*as is evident in all Curves*) therefore ſhall $dt = dx$, *viz.* The *Differential* of the Part of the Axis between the Ordinate and the Tangent, equal to the *Differential* of the *Abſciſſa*: Which is alſo thus manifeſt: Becauſe $GF$, $FI$, lie *in directum*, the Tangents $GL$, $FL$, ſhall cut the Axis in the ſame Point $L$; and, conſequently, the *Differential* of the *Abſciſſa* $DC$, will alſo be the Difference of $DL$ and $CL$.

The *Celebrated Author* of the *Differ. Calculus*, has given another Theorem for this (in the *Acta*,) *Viz.* Since the Triangles $EGF$, $MFI$, (becauſe of the equal Angles $EGF$, $MFI$,) are ſimilar; it follows, That if $EF$, $MI$, that is the $dx$, are equal, alſo $EG$, $MF$, or the $dy$, ſhall be equal too; and, conſequently, $ddy = 0$.

2. In the Curves whoſe Applicates tend to ſome common Point or Centre $A$. The Angle $EGF$




$= GAF + GFA = DAC + CFL$: Whence, ſince $CL$ is the Tangent of the Angle $CFL$ to the Radius $CF$, and $DH$ the Tangent of the Angle $DGH$ to the Radius $DG$, the Difference of the Right Lines, $CL$, $DH$, ſhall be equal to the Difference of the Tangents of the two Angles, that differ by the Angle $DAC$; one of which is to the Radius $CF$, and the other to the Radius $DG$. For tho' the Difference of the Radii $EG$ vaniſhes in compariſon of the *whole Radius or Tangent*; yet 'tis not to be neglected, if compared with their *Differences*.

Let $AC = r$; $DC = dx$; $CF = y$; $CL = t$; and conſequently, $FL = \sqrt{yy + tt}$. Alſo, Let it be $AC\,(=r) : DC\,(=dx) :: CF\,(=y) : = \frac{y\,dx}{r}$ an Arch, that is the Meaſure of the Angle $DAC$, with the Radius $CF$. This Arch (by *Sect.* 4.) Is to the Difference of the Tangents, in the Duplicate Ratio of the Radius to the Secant. Wherefore $FC^q\,(=yy) : FL^q\,(=yy + tt)$ :: The Arch found $\frac{y\,dx}{r} : \frac{yy\,dx + tt\,dx}{ry} =$ the Difference of two Tangents, each to the Radius $CF$. To which if we add $EF = \frac{r\,dx - y\,dx}{r}$ (which Is to $EG$, As $DH$ To $DG$, or $CL$ to $CF$, or Tangent to Radius) the Aggregate will be $\frac{ry\,dx + tt\,d^x}{ry}$, or $dx + \frac{tt\,dx}{ry}$, the Difference of two Tangents, the one of which agrees to the Radius $DG$, that is the Difference of the Right Lines $CL$, $DH\,(=t;)$ and therefore $dt = dx + \frac{tt\,dx}{ry}$.

The ſame is more clearly ſhewn thus. On the Centre $C$, with the Radius $CL$, deſcribe the Arch $LK$: For then the Angle $ACL + LCK = AMH = ADM + DAC = ACL + DAC$, and ſo $LCK = DAC$. (*Note, That* CM *is neglected here, and the Points* C *and* M *eſteem'd as co-incident; ſince* C M *is infinitely leſs than the Differentials* D C, L K, E G, *which are infinitely ſmall themſelves.*) Whence, $AC\,(=r) : CD\,(=dx) :: CL\,(=t) : \frac{t\,dx}{r} = LK$. Again, $GD\,(=y) : DH\,(=t) :: LK\,(= \frac{t\,dx}{r} : \frac{tt\,dx}{ry} = KH.)$ Wherefore $dt\,(= DH - CL = DH - CK = DC + KH =)$ $dx + \frac{tt\,dx}{ry}$.

### COROLLARY.

If $r$ be Infinite; that is, If $CA$, $DA$, be parallel, then $\frac{tt\,dx}{ry}$ will vaniſh, and $dt = dx$, as above.

My *Brother*, inſtead of the Ratio $\frac{GD}{DH}$ or $\frac{GA}{AP}$, aſſumes $\frac{GE}{EF}$, putting $AF = y$, $AP = t$, $EF = dz$; and ſo finds $dt = \frac{dz\,c}{dy\,q}$: Which Theorems well deſerve notice, upon the account of their Univerſality.

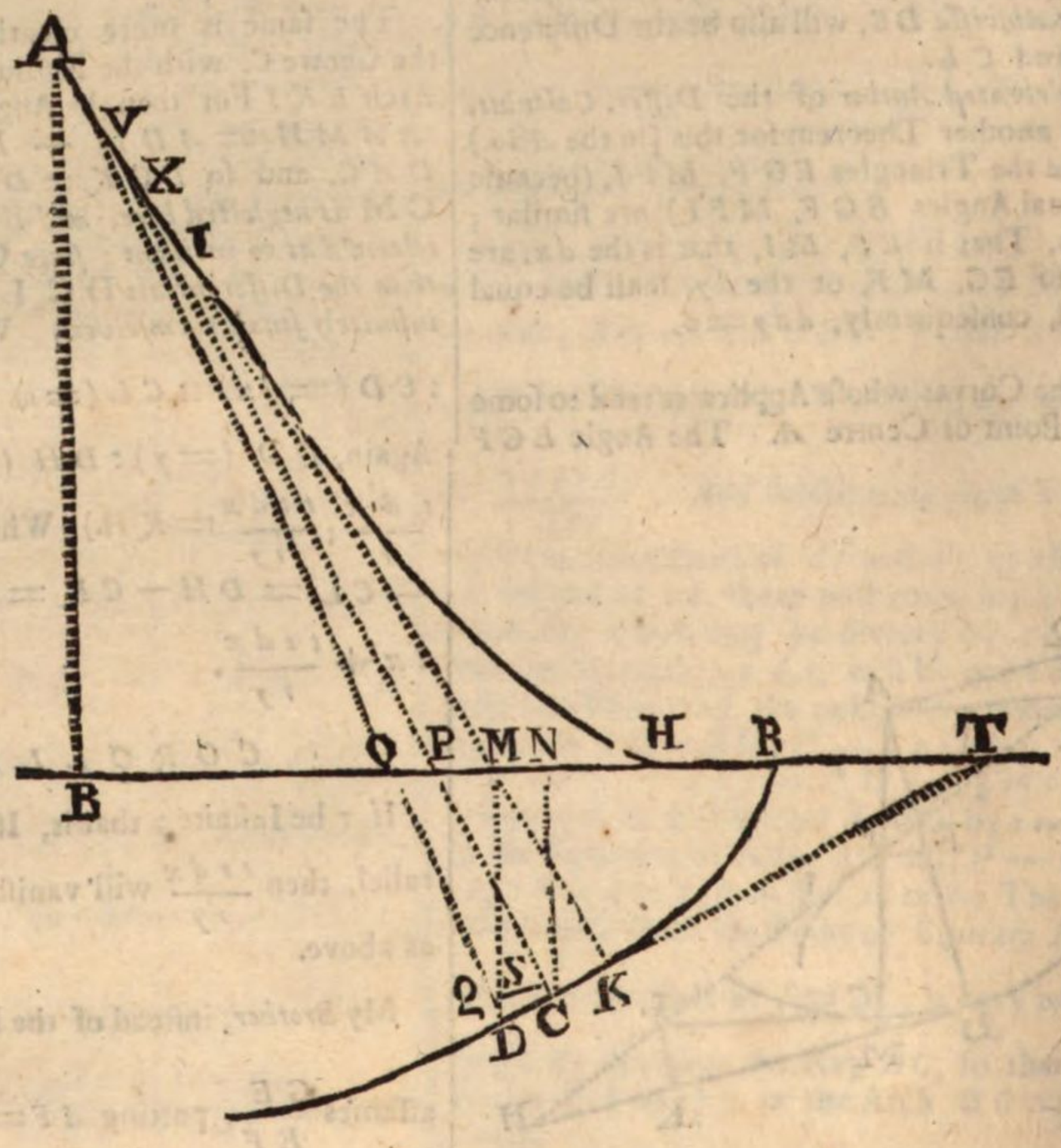
For a particular Application of this to the *Parabolick Spiral*: Becauſe $CL\,(= t$, *Fig. preced.*) was found before $= \frac{2rry - 2y^3}{lr}$, then ſhall $dt = \frac{4ry\,dy - 6y\,dy}{lr}$; and ſince $dx = \frac{2y\,dy}{l}$, ſubſtituting the Values of $tt$, $dt$, $t$, $dx$, and dividing by $dy$; and reducing the Equation, we ſhall find $y^5 - 2ry^4 + rry^3 * + \frac{5}{4}rrlly - \frac{1}{4}r^3ll = 0$, as before.

5. *The higheſt Point of the Curve* above the Radius $BA$, is found by making $AO$ (found before) Infinite,

finite; *viz.* $\frac{2rrsy-4rsyy+2sy^3}{2rry-2ry-rlt} = In$-

*finito*, or $2rry-2ryy-rlt = o$; or instead of $y$ substituting $\sqrt{lx}$, we have $2r\sqrt{lx} - 2lx - lt = o$: Or in the Case of $l = \frac{rr}{c}$, $2\sqrt{cx} - 2x = t$. Which Equation cannot be *Geometrically* resolv'd, upon the account of the inexplicable Ratio of the Arch to the Tangent. But the Point sought may be found *Mechanically* near the Truth, thus, by counting 70°. 12′. from *B* towards *M*. I Note here, by the By, That it may be demonstrated from hence, that an *Indefinite Quadrature* of the Circle, and in general the *Rectification* of any *Geometrical Recurrent* Curve, is impossible: For if this were possible, there wou'd be given the Relation between the *Curve* and the *Ordinate* or *Abscissa*: And since the Relation of these to one another, as also to the *Tangent*, is supposed to be given; also the Relation of the *Curve* to the *Tangent* would be given too. Wherefore, if the Equation that expresses this Relation, be duly compared with the other $2\sqrt{cx} - 2x = t$, according to the Laws of *Algebra*, in order to fling out one of the Indeterminates, $x$ or $t$: There wou'd then come forth another Equation of a *certain* and *definite Degree*; the Roots of which (which can never be more than the Equation has *Dimensions*) wou'd determine all the highest Points of our Curve. But this is impossible; for this *Spiral*, if it be continued, will wind about the Radius *AB* with an infinite Number of Gyres and Turnings, in each of which there is some one *highest* Point; and therefore the Number of those Points is Infinite.

6. *Of the Evolution of Curves.* If *DC* be the Periphery of a Circle, then all the *Normals*, *DA*, *CA*, *KA*, &c. will meet in one common Point




*A* (the *Centre*) and will each of them be equal to a constant Right Line (the *Radius.*) But if *DC* be any other Curve, the said Perpendiculars will be indeterminate, and will intersect one another into many different Points, *A*, *V*, *X*, *I*; which all joyn'd make a new Curve; the Nature of which is now to be Investigated.

Let the Curve proposed be *RCD*, its Axis *RB*, *Abscissa's RN*, *RM*, Ordinates *NC*, *MD*, Tangent *DCT*. Let $RN = m$; $CN = p$; $Nt = q$. Whence, $TN : NC :: NC : NP$

$q : p :: p : \frac{pp}{q} = MO$;

Also, $NC : NP\ (= MO) :: SD : SQ$

$p : \frac{pp}{q} :: dp : \frac{pdp}{q}$. Farther, $QS + SC = QC$.

$\frac{pdp}{q} + dm = \frac{pdp+qdm}{q}$. Again, $OP = MN + OM - PN = dm +$ the *Differential* of $\frac{pp}{q} = dm \frac{\pm 2pqdp \pm p^2dq}{qq} = \frac{qqdm \pm 2pqdp \pm ppdq}{qq}$.

Lastly, $QC - OP : QC :: ppdq - pqdp : \frac{pdp+qdm}{q} :: \frac{CA-PA}{\sqrt{ppqq+p^4}} (= CP = \sqrt{CN^q + NP^q}) : CA$

$: C A.$

$: \frac{p dq + q dm \times \sqrt{pp + qq}}{pdq - pdp}$.

7. *Application to the Parabola.* If $RCD$ be a Parabola, whose Parameter $= l$, so that $lm = pp$, then $l dm = 2p dp$, and $dm = \frac{2p dp}{l}$, and $q = 2m$. Substituting these in the Value of $CA$, we shall find $CA = \frac{ll + 4pp\sqrt{ll + 4pp}}{2ll}$; that is, since $PN = \frac{1}{2}l$, and $PC = \sqrt{\frac{1}{4}ll + pp}$, $CA$ will $= \frac{PC^3}{PN^2}$, that is a Fourth Proportional to $PN$ and $PC$.

8. *To find the Nature of the Curve* AVX (*form'd by the Interſections of the Perpendiculars* DA, CA,) *with reſpect to the Axis* RB. Cut off $RH = \frac{1}{2}l = PN$, and put $HB = y$, and $BA = z$, and then $AB + NC : AC ::$

$z + p : \frac{ll + 4pp\sqrt{ll + 4pp}}{2ll} ::$

$NC : CP$;

$p : \sqrt{\frac{1}{4}ll + pp}$; and $\frac{Vz}{z}$ will $= 2p^2$.

Again, $NC : AB :: PN : PB$;

$p : z :: \frac{1}{2}l : \frac{lz}{2p}$; but $y =$

$HB = PB + PH = PB + NR = \frac{lz}{2p} +$

$\frac{pp}{l}$, or $2p^2 \left(= \frac{llz}{2}\right) = 2ply - llz$; that is,

$\frac{3lz}{4y} = p$, and $4p^2 \left(= llz\right) \frac{27l^3z^2}{16y^2}$; that is,

$16y^3 = 27lzz$.

Farther, becauſe $AD$, $AC$, are perpendicular to the Curve $DC$, and the Particle $DC$ is infinitely ſmall; therefore ſhall $AD = AC = AV + VC$; but (becauſe of the ſame Reaſon) $VC = VX + XK$, and $XK = XI +$, &c. And therefore $AD = AV + VX + XI$, &c. $=$ Curve $AIH + HR$. And ſince the *Curve* $AIH$ ariſes from the Interſections of the *Indiſtant* Perpendiculars $DA$, $CV$, $KX$, it follows, that they are Tangents to it in the ſame Points, and, conſequently, that the Curve $RKD$ is that Curve which is deſcribed by the Evolution of the Curve $HIA$. From whence are manifeſt, at firſt view, all that *Hugenius* and others have publiſh'd about *Evoluta's*, as alſo the excellent Diſcoveries of *Tſchirnhauſius* and *Leibnitz*, about the Curves formed by the Reflex'd Rays.

HELISPHERICAL *Line*, is the Rhumb Line in Navigation; and is ſo call'd becauſe on the Globe it winds round the Pole ſpirally, and ſtill comes nearer and nearer to it, but can't terminate in it.

HEM. The Ovens wherein the *Lapis Calaminaris*, or *Calamine*, is baked, have a Hearth made on one ſide of the Oven, divided from the Oven it ſelf by a Partition open at the Top, by which the Flame paſſes over, and ſo heats and bakes the *Calamine*. This Partition is called the *Hem*.

HEMITONE, in Muſick, was what we now call an *Half Note*.

HERALD, with us ſignifies an Officer at Arms, whoſe Buſineſs it is to denounce War, to Proclaim Peace, or otherwiſe to be employ'd by the Sovereign in Martial Meſſages and other Buſineſſes. The *French* call him *Herault*; *quaſi Herus altus*. But *Verſtegan* will derive the Word from two *Dutch* words, *viz. Here*, *exercitus*, and *Healt*, *Pugil magnanimus*; as if he ſhould be ſo called, as being *Champion of the Army*. The *Romans* called Men of this Office in the Plural *Feciales*. With us they are the Judges and Examiners of Gentlemen's Arms: They Marſhal all the Solemnities at the Coronation of Princes; formerly manag'd Combats, &c.

The Three Chief Heralds with Us are called *Kings at Arms*: The Principal of which is *Garter*, created by *Henry* V. His Office is to attend Knights of the Garter at their Inſtalments, or other Solemnities; To Marſhal the Funerals of all the greater Nobility, as Princes, Dukes, Marquiſſes, Earls, Viſcounts, and Barons.

The next *Herald* is *Clarencieux*, Ordain'd by *Edw.* IV. for his gaining the Dukedom of *Clarence*: His Office is to Marſhal and Diſpoſe the Funerals of all the leſſer Nobility; as of all Knights and Eſquires on this Side *Trent*.

The Third is called *Norroy*, or *North Roy*; whoſe Office is the ſame on the North Side of *Trent* as that of *Clarencieux* is on the South Side.

Beſides theſe there are Six others, which are properly called *Heralds*, according to their Originals, as they were Created to attend Dukes, &c. in their Martial Expeditions; as *York*, *Lancaſter*, *Somerſet*, *Richmond*, *Cheſter* and *Windſor*.

There alſo are four others call'd *Marſhals*, or *Purſuivants at Arms*, reckon'd after a manner in the Number of *Heralds*, and do commonly ſucceed in the Place of *Herald* when they die, &c. and theſe are call'd *Blue-Mantle*, *Rouge Croſs*, *Rouge Dragon*, and *Port-Cullis*.

HERBENGER, or *Harbinger*, is an Officer in the King or Queen's Houſe, who allotteth the Noblemen and thoſe of the Houſhold their Lodgings.

HERETICO *Comburendo*: See *Hæretico*, &c.

HERIOT, was originally a Proportion of Horſe and Armour according to the Quality of the Deceas'd: This was ſettled by the Laws of K. *Canutus*, cap. 69. and is ſtill (uſually) the beſt Riding Horſe of which a Tenant dies poſſeſs'd.

HERIOT *Cuſtom*, was when a Tenant for Life was by Cuſtom oblig'd to ſuch a Payment at his Death; which Payment to be made not only by the next Heir in Blood, but by any the next Succeſſor. In Abbeys of Royal Patronage, at the Death or Ceſſion of the Abbot, his Cup and Horſe were paid as an *Heriot* to the King. Thoſe alſo who held in Bondage and Villenage paid *Heriots*. The Religious Appropriators reſerv'd the *Live Heriots* (*i. e.* ſuch as were paid in Cattle) to themſelves, and allow'd the inanimate ones of ſmall value to the Vicar: And ſome Appropriators had a *Heriot* from the Vicar when he died. *Kennet's Gloſſary*.

HERIOT *Service*, was a Reserve by Charter or other Conveyance, and made one Condition of the Tenure of Eſtates in Fee Simple; which is now for the moſt part extinguiſh'd.

HERMITAGE, ſtrictly ſignified a Convent of Hermits or Friars Minors, who, under the Inſtitution and Diſcipline of St. *Paul*, inhabited Deſerts and ſolitary Places. But this name at laſt came to be attributed to any one Religious Cell, built and endow'd in ſome private and recluſe Place, and then annex'd to ſome larger Abbey, of which the *Prelate* or Governour was called *Hermita*. Dr. *Kennet's Gloſſary*.

HERMITAN, is the Name of a dry North and North-Eaſterly Wind, uſually, which blows on the Coaſt of *Guinea* in *Africk*; but ſometimes it blows alſo from other Points.

HERMITORIUN, is the Oratory or Chappel belonging to an Hermitage.

HETERODROMUS, in Staticks, is the Term for the common *Vectis* or *Leaver*, which hath the *Hypomochlion* placed below the *Power* and the *Weight*: And where the Weight is *elevated* by the deſcent of the Power, *& viſe verſa*. (See the *Fig.* in *Homodromus*.)

The *Dung-fork* and *Prong* are Leavers of this kind, whoſe Hypomochlion is uſually the Knee of the Workman: And all Pincers, Sheers, Sciſſars, Cutting-Knives faſten'd to Blocks are double.

HETERODROMOUS *Leavers*. The Wheel, Windlaſs, Capſtand, Crane, *&c.* are perpetual *Heterodromous Leavers*: As are alſo the outermoſt Wheels of all Wind and Water-Mills, and all Cog-Wheels, *&c.*

HETERODROMUS *Vectis*, in Mechanicks, when the *Weight* to be rais'd by a Leaver is placed beyond the *Hypomochlion* or *Fulcrum*, and ſo moves a contrary way to the Power, *viz.* is rais'd when that deſcends, and deſcends when that riſes.

HEYBOTE, or *Haybote*, was antiently the *Saxon* Term for the Liberty granted to a Tenant for cutting ſo much Under-wood, Buſhes, *&c.* as was neceſſary for Mending and Maintaining the Hedges or Fences belonging to his Land.

HIDAGE, was a Royal Aid or Tribute rais'd in ſuch a Proportion on every Hide of Land: *William the Conqueror* impoſed Six Shillings on every Hide; and *William Rufus* Four Shillings; and K. *Henry* I. Three Shillings. When the Lord paid *Hidage* to the King, the Tenants paid a Proportion to the Lord of the Mannor.

King *Ethelred*, when the *Danes* landed at *Sandwich*, rais'd this *Hidage* ſo, that every 310 Hides of Land found an arm'd Ship; and every 8 Hides found a *Jack* and a *Saddle*.

HIDE *of Land*, or *Plough-Land*, was as much as one Plow could Cultivate in a Year; for the Quantity was never expreſly determin'd: Some call it 60, ſome 80, and ſome 100 Acres. One *Hide* of Land at *Cheſterton* in the 15th of *Hen.* II. contain'd 64 Acres: And in the 35th of *Hen.* III. the yearly Value of a *Hide* of Land at *Blecheſdon* in *Oxfordſhire* was Forty Shillings. *Kennet's Paroch. Antiq.*

*Bede* calls it *Familiam*, implying by it, that it was as much as wou'd maintain a Family.

The Diſtribution of *England* by *Hides of Land* is very antient: Mention being made of it in the Laws of King *Ina*, *cap.* 14. And *Henry* I. to Marry his Daughter, had Three Shillings from every *Hide* of Land. This Tax was call'd *Hidage*: See *Hidage*.

HIP-*Roof*, in Architecture, is ſuch a Roof as hath neither *Gable-Heads*, *Shread-Heads*, nor *Jerkin-Heads*: (By which is meant ſuch Heads as are both Gable and Hip at the ſame End; that is, Gable as far as the Cott or Beam, and then their over ſhort Hips, which ſhut up with their Tops to the Tops of a pair of Rafters, call'd *Singlers* by the Country Workmen.) For a *Hip-Roof* hath Rafters as long, and with the Angles at the Foot, *&c.* at the Ends of Buildings, as it hath on the Sides: And the Feet of the Rafters on the Ends of ſuch Buildings as have *Hip-Roofs*, ſtand on the ſame Plane, *viz.* parallel to the Horizon, and at the ſame Height from the Foundation with the Rafters at the Sides of the Roofs. Theſe *Hip-Roofs* ſome call *Italian Roofs*.

HIPS, in Architecture, are thoſe Pieces of Timber which are at the Corners of a Roof: They are a good deal longer than the Rafters, becauſe of their oblique Poſition; for they are level at every Angle. The Country Workmen call them Corners; and by ſome they are call'd Principal *Rafters*, by others *Sleepers*. As Rafters have four plain Sides, theſe have uſually five.

HOBELERS, were formerly a ſort of Light-Horſe-Men, which rode on ſmall nimble Horſes, and with only light Armour on; ſo that they were fit, (like our Dragoons) for any expeditious Service: At length they became ty'd by their Tenure, to maintain a little light Nag, for giving expeditious Notice of any Invaſion or Danger: See 18 *Edw.* III. *c.* 7. 25 *Edw.* III. *c.* 5, 8. and *Cambd. Britan.*

HOBITS, are a ſort of ſmall Mortars from 6 to 8 Inches Diameter: Their Carriages are like thoſe of Guns, only much ſhorter. They are very good for Annoying the Enemy at a diſtance with ſmall Bombs, which they will throw two or three Miles: Or in keeping of a Paſs, being loaded with Cartouches.

HODOMETRICAL *Method* of finding the Longitude at Sea, is that of the Computation of the *Meaſure of the Way* of a Ship between place and place; *i. e.* of obſerving the ſeveral Rhumbs or Lines in which the Ship ſaileth; and *what Way* ſhe hath made, or how many Leagues and parts of a League ſhe hath run.

HOGENHINE, was formerly the Term for one that coming Gueſt-wiſe to an Inn or Houſe, lay there the third Night: After which he was accounted one of the Family; and the Hoſt was anſwerable for his Breach of the King's Peace. In the Laws of K *Edward*, ſet forth by *Lambert*, he is call'd *Agenhine*; and often in other places *Third-Night Awnehine*.

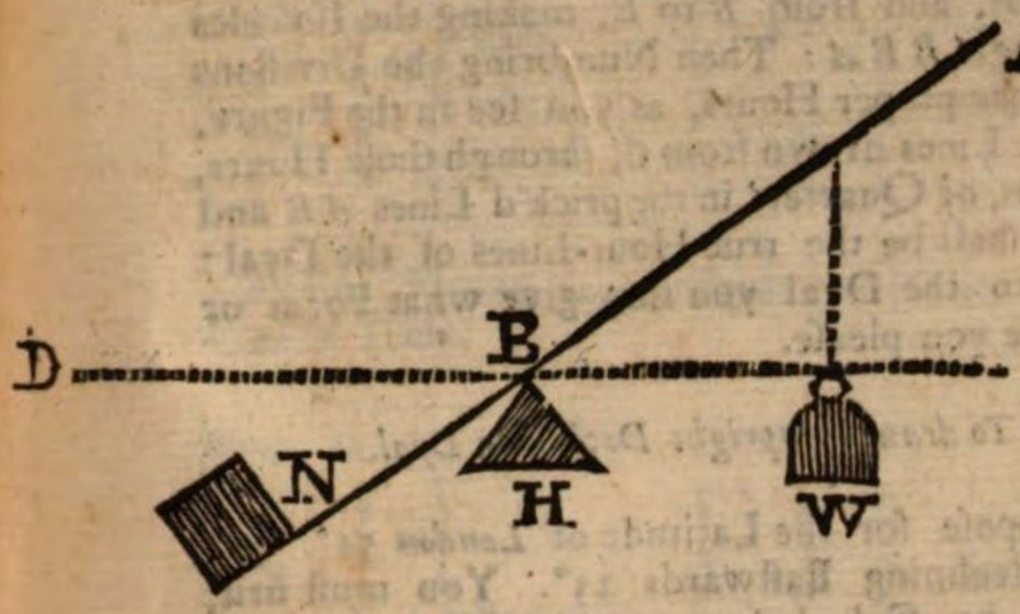
HOKE-*Day*, was the *Tueſday* Fortnight after *Eaſter-Day*; and was antiently celebrated with Sports and Rejoycings, in Memory of many of the *Danes* being kill'd on that Day, and the reſt expell'd the Kingdom. This was done *A. D.* 1002. in the Reign of K. *Ethelred*.

HOKE-*Tueſday-Money*, was a Duty paid by the Tenants to their Landlord, to have leave to celebrate the *Hoke-Day*.

HOMAGIUM *Reddere*, was renouncing Homage, when a Vaſſal made a ſolemn Declaration of diſowning and defying his Lord; for which there was a ſet Form and Method preſcrib'd by the *Feudatory Laws*.

HOMO-

HOMODROMUS, is a Term in Staticks for a Leaver, as *A B*; one of whose Ends, *B*




is fixed on the Obex or Hypomoclion *H*: And the other End *A*, is applied to the Moving of the Weight *W*, which hangs or lies somewhere in the middle, between the Hypomoclion *H*, and the Power in *A*. Here the Weight moves the same way with the Power: Whence this kind of *Vectis* takes its Name of *Homodromus*. Whereas, in the other Leaver, the Weight *N* is raised up by means of the Obex or Hypomoclion *H*; while the Power at *A*, the other End of the Leaver, descends; and therefore this is called *Heterodromus*. Of this Homodromus kind of Leavers, are the Rudders and Oars of Ships and Boats; as also their Masts.

HONOR, is used for the nobler sort of Seigniories, whereon other Inferior Lordships and Mannors do depend, by performance of Customs and Services to those that are Lords over them: And it seems as if none were *Honors* originally, but such as belong'd to the King, tho' given afterwards in Fee to Noblemen. The Manner of Creating these *Honors* may in part be collected from the Statutes 34 *H.* VIII. *c.* 5. where *Hampton-Court* is made an *Honor*: And 33 *H.* VIII. *c.* 37, 38. where *Grafton* and *Ampthill* are made *Honors*. There are many other *Honors* in *England*; see 37 *H.* VIII. *c.* 18, *&c.*

HONOR-*Courts*, are such Courts as are held within the abovemention'd Honors.

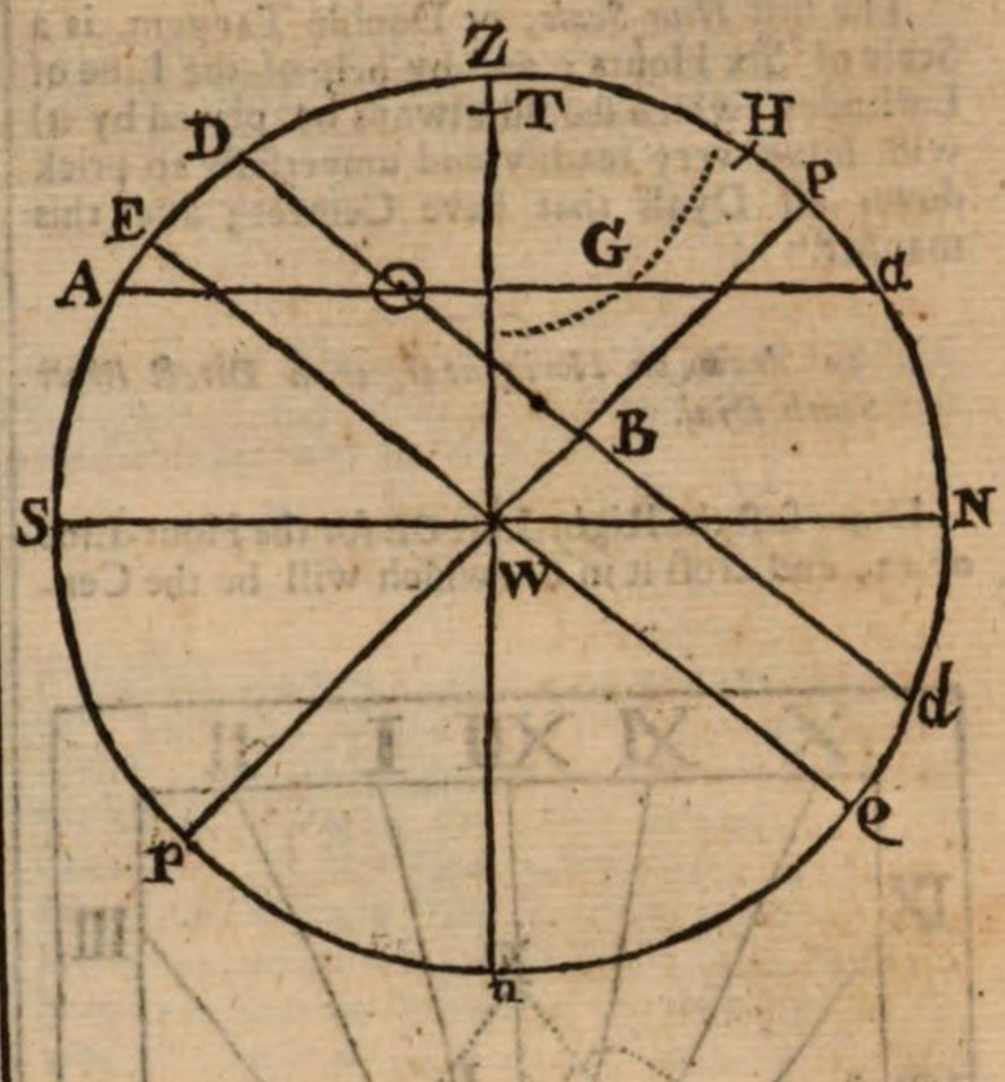
HONORARY *Services*, are such as are incident to *Grand Sergeantry*, and annexed usually to some *Honor*.

HOOK-*Pins*, are taper Iron Pins, with an hook Head; and are used to pin the Frame of a Floor or Roof together, by being put in through the Pin-holes in the Mortesses and Tennons, whilst it is framing or fitting into its due Position: As soon as which is done, these *Hook-Pins* are struck out, and 'tis pinn'd up fast with Wooden Pins.

HORIZONTAL-*Line* in Dialling, is a Line drawn on any Plane parallel to the Horizon. It is drawn on an Erect or Reclining Plane by a Level; or by applying a Quadrant to the Edge of a Ruler so, as that the String and Plummet shall cut 00. or 90 Degrees in the Limb.

HOSPITALLERS, were the Knights of a Religious Order; so call'd, because they builded an Hospital at *Jerusalem*, wherein Pilgrims were received. To these, when the Templers were suppress'd by the Council of *Vienne* in *France*, P. *Clement* transferr'd that Order. Their chief Abode is now at *Malta*, and they are call'd *Knights of Malta*. All the Lands and Goods of such as were here in *England* were given to the Crown: See 32 *H.* VIII. *c.* 34.

HOUR *of the Day*: To find this readily by Projection of part of the *Analemma*, proceed thus: With 60 of the Chords draw the Circle ♑ *S n N* for the Meridian of your Place: Then




having given you, as you must have, the Latitude of your Place, and the Sun's Declination and Altitude, set the first of these three from *N* to *P*; so is *P*, the Pole of the World, draw *P W p* for the Axis. Set next the Latit. also from ♑ to *E*, and draw *E W* ♑ for the Equinoctial. Then set the Sun's Declination from *E* to *D*, and from ♑ to *d*, when 'tis North, as here; but on the lower Side of *E* ♑ when 'tis South; and draw the Parallel of Declination *D d*: Then set the Sun's Altitude from *S* to *A*, and from *N* to *a*, draw *A a* for the Almacanter or Parallel of the Sun's Altitude at the Time. The common Intersection of these two Parallels in ⊙, will give you the Sun's Place in the Heavens at that Time. And, consequently, setting the Sector to the Radius *D B*, ⊙ *B* will be the Sine of the Hour from 6, either in the Morning or Afternoon. If a Sector be not at Hand, you may find the Hour by your Chords, thus; Set the Extent *B D* from *W* to *T*; on which Point *T*, as a Centre, with the Extent *B* ⊙ (the parallel Sine of the Hour from 6) strike the Arch *G*; for then a Ruler laid from *W* just to touch the Convexity of the Arch *G*, will cut the Limb in *H*. Then *H N* measured on the Chords, will give the Degrees of the Hour from 6, which must be turned into Time.

HOUR-*Scale*: On one of the Edges of *Collin*'s Quadrant there is usually an *Hour-Scale* (as on the other Edge is a Line of Latitudes) which is no other than a Double Tangent, or two Lines of Tangents, each of 45 Degrees, set together in the middle; and so might, if there were need, be continued *in Infinitum*.

And on the other Face of this Quadrant there is also an *Hour-Scale* of another kind; being 62 Degrees of a Line of Sines, whose Radius is made equal to half the Secant of the Latitude (being fitted for *London*) to the Common Radius

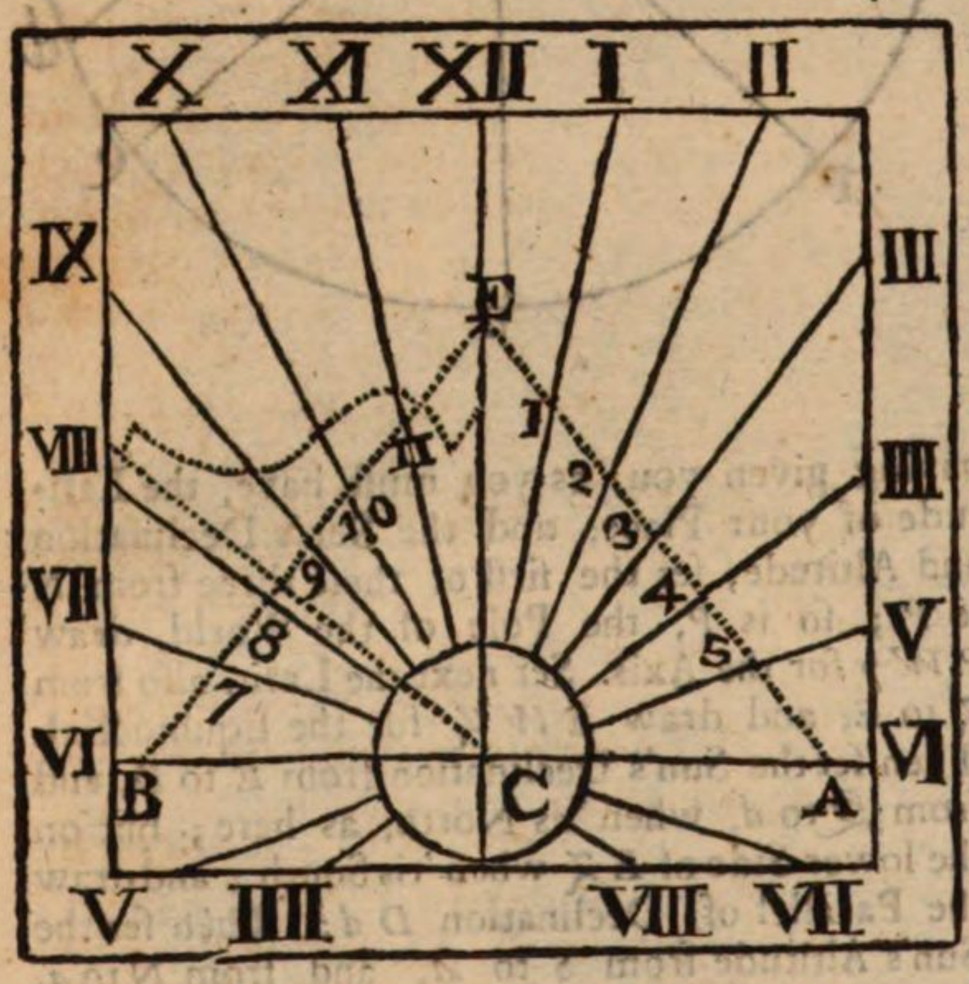
of the Sines. Againſt it, and running by it, is a prick'd Line of Declinations: To the Sun's greateſt Declination is alſo a Portion of the Line of Sines, whoſe Radius is equal to the Sine of the Latitude of *London*, taken out of the other part of the Scale.

Theſe *Hour-Scales* (eſpecially the former) may be put on any Ruler, Sector, *&c.* and will ſerve for theſe Uſes.

The firſt *Hour Scale*, or Double Tangent, is a Scale of Six Hours; and by help of the Line of Latitudes (which ſhould always be placed by it) will ſerve very readily and univerſally to prick down all Dyals that have Centres; after this manner.

I. *To draw an Horizontal, or a Direct Erect South Dyal.*

Draw firſt the Right-Line *CE* for the Hour-Line of 12, and croſs it in *C* (which will be the Centre of the Dyal) with the Perpendicular *B A*: Then from the Scale of Latitudes take off the Latitude of the Place for an Horizontal (or the *Co-Latitude*, for a Direct South and Vertical) Dyal, and ſet it with your Compaſſes each way from *C* to *A* and *B*: Then take with your Compaſſes the whole *Hour-Scale*, and ſetting the End of it at *A* and *B*, and its Beginning at *E*, transfer it, and all its Diviſions (or ſuch as you ſhall have occaſion for at leaſt) on each Side from *A* to *E*, and from *B* to *E*, making the Iſoſceles Triangle *B E A*: Then Numbring the Diviſions with the proper Hours, as you ſee in the Figure, Right Lines drawn from *C*, through thoſe Hours, Halves, or Quarters in the prick'd Lines *A E* and *B E*, ſhall be the true Hour-Lines of the Dyal: And to the Dyal you may give what Form or Figure you pleaſe.

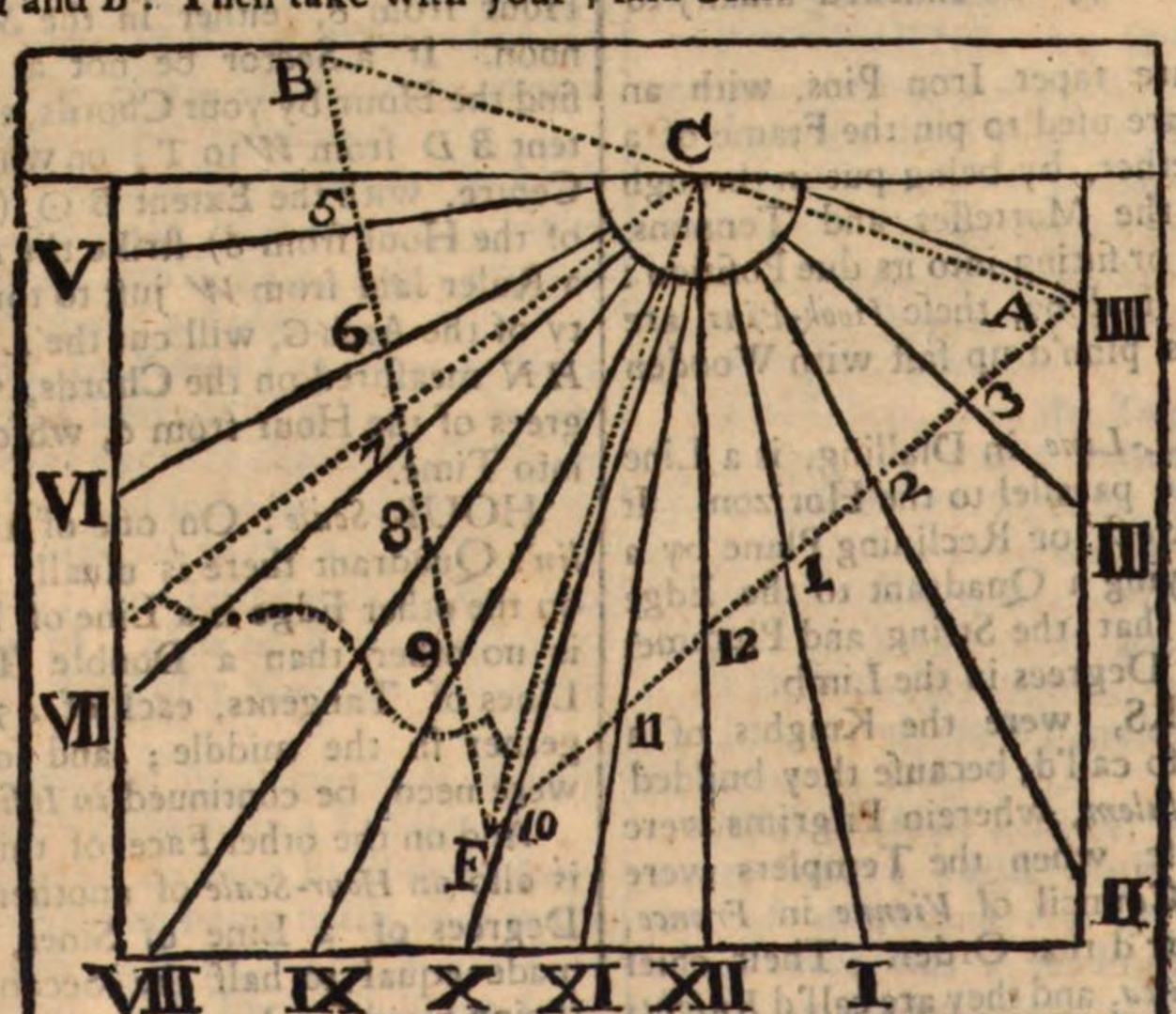



II. *To draw an upright Declining Dyal.*

Suppoſe for the Latitude of *London* 51°. 30′. and declining Eaſtwards 25°. You muſt firſt, either by Calculation, or by *Collin*'s Dialling-Scales, *&c.* find the Requiſites of your Declining Dyal; which will be theſe:

| | |
|---|---|
| The Subſtiles Diſtance from the Meridian will be | 18°. 34′. |
| The Angle of the Hour-Lines of 12 and 6 will be | 62°. 00′. |
| The Angle of the Inclination of Meridians will be | 30°. 47′. |
| And the Styles Height will be an Angle of | 34°. 19′. |

Being thus prepared, you may then draw the Line VIII, II, as the true Horizontal Line of your deſign'd Dyal, and then to it, at Right-Angles, the Line XII *C* for the Meridian. Next make the Angle *F C* XII equal to 18°. 34′. the Subſtile's Diſtance from the Meridian; and by the Chords prick off *FC* for the *Subſtile*. To which in *C*, the Centre of the Dyal, draw the Perpendicular *B A*: Then make *C A* and *C B* equal to the Style's Height 34°. 19′. (taking it in your Compaſſes from the Line of Latitudes;) And then apply the whole Scale of Hours (as before in the Horizontal Dyal) on each ſide *C F*, from *A* to *F*, and from *B* to *F*. Next get the *Difference* between 30°. 47′. the proper Inclination of Meridians, and the next Hours Diſtance from the Meridian that is leſs than that Angle; which in this Caſe is 10, or 30°. from 12. This Difference will be found here to be 47′. or, in Time, nearly 3 Minutes. The fitting the Scale of Hours, was before taught from *A* to *B*; count upon the ſaid Scale



| *Hour.* | *Min.* | | | |
|---|---|---|---|---|
| 0 | 3 | } From *F* to | 10 | } |
| 1 | 3 | | 11 | |
| 2 | 3 | | 12 | |
| 3 | 3 | | 1 | |
| 4 | 3 | | 2 | |
| 5 | 3 | | 3 | |

And make Points at the Terminations with a Pin or Pen: And draw Lines from thoſe Points to the Centre *C*; and they ſhall be the true Hour-Lines on this Side the Subſtile.

Again, Fitting in the Scale of Hours from *B* to *F*, count from the End at *B*, the former Arks of Time.

| *Hour.* | *Min.* | | | |
|---|---|---|---|---|
| 0 | 3 | } From *B* to | 4 | } |
| 1 | 3 | | 5 | |
| 2 | 3 | | 6 | |
| 3 | 3 | | 7 | |
| 4 | 3 | | 8 | |
| 5 | 3 | | 9 | |

And make Points at the Terminations, as before; through which draw Lines to the Centre, and they ſhall be the Hour-Lines on the other Side the Subſtile.

The like muſt be done for the Halves, Quarters, *&c.* getting the Difference between the Half-hour next leſs (in this Example 22° 30′.) under the Ark called the Inclination of Meridians, the Difference is 1°. 17′. (in Time nearly 33′.) to be continually augmented an Hour at a time, and ſo prick'd off as before was done for the Whole Hours.

If the Scale of Hours reach above the Plane, as in this Caſe at *B*; ſo that *B C* cannot be prick'd down: Then may an Angle be laid down on the upper Side of the Subſtile, equal to *F C A* on the under Side, and thereby the Scale of Hours laid in its true Situation, having firſt found the Point *F* on the under Side.

The Stile may be eaſily laid down by the Chords, or a Protractor. And if your Scales are large and carefully made, as this is one of the eaſieſt, ſo 'tis as exact a Way of Drawing Dials as any whatſoever.

HOUSEBOTE, the ſame with *Eſtovers*, or an Allowance of neceſſary Timber out of the Lord's Wood, for the Repair and Support of a Houſe or Tenement.

HOWKER, or *Houcre*, is a Veſſel much uſed by the *Dutch*; built ſomething like a Pink, but Maſted and Rigg'd like a Hoy. They carry from 50 to 200 Tun: And with a ſmall number of Hands will go to the *Eaſt-Indies*. They Tack ſoon and ſhort; will Sail well, and lie near the Wind; and will live almoſt in any Sea.

HULKS, are large Veſſels, having their Gun-Decks from 113 to 150 Foot long, and from 31 to 40 Foot broad. They will carry from 400 to 1001 Tons. But their chiefeſt Uſe is for ſetting in Maſts into Ships, and the like. Though antiently the Word *Hulka* ſeems to ſignifie a ſmall Veſſel.

HUNDRED, is a Part of a Shire or County, properly ſo called, becauſe it contained Ten *Decennæ* or *Tythings*: And either becauſe at firſt there were an Hundred Families in each *Hundred*; or elſe that the *Hundred* found a hundred Men for the King's Wars. Theſe Hundreds were firſt Ordain'd by King *Alfred*, the 29th King of the *Weſt Saxons*; and he took the way of doing it from *Germany*; where *Centa*, or *Centena*, is a Juriſdiction over an hundred Towns. Hence you ſee the Original of *Hundreds*, which ſtill keep the name, and remain, in ſome ſort, the ſame, as to their Service in ſeveral reſpects: But their *Juriſdiction* is transferr'd to the County Court; ſome few excepted, which have been by Privilege annex'd to the Crown, or granted to ſome Great Subject, and ſo remain ſtill in the nature of a Franchiſe: And this hath been ever ſince the Statute of 14 *Edw.* III. 1. *c.* 9. whereby theſe *Hundred-Courts*, formerly Farm'd out by the Sheriffs to other Men, were reduc'd all, or moſt of them, to the County-Court; and ſo remain at preſent. Where-ever therefore we meet with the Word *Hundred-Court* now, it ſignifies ſome Franchiſe, where the Sheriff does not intermeddle by his ordinary Authority, unleſs when they of the Hundred refuſe to do their Duty.

HUNDRED-*Courts*, were held antiently by the *Hundredarius*, or Chief-Conſtable, of every *Hundred*, for better ſupport of his Office. Theſe Courts were held in ſome Places once in three Weeks, and in others once a Month. And by Stat. 14 *Ed.* III. theſe *Hundred-Courts* were reduc'd to the County-Courts; tho' in ſome few *Hundreds* the Old Franchiſes are ſtill remaining.

HUNDREDERS, are Men Empanelled, or fit to be Empanelled, on a Jury, upon a Controverſie; and who dwell in the Hundred where the Land in queſtion lies. But

HUNDREDARIUS, the *Hundreder*, is he that hath the Juriſdiction of a Hundred, and who holdeth the Hundred-Court. And ſometimes 'tis uſed for the Baily of the Hundred.

HUNDREDI *Secta*, was the Payment of perſonal Attendance, ordering Suit and Service at the *Hundred-Court*.

HUNDREDUS *Affirmatus*, was the Profits of an *Hundred-Court*, *Firmed* or Farmed out for a ſtanding Rent.

HURRICAN, is a moſt furious and dreadful Storm of Wind, which the *Caribbe-Iſlands* and ſome other Parts of the *Indies* are ſubject to: Its Extent and Continuance is but ſmall, but its Violence prodigious.

HUSE-BOTE, was formerly the Liberty a Tenant had to cut as much Wood on the Premiſſes as was neceſſary for the Support and Repair of the Farm-Houſe and adjoyning Buildings. This is now call'd *Eſtovers*, *Eſtoverium*.

HYDE-LAND: See *Hide-Land*.

HYDROSTATICKS. Weights which force out of the ſame Tube equal Quantities of the ſame Fluid, are to one another as the Squares of the Times in which the Fluid is forc'd out: But if the Times are equal in which the ſame Quantity of the Fluid is forc'd out thro' unequal Tubes; then the Powers are reciprocally as the Orifices of the Tubes: And therefore Powers which thruſt out the ſame Quantity of a Fluid through unequal Tubes, are to one another in a reciprocal Proportion, compounded of the Squares of the Times, and of the Orifices of the Tubes.

HYDROSTATICAL-BALLANCE. *A Deſcription of an* Hydroſtatical-Ballance, *for finding the Specifick Gravities of Liquids and Solids with eaſe and accuracy. By* F. Hawkſbee, *in* Vine-Office-Court *in* Fleet-Street.

*For* LIQUIDS.

*a a*, *a a*, is the Foot to which the upright Piece or prop'd *b b*, *b b* is to be ſcrew'd: (See *Fig.* 1.) To the upper End of this upright Piece is faſtned a double Cheek of Steel, *c c*, *c c*, on which the Beam *d d*, *d d* is ſuſpended. To one End of this Beam put on the General Scale, expreſs'd by *e e*, *e e*, *e e*. At the other End of it, hang on the other Scale, which is a very thin and light one, and is only expreſs'd on the Ballance by the Characters of *f f*. To the Loop at Bottom of it, is to be ſuſpended by its Hair, and the Bottle *g g*, *g g*. Thus prepared, the Bottle being plung'd into the Glaſs of Water, *h h*, *h h*, the Beam will form an Horizontal Poſition: But if it happen ſomething too light, or too ponderous (for all Waters have not the ſame Specifick Gravity, nor at all times) it muſt be adjuſted by putting Weights on the lighteſt End, till brought to an *Equilibrium*. Theſe Weights, in the Experiment, are to be taken no notice at all of. And by an Experiment, by and by to be mention'd, I found two Grains to be the greateſt Variation, between the Weight of a Bulk of Water, equal to 574 Grains, at the greateſt Degree of Heat in this Climate to the Freezing Point. And thus you may find the Specifick Gravities of all manner of Liquids, in compariſon to their like Bulk of Common Water: For the Bottle will ſink down in *lighter*, and be buoy'd up in *heavier* Fluids; and the Grains or Part of Grains, which muſt be put into one of the Scales, to reduce the Beam to an Horizontal Poſition, will ſhew the Difference of the Specifick Gravity.

*For* SOLIDS.

The General Scale *e e* remains in its Place: But inſtead of the Scale *f f* muſt be ſuſpended the Braſs Piece, repreſented by the Figure *i i*, *i i*. (See *Fig.* 2.) To the Loop, at the Bottom of which, muſt the Glaſs Bucket *k k*, *k k* be ſuſpended by its Hair, which then becomes a Ballance to the other End. Into this Bucket muſt be put the Solid (what ever it be) whoſe Specifick Gravity you would find, or whoſe Weight you have a mind to compare with that of the like Bulk of Water: And having ballanc'd it by Weights at the other End, take it out of the Bucket, and plunge the Bucket empty into the Water. Then putting the Braſs Diſh *l l*, by its Slit on the Braſs piece *i i*, a Notch being cut in't to receive it; the Bucket then in the Water will be in *æquilibrio* with the General Scale *e e*; the Diſh *l l* being the Weight of a Bulk of Water equal to the Solidity of the Bucket: But if it chances to vary a little, you muſt reduce it as before. Then putting the Solid Body into the Bucket (having firſt well wetted it all over in Water; and it be irregular, take care that no Air lodges in any part of it) then you will ſoon find what it has loſt of its Weight, in compariſon to what it weigh'd in the Air: And by the Difference of which Weights, divide the Weight firſt found, which exactly gives you its Proportion to the like Bulk of Water: See *Specifick Gravity* in Vol. I. Where the Reaſon of this Practice is ſhewn: What is here deſign'd being only the Uſe of a commodious Ballance for ſuch kind of Hydroſtatical Experiments.

*An Experiment, touching the different Denſities of common Water, from the greateſt Degree of Heat in this Climate to the Freezing Point; obſerv'd by a Thermometer. By Mr.* Hawksbee.

I took about a Quart of Common Water, and gave it a pretty conſiderable degree of Heat over the Fire: Then putting it into a convenient Glaſs together with my Thermometer, where the Spirit ſoon aroſe into the ſmall Ball a-top, and continued to remain there till the Water began to abate of its Heat; by which Time the Spirit in the Thermometer became of an equal degree of Temperature with the Water in which it was plac'd. When the Spirit has deſcended to 130 Degrees above the Freezing Point, (which is the greateſt Height it has been obſerv'd in this Climate) I began my Obſervations, and found that the Bulk of Water, equal to that of the Bottle I weigh'd in't, in that State, was equal to 574 Grains, at 80 Degrees above the Freezing Point, the Bulk of Water, equal to the Bottle, then weigh'd $\frac{1}{4}$ of a Grain more than before: At 32 Degrees above the pre-mention'd Point, the like Bulk of Water equal to the Bottel, was again increaſed $\frac{1}{4}$ of a Grain; at the Freezing Point it weigh'd about $\frac{1}{2}$ of a Grain more: in all about 2 Grains, from 130 Degrees above the Freezing Point, to the ſame Point: Which to me ſeems very conſiderable, and ought to be obſerv'd by thoſe, who at different Seaſons, have occaſion to find the Specifick Gravities of Liquids and Solids.

HYPERBOLA. In *Philoſ. Tranſact.* N. 34. you have a Quadrature of the *Hyperbola* by the Ld. Viſcount *Brouncker*, by a Series founded on what Dr. *Wallis* hath demonſtrated in his *Arith. of Infinites*, Prop. 87, 88, 89, &c. And in *Philoſ. Tranſact.* N. 306. by a *New Quadratrix*, invented by the Ingenious Mr. *J. Perks*, of *Great Swinford* in *Worceſterſhire*; together with the Conſtruction and Properties of that Quadratrix.

HYPERBOLICAL *Cylindroid*, is a Solid Figure, whoſe Generation is given by Sir *Chriſtoph. Wren*, in *Philoſoph. Tranſact.* N. 48. There are two oppoſite *Hyperbolæ*, join'd by the *Axis Tranſverſus*; and thro' the Center there is a Right Line drawn at Right-Angles to that *Axis Tranſverſus*; and about that, as an Axis, the *Hyperbolæ* are ſuppoſed to revolve: By which Revolution a Body will be generated, which he calls an *Hyperbolick*

*This must be placed at the Word* Hydrestaticall Ballance.

*Fig*: I.

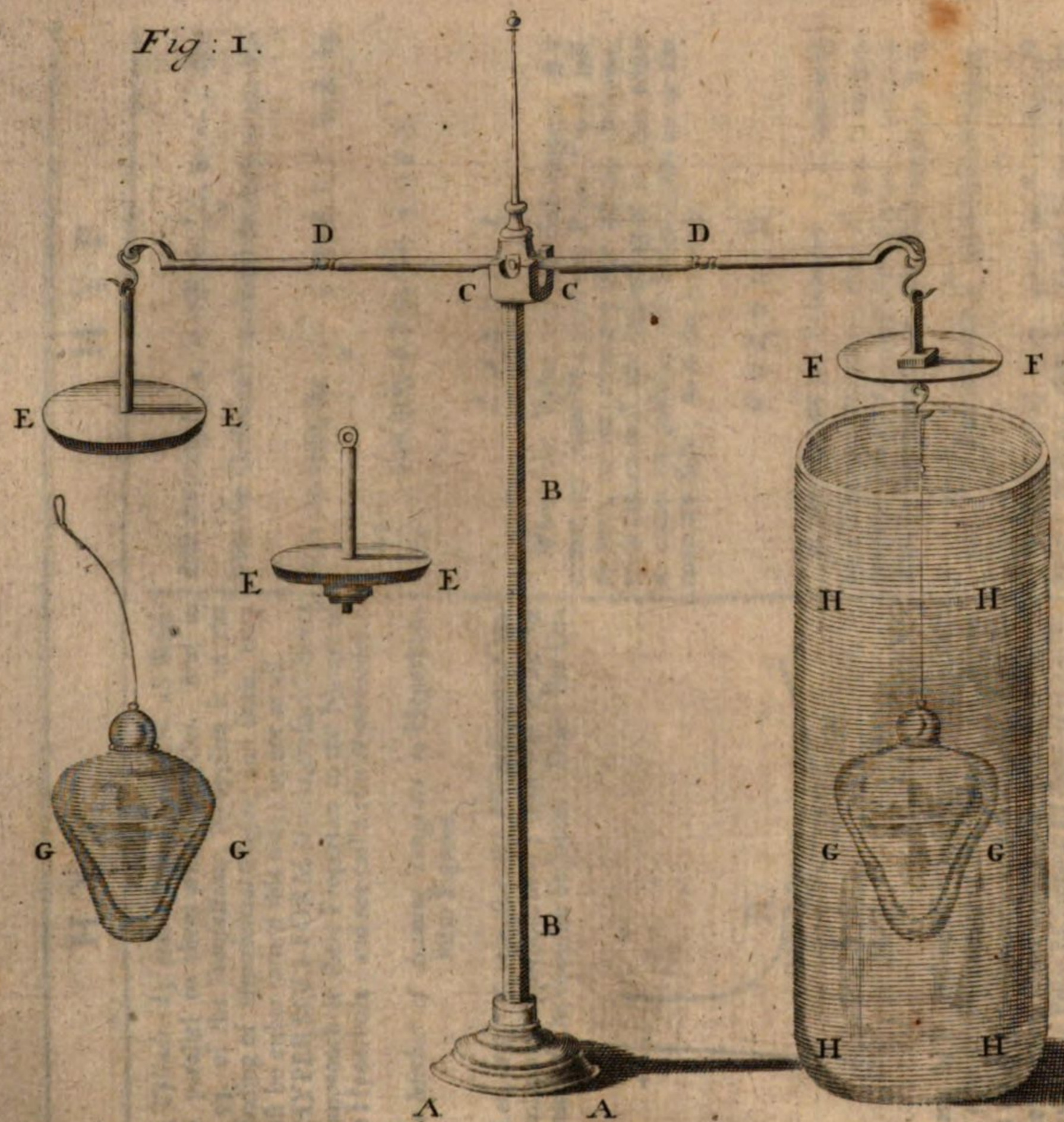
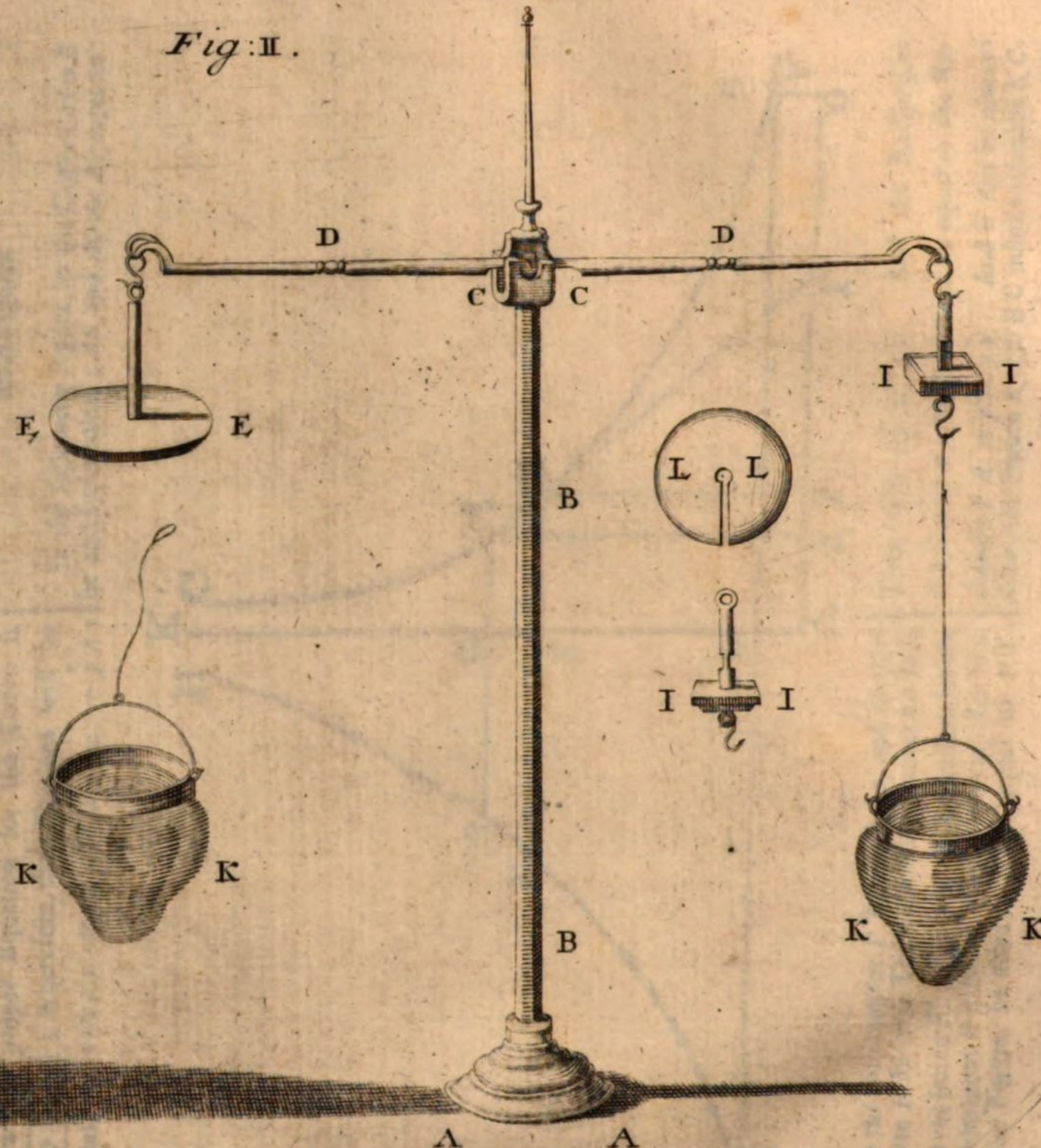
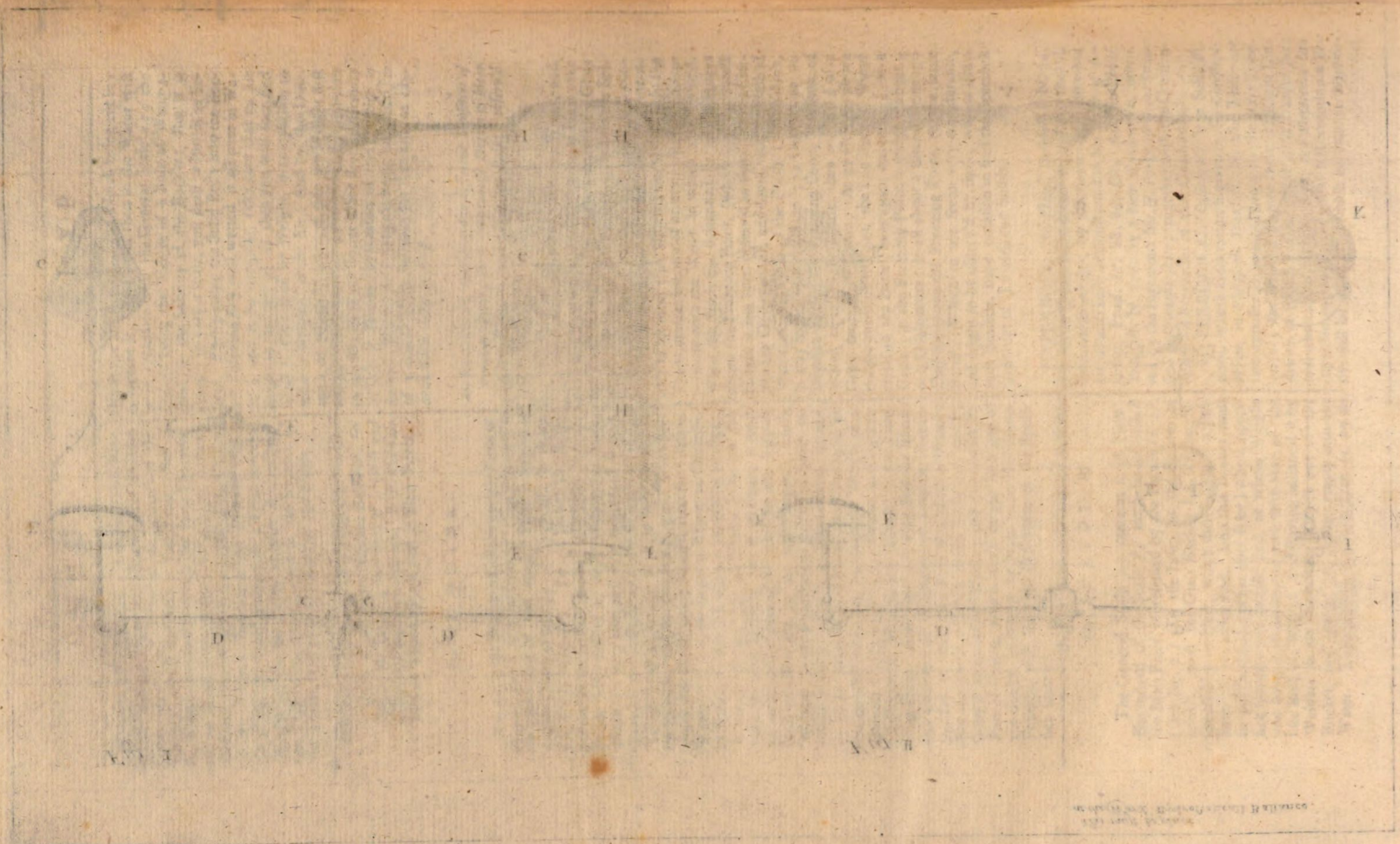



*Fig*: II.



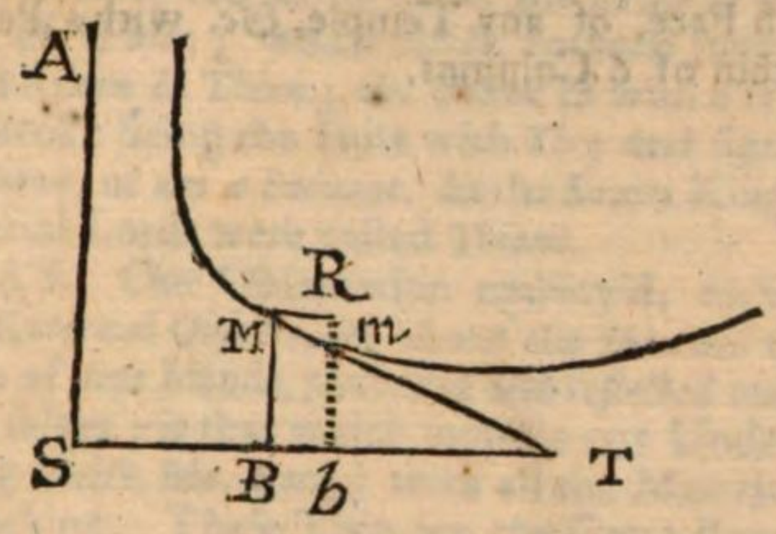


*lick Cylindroid*; and whose Baſes, and all Sections parallel to them will be Circles. And in N. 53. of the *Tranſactions*, he applies it to the Grinding of *Hyperbolical Glaſſes*, and ſaith, they muſt be either form'd this way, or not at all.

HYPERBOLI-FORM *Figures*, are ſuch Curves as approach in their Properties to the Nature of the Hyperbola; and are call'd alſo *Hyperboloids*.

*The Method of drawing Tangents to* Hyperboliform Figures.

Let $AS$, $ST$, repreſent the Aſſymptotes of the Equilateral Hyperbola $Mm$; then will $S$ be the Centre of the oppoſite Sections. Draw the Ordinate $MB$, and another infinitely near, as $mb$. Let $p$ be the Parameter of the Figure, let $SB = x$, and $MB = y$: $Rm = \dot{y}$, and $Bb = \dot{x}$. And let it be required to draw $MT$, a true Tangent to the Curve in the Point $M$, ſuppoſe all done, as in the Figure: Then will the Triangles $MBT$, and $MRm$ be ſimilar; and therefore $\dot{y} : \dot{x} :: y : \frac{\dot{x}y}{\dot{y}}$ $(= BT.)$




Now the proper Equation for the Curve is $\overline{|pp = xy|}$; wherefore their Fluxions will be equal, *viz*, $0 = \dot{x}y + y\dot{x}$; or $\dot{x}y = -y\dot{x}$: And dividing by $x$, it will be $\frac{\dot{x}y}{x} = -\ddot{y}$. But from the Ordinate's continual decreaſe as the Abſciſſa increaſes, the $\frac{\dot{x}y}{\dot{y}}$ $(= BT,)$ muſt be $\frac{\dot{x}y}{-\dot{y}}$, you have $BT = -x = SB$.

*COROL.* I.

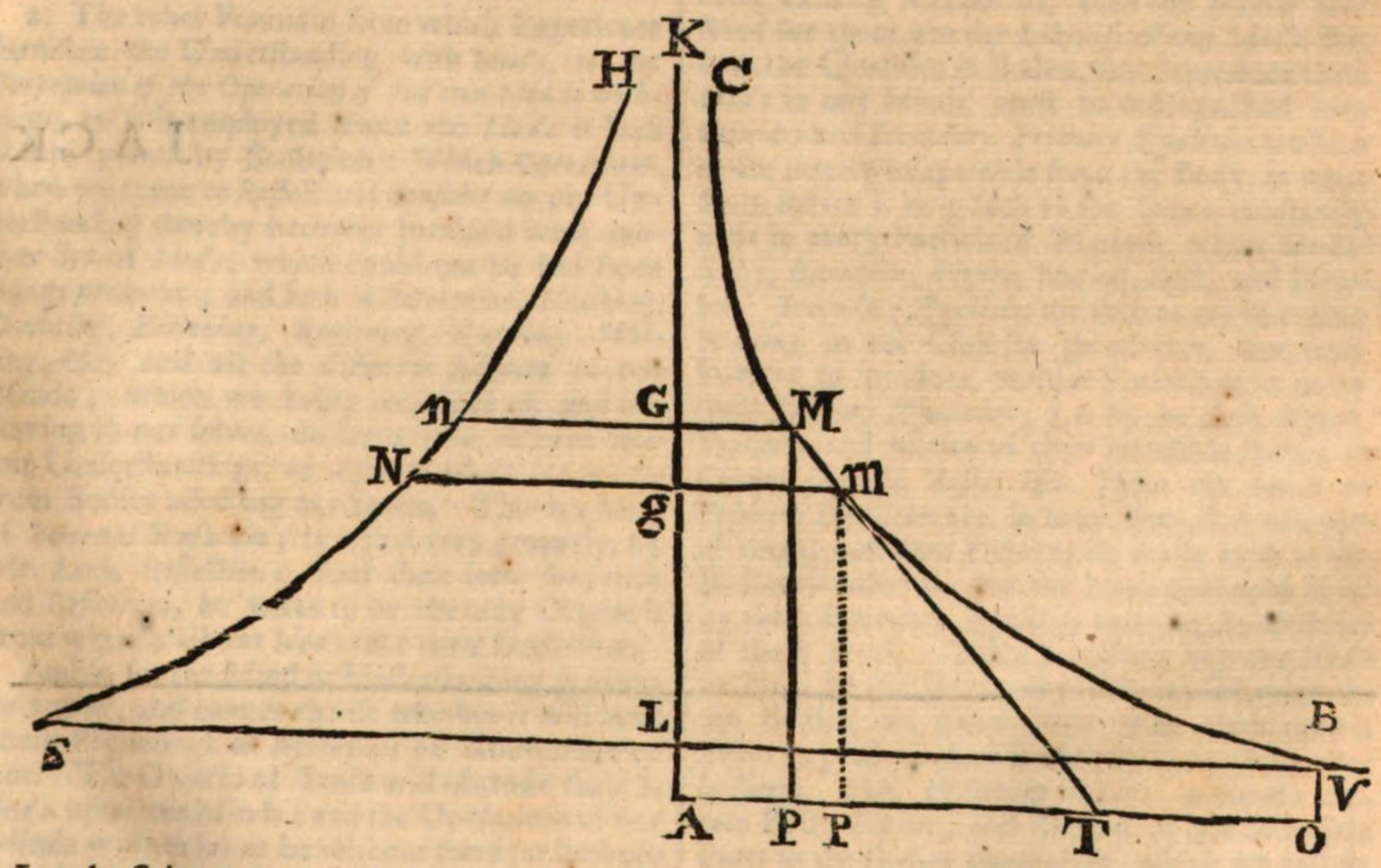
When the Value of the Sub-tangent $BT$ comes out negative; then the Point $T$ will fall, as here, on the contrary Side of the Ordinate, with regard to $S$, the beginning of $x$. But when it comes out poſitive, the Point $T$ will be on the contrary Side; as in the *Parabola*.

*COROL.* II.

If you ſuppoſe the Parameter $= 1$, and $m$ to be a Negative Number; then $y^m = x$ is an Expreſſion for all *Hyperboli-form Figures*; and univerſally the Length of the Sub-tangent $BT$, $\left(= \frac{\dot{x}y}{\dot{y}}\right) =$ (becauſe $y^m = x$ and conſequently $my^{m-1}\dot{y} = \dot{x}$) I ſay, $=$ to $my^m =$ (bec. $y^m = x$) to $mx$; that is, *To the Exponent of the Power of the Ordinate multiplied into the Abſciſſa.*

*To Inveſtigate the Area's of all ſorts of* Hyperboliform Figures.

In the following Figure, let the Curve $CMmB$ be an Hyperboloid; $AK$ and $AO$ the Aſymptotes:




Let the Sub-tangent $PT$ be called $t$, and the Ordinate $PM = y$. The General Equation for ſuch Curves being $y^m = x$; and the Expreſſion for the Sub-tangent $PT$ being $mx$, as above. Let $Gn$, in the Figure, be always taken equal to $PT$: Then will $t\dot{y} = y\dot{x}$. And the Rectangles $NIGn = t\dot{y}$, will always be equal to the Rectangle $PR\ mp = y\dot{x}$: And if this be always done, the Figure $KAOBC$ infinite towards $KC$, will

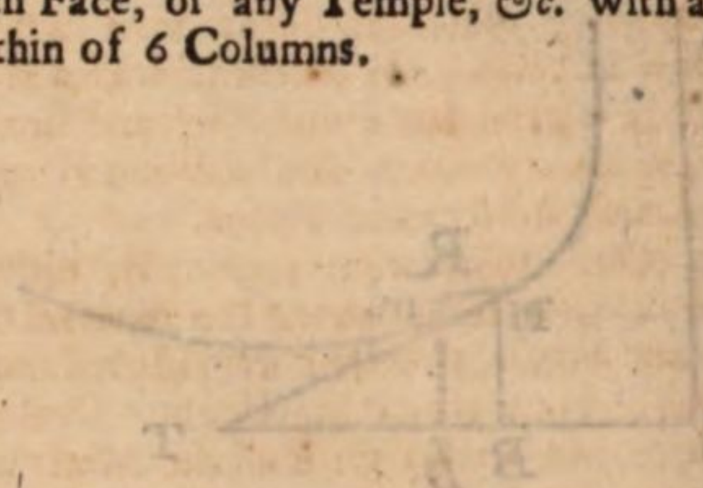
will be equal to Figure $KLSH$, equal to all the $t\dot{y} =$ (becauſe $t = mx$) all the $mx\dot{y}$. But (ſuppoſing the Figure $KAOBC - b$; and the inſcribed Rectangle $LBOA = d$) then will the Figure $KLBC = b - d =$ all the $x\dot{y}$ (becauſe $IR = x$, and $RM = y$.) Whence all the Rectangles $mx\dot{y} =$ all the $y\dot{x} = b$, are to all the $x\dot{y} = b - d$, as $m$ is to 1. And by Diviſion, $m : m - 1 :: b : n$; That is, the Figure $KAOBC$: Is to the inſcribed Rectangle :: As the Exponent of the Power of the Ordinate $m$: Is to the ſame Exponent leſs 1.

*COROLLARY.*

If $m$ be greater than 1; then the Space, indeterminate towards $K$, may be meaſured: But if $m = 1$, then the ſecond Term in the Analogy $m - 1 = 0$; and conſequently, the Space $KAOBC$ is infinite towards $K$; and infinitely great in reſpect of the Rectangle $LO$. But if $m$ be leſs than 1, that Space $KAOBC$ will be more than infinite.

Thus in the common *Apollonian Hyperbola*, whoſe Equation is $y^{-1} = x$; or (ſuppoſing $a$ the Parameter $= 1$) $aa = xy$; it appears that $m - 1 = 0$; and conſequently, it appears that the Proportion between the Rectangle $LO$, and the ſaid infinite Space is infinitely great: *See more of this in* Hayes's Fluxions, *p.* 61, *&c.*

HYPETHRE, in the Antient Architecture, was two Ranks of Pillars all about, and ten at each Face, of any Temple, *&c.* with a Periſtile within of 6 Columns.



JACK, in a Ship, is that Flag which is hoisted up at the Sprit-Sail-Top-Mast-Head.

JACTIVUS, *Jativus*, a Latin Word, signifying in the Law, him that loseth by Default: *Placitum suum neglexerit*, & Jactivus *exinde remansit*. Formul. Solenn.

JAM, or *Jamb*, is in the Language of our Lead Miners in *Mendip*, a thick Bed of Stone, which hinders their Work when they are pursuing the Veins of Oar.

ICH DIEN, the Motto under the Arms of the Prince of *Wales*; which Sir *H. Spelman* judges to be in *Saxon Ic Thien*; the *Saxon* D with a traverse Stroke being the same with *Th*; and signified *I Serve*, or *am a Servant*. As the *Saxon* King's Ministerial Lords were called *Thiens*.

IDEA'S. Our Observation employ'd, either about *External Objects*, or about the *Internal Operation* of our Minds, *perceived* and *reflected* only by our selves; is that which supplies our Understanding (saith Mr. *Locke*) with all the Materials of Thinking. These Two are the Great Fountains of Knowledge from whence all the *Idea's*, Notions, Phantasms, Species, &c. which we have, or can naturally have, do spring and arise.

1. Our Senses, being conversant about particular Sensible Objects, do convey into the Mind several distinct Perceptions of things: And this way we gain the *Idea's* of *Yellow*, *White*, *Heat*, *Cold*, *Soft*, *Hard*, *Bitter*, *Sweet*, and all those which we properly call *Sensible Qualities*; and this Great Source of most of the *Idea's* we have, depending wholly on our Senses, and derived by them to the Understanding, is called *Sensation*.

2. The other Fountain from which Experience furnishes the Understanding with *Idea's*, is the *Perception of the Operation of our own Minds within us*, as it is employed about the *Idea's* it hath before gotten by Sensation: Which *Operations*, when we come to *Reflect* and *Consider* on, our Understanding thereby becomes furnish'd with another Set of *Idea's*, which could not be had from things without; and such is *Perception*, *Thinking*, *Doubting*, *Believing*, *Reasoning*, *Knowing*, *Willing*, &c. and all the different Actions of our Minds; which we being conscious of, and observing in our selves, do from these receive into our Understandings, as *distinct Idea's*, as we do from Bodies affecting our Senses. This is a kind of *Internal Sensation*; is called very properly, by Mr. *Lock*, *Reflection*: And these two, *Sensation* and *Reflection*, he takes to be the only Originals from whence all our *Idea's* take their Beginnings.

And so far the Mind or Understanding is meerly *passive*; and cannot choose whether it will have these Beginnings or Materials of Knowledge or not. The Objects of Sense will obtrude their *Idea's* upon our Minds; and the Operations of our Minds will not let us be without some (at least obscure) Notions of them. No one can be wholly ignorant of what he doth when he Thinks: And as the Mind is forced to receive Impressions from without, so it cannot avoid the Perception of those *Idea's* that are annex'd to them.

IDE

Of *Idea's*, some (as we should carefully observe) are *Simple*, and others *Complex*. All those *Idea's* that come into our Minds by *Sensation*, are of the former kind: And tho' the Qualities in Bodies that affect our Senses are in the Things themselves, so united and blended, that there is no Separation nor Distance between them; yet the *Idea's* they produce in the Mind enter by the Senses simple and unmix'd. Some *Idea's* come into our Minds only by *one Sence*, which is peculiarly adapted to receive them: As the *Idea's* of all *Colours* are received only by the Eye; all *Sounds* and *Tones* by the Ear, &c. *Heat*, *Cold*, and *Solidity*, by the Touch.

Other *Idea's* we gain by more than one Sence; as of *Space*, *Extension*, *Figure*, *Rest*, and *Motion*: For these make forcible Impressions both on the Eyes and Touch.

There are other *Simple Idea's*, which convey themselves into the Mind by all the ways of *Sensation* and *Reflection*; as *Pleasure*, *Pain*, *Power*, *Existence*, *Unity*, and *Succession*; and these are all, or, at least, the most considerable of those *Simple Idea's* which the Mind hath; and out of which is made all its other Knowledge.

To understand the Nature of these *Simple Idea's* the better, and to discourse of them intelligibly, it will be convenient to distinguish them as they are *Idea's* or *Perceptions* in our Minds, and as they are Modifications in the Bodies that cause such Perceptions in us; that so we *may not think* (as perhaps is usually done) that they are exactly the *Images* and *Resemblances* of something inherent in the Subject: For most of those of *Sensation* are in the Mind no more the *Likeness* of something existing without us, than the *Names* that stand for them, are the *Likeness* of our *Idea's*. But here the Qualities in Bodies, which produce these *Idea's* in our Minds, must be distinguished into *Primary* and *Secondary*. *Primary Qualities* are such as are utterly inseparable from the Body, in what State soever it be; such as the Sence constantly finds in every Particle of Matter; which are *Solidity*, *Extension*, *Figure*, *Motion*, *Rest*, and *Number*. *Secondary Qualities* are such as are in reality *Nothing* in the Objects themselves, but only Powers to produce various Sensations in us by their *Primary Qualities*; *i. e.* by the *Bulk*, *Figure*, *Texture*, and *Motion* of their Insensible Parts; as *Colours*, *Sounds*, *Tasts*, &c. Now the *Idea's* of *Primary Qualities* are, in some sence, *Resemblances* of them, and their Patterns do really exist in the Bodies themselves; but the *Idea's* produced in us by these *Secondary Qualities* have no *Resemblance* of them at all. There is nothing like our *Idea's* existing in the Bodies themselves: They are in the Bodies, we denominate from them only a *Power* to produce those Sensations in us: And what is *Sweet*, *Blue*, or *Warm* in *Idea*, is but the certain Bulk, Figure, and Motion of the insensible Parts in the Bodies themselves, which we call so.

There are several Faculties which the Mind hath of managing these *Simple Idea's*, which are very well worth our Observation; as that of *Discerning* duly, and rightly *Distinguishing* one from another: In this consists the Accuracy of Judg-

ment,

ment, and the avoiding all Confuſions and Miſtakes.

2. That of *Comparing* them one with another, in reſpect of *Extent*, *Degree*, *Time*, *Place*, or any other Circumſtances of *Relation* or Dependance one on another.

3. The Faculty of *Compounding* or putting together the *Simple Idea's* receiv'd by *Senſation* or *Reflexion*, in order to make *Complex* ones.

4. When Children, by repeated *Senſations*, have got ſome *Idea's* fix'd in their Memories, they, by degrees, begin to learn the Uſe of Signs; and when they can ſpeak articulately, they make uſe of Words to ſignifie their *Idea's* to others: And the Uſe of Words being to ſtand as outward Marks of our Internal *Idea's*; and thoſe *Idea's* being taken from particular things, if every particular *Idea* that we take in ſhould have a particular Name, Names muſt grow endleſs. To prevent this, the Mind, by,

5. Another Faculty, can make the Particular *Idea's* received from ſuch Objects, to become *General*: Which is done by conſidering them as they are in the Mind ſuch Appearances, ſeparate from all other Exiſtences, and the Circumſtances of real Exiſtence; ſuch as *Time*, *Place*, or any other concomitant *Idea's*; and this is called *Abſtraction*; whereby *Idea's* taken from particular Things, become general Repreſentatives of all of that kind; and their *Names*, general Names applicable to whatever exiſts conformable to ſuch *Abſtract Idea's*. Thus the ſame Colour being obſerv'd to Day in Chalk or Snow, which the Mind Yeſterday received from *Milk* or *Ceruſſe*; it conſiders that Appearance alone; makes it a Repreſentative of all of that kind; and having given it the name of *Whiteneſs*, it by that ſound ſignifies the ſame Quality whereſoever to be met with or imagined. And thus *Univerſals*, whether *Idea's* or *Terms*, are made.

From the Power which the Mind hath of *combining* thus, *comparing*, and *ſeparating* or *abſtracting* its *Simple Idea's*, which come into it by *Senſation* and *Reflection*, all *Complex Idea's* are form'd; and, as before in the *Perception of Idea's*, the Underſtanding was *paſſive*, ſo here 'tis *active*; exerting the Power it hath in the ſeveral Acts and Faculties above-mention'd, in order to frame *Compounded Idea's*.

All *Complex Idea's*, tho' their Number be infinite, and Variety endleſs, may be, as it ſeems, all reduc'd to theſe three Heads, *viz*. *Modes*, *Subſtances* and *Relations*.

*Modes* are ſuch *Complex Idea's*, which however compounded, are not ſuppoſed to exiſt by themſelves, but are conſidered as *Dependancies* on, or *Affections* of Subſtances: Such are the *Idea's* ſignified by the Words *Triangle*, *Gratitude*, *Murther*, *&c.* and theſe *Modes*, as Mr. *Locke* calls them, are of two ſorts.

1. Such as are only Variations, or different Combinations, of the ſame Simple *Idea*, without the Mixture of any other; as a *Dozen*, a *Score*, *&c.* and theſe may be called *Simple Modes*.

2. There are others compounded of Simple *Idea's* of ſeveral kinds put together to make one Complex one; as *Beauty*, *Theft*, *&c.*

*Subſtances* have their *Idea's* ſuch Combinations of Simple *Idea's*, as are taken to repreſent diſtinct particular things ſubſiſting by themſelves; in which the ſuppoſed, or confuſed *Idea* of Subſtance, ſuch as it is, is always the Firſt and Chief.

*Relations*, are a ſort of *Complex Idea's* ariſing from the Conſideration and Compariſon of one *Idea* with another. Of theſe, ſome depend only on the Equality or Exceſs of the ſame Simple *Idea* in ſeveral Subjects; and theſe Mr. *Locke* thinks may be called *Proportional* Relations; ſuch as *equal*, *more*, *bigger*, *ſweeter*, *&c.* Another Occaſion of comparing things together, is the Circumſtances of their Origin or Beginning; and this being not afterwards to be altered, make the *Relations* depending thereon as laſting as the Subjects to which they belong: Theſe are *Natural Relations*, ſuch as *Father*, *Brother*, *Uncle*, *Couſins*, *&c.* There are alſo Relations by *Inſtitution*, as *Prince* and *People*, *General* and *Army*, *&c.* *Moral Relations*, are the Conformity or Diſagreement of Men's free Actions to Laws and Rules, whether *Divine* or *Human*.

It may be conſidered alſo further about our *Idea's*, that ſome are *clear* and *diſtinct*; others *obſcure* and *confuſed*. Our Simple *Idea's* are *clear*, when they continue ſuch as the Objects repreſent them to us, when our Organs of Senſation are in a good Tone and Order; when our Memories *retain* them, and can produce and preſent them to the Mind when ever it hath occaſion to conſider them: And if along with this the Mind ſees that theſe Simple *Idea's* are ſeverally different one from another, and each ſingle one from all the reſt; then they are diſtinct alſo as well as clear: And the contrary to this will occaſion *Obſcurity* and *Confuſion*.

IDENTITY: The Idea's of *Identity* and *Diverſity* come into our Minds by the Power it hath of comparing the very *Beings* of Things; whereby conſidering any thing, as exiſting in any determined Time and Place, we compare it with it ſelf exiſting at another time; and accordingly pronounce it to be the *ſame* or diverſe. When we ſee any thing to be in any Place in any *Inſtant* of Time, we are ſure (be the thing what it will) that it is *that very thing*, and not another: For what ever is *another* thing, muſt at that ſame time exiſt in another place, how like ſo ever it may be in all other reſpects. And in this conſiſts *Identity*; when the Idea's it is attributed to, vary not at all from what they were that moment, wherein we conſider'd their *former* Exiſtence, and to which we compare the *preſent*: for never finding nor conceiving it poſſible, that two things of the ſame kind ſhould exiſt in the ſame place at the ſame time, we rightly conclude, that whatever exiſts any where at any time, excludes all of the ſame kind, and is there it ſelf alone. When therefore we demand, Whether any thing be the *ſame* or not? It always refers to ſome thing that exiſted at ſuch a time in ſuch a place, which, 'twas certain, at that inſtant, was the ſame with it ſelf and no other. From whence it follows, that *one thing* can't have *two Beginnings*

of Exiſtence, nor *two* things *one*; it being impoſſible for two things of the ſame kind, to be or exiſt in the ſame inſtant, in the very ſame place; or one and the ſame thing in divers places. Whatever therefore had *one Beginning* is the ſame thing; and that which had a different Beginning in Time and Place from *that*, is not the ſame with that, but different from it.

We ſeem to have Idea's but of three ſorts of Subſtances, G O D, *Finite Intelligences* or *Spirits*, and *Bodies*. Of G O D, 'tis demonſtrable that He is without Beginning, Eternal, Unalterable, and Omnipreſent; wherefore of His *Identity* there can be no doubt.

*Finite Spirits* having had each its determinate Time and Place of Beginning to *exiſt*; the Relation to that Time and Place, will always determine to each of them its *Identity*, as long as it *exiſts*.

And the ſame will hold of *Bodies*: And in every Particle of Matter, to which no Addition or Subſtraction of Matter being made, it is the ſame. And though theſe three ſorts of Subſtances do not exclude *one another* out of the ſame Place; yet we cannot conceive but that they muſt neceſſarily *each* of them exclude *any other of the ſame kind*, out of the ſame Place: or elſe the Notions and Names of *Identity* and *Diverſity* would be in vain; and there could be no ſuch Diſtinction of Subſtances, or any thing elſe from one another. Thus, *v. gr.* if two Bodies or Particles of Matter could be in the ſame place at the ſame time; then take them, great or little, they muſt be *one* and the *ſame*; nay, thus all Bodies muſt be one and the ſame.

'Tis plain then that the ſo much diſputed *Principium Individuationis* is Exiſtence it ſelf; which determines a Being of any ſort to a particular Time and Place, incommunicable to two Beings of the ſame kind.

And here it will do well to diſtinguiſh between dead and unactive Lumps of Matter, and ſuch Bodies as thoſe endow'd with Vegetable or Animal Life. If you conſider one of the former kinds of Bodies; if it conſiſt only of *one*, or a determinate Number of many Atoms, any way combined together; while that *one* continues without mixture with others; or while the *many exiſt*, united together in the ſame Maſs, it will ſtill be the ſame Body; but if one Atom be taken away, or any new one added, it is no longer the ſame Maſs, or the ſame Body. But in the State of Living Creatures, their *Identity* depends not on a Maſs of the ſame *Particles*, but on ſomething elſe; for in them the Variation of great Parcels of Matter alters not the *Identity*. An Oak growing from a Plant to a great Tree; and a Child growing to an Adult Perſon, are ſtill the ſame; tho' in both Caſes there be a manifeſt Change of Parts: For here 'tis ſuch a peculiar Diſpoſition and Organization of Parts in one coherent Body, and partaking of one common Life, that conſtitutes their *Identity*; and as long as that continues, it will be the ſame Oak or Man. And ſo it is in a Watch; as long as the Mechaniſm of it continues the ſame, and it goes and anſwers the End of its Organization, 'tis the ſame Watch, tho' many Particles of Matter continually rub off and wear away. 'Tis clear therefore wherein conſiſts the *Identity* of any Animal or Vegetable.

But there is another ſort of *Identity*, which hath not been improperly called *Perſonal*; which I think Mr. *Lock* truly determines to conſiſt in the *Sameneſs of a Rational Being*: Since by *Perſon* we underſtand an Intelligent Being, having Reaſon and Reflection: And ſince there is a *Conſciouſneſs* which always accompanies Thinking; it is that which makes every one to be that, which he calls *himſelf*, thereby diſtinguiſhing him from all other Beings that think, and give him his *Perſonal Identity*. See *Eſſay of Human Underſtanding*, Book 2. Ch. 27.

JEWISH *Hours*, are the 24 Hours of the Day, accounted from Sun-ſetting to Sun-ſetting again, much after the manner as the *Italians* do now.

IKEMILDESTREET, one of the four old *Roman* Ways in *England*: See *Watling-ſtreet* in Vol. II. It was called *Stratum Icenorum*, becauſe it took its Beginning from the *Iceni*, which were thoſe that inhabited *Suffolk*, *Norfolk*, and *Cambridgeſhire*.

ILLEVIABLE, is what cannot or may not be *levied*: And therefore *Nihil* is a Word ſet upon a Debt that is *Illeviable*.

IMPARSONEE, in the Law, or a Parſon Imparſonee, is one that is Inducted into the Poſſeſſion of a Benefice. And *Dyer* ſaith, a Dean and Chapter are *Parſons Imparſonees* of a Benefice appropriate to them.

IMPEACHMENT *of Waſte*, *Impetitio vaſti*, from *French Empeſchment*, *Impedimentum*, ſignifies in Law a Reſtraint from committing Waſte on Lands and Tenements. And thus he that hath a Leaſe without *Impeachment of Waſte*, hath by it a Property or Intereſt given him in the Houſe and Trees, and may make *Waſte* in them, without being *Impeached* for it; that is, without being queſtion'd or demanded any Recompence for the Waſte done.

IMPLEAD, in our Law, ſignifies to Sue, Arreſt or Proſecute by Courſe of Law.

IMPOST, is the Tax which the Crown receives for Merchandize brought into any Haven within its Dominions, or from Foreign Parts. 31 *Eliz.* 5. and thus it may be diſtinguiſhed from *Cuſtom*; which is rather the Profit which the Queen makes of Wares exported: But they are frequently uſed promiſcuouſly.

IMPOSTS in Architecture, are what are ſome times called *Chaptrels*, being the Parts on which the Feet of Arches ſtand: Or the Capitals of Pilaſters that ſupport Arches. Theſe Impoſts conform to their proper Orders: The *Tuſcan* hath a *Plinth* only: The *Dorick* two *Faces and a Round*: The *Ionick* a *Plancere* or Cavity between the two *Faces*; with, ſome times, carved Mouldings; as the *Corinthian* and *Compoſite* have their *Freiſes*. But the *Sallies* of the *Impoſts* muſt not exceed the Body of the Pilaſter. Sometimes the Entablature of the Order ſerves for the Impoſt of the Arch; and this looks very great and ſtately.

IMPROPRIATION, is the Word for the Profits of an Eccleſiaſtical Benefice, being in the Hands of a Lay-Man: As *Appropriation* is the Term, when 'tis in the Hands of a Biſhop, College, or Religious Houſe. Tho' theſe two Words are now often uſed promiſcuouſly. It is ſaid there are 3845 Impropriations in *England*. *Cowel's Interpreter.*

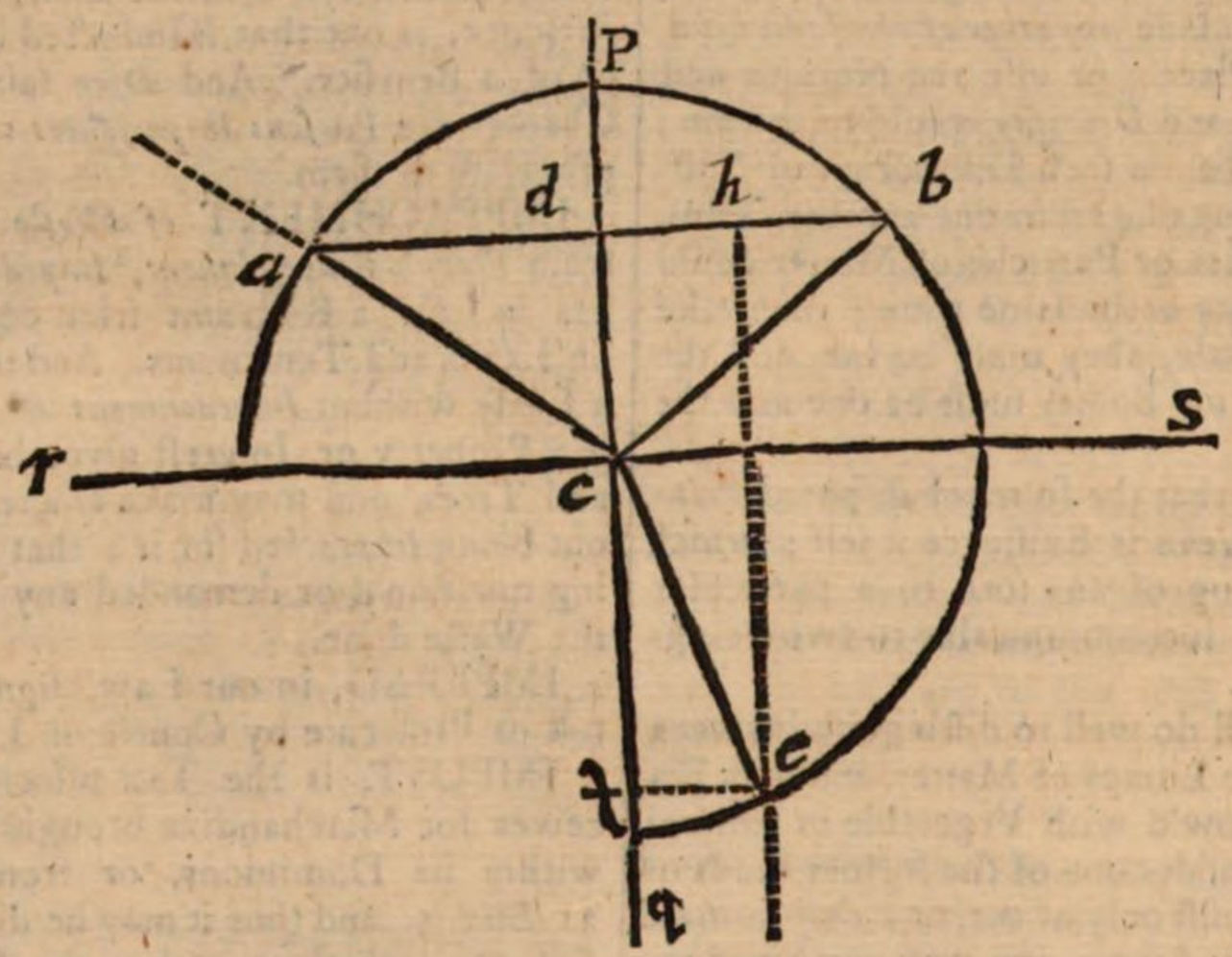
IN *Alto & Imo*; the ſame with *Alto & Baſſo*; which ſee.

INCIDENCE. Sir *Iſaac Newton*, in his *Opticks*, Printed ſince the firſt Edition of this Book, ſaith, That the *Sine of Incidence is either accurately, or very nearly, in a given Ratio to the Sine of Refraction*: (And the Angles of Incidence, Reflexion, and Refraction, are all in one and the ſame Plane.) Wherefore if that Proportion be known in any one Inclination of the Incident Ray, 'tis known in *all*; and thereby the Refraction in all Caſes of *Incidence* on the ſame Refracting Body may be determin'd. Thus, if the Refraction be made out of Air into Water, the Sine of *Incidence* of the Red Light Is to the Sine of the Refraction, As 4 To 3. If out of Air into Glaſs, the Sines are As 17 To 11. In Light of other Colours the Sines have indeed other Proportions; but the Difference is ſo little, that it need ſeldom be conſider'd.

To illuſtrate all this, Sir *Iſ. Newton*, *Opt.* p. 5. gives this Example:

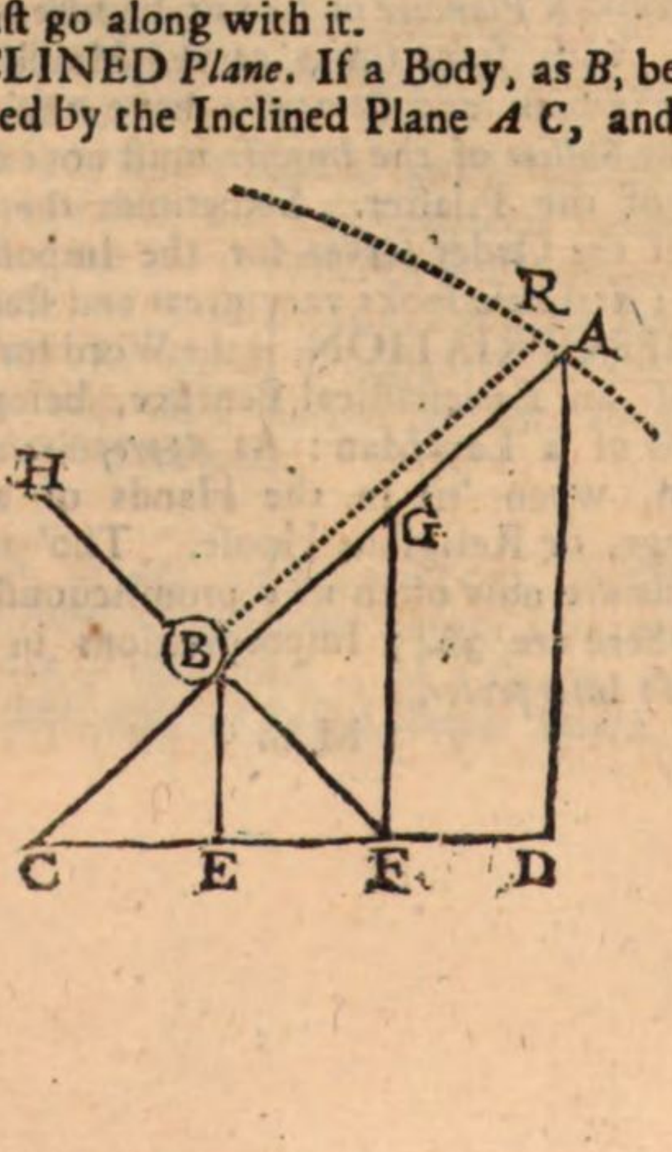
Let *r s* be the Surface of the Still Water, *c* the Point of *Incidence*, in which any Ray coming in the Air from *a* in the Line *a c*, is reflected or refracted: I would know whither this Ray ſhall go after ſuch Reflexion or Refraction.

On the Surface of the Water *r s*, and in the Point *c*, I erect the Perpendicular *c p*, and produce it downwards to *q*. Knowing therefore that the Ray after Reflexion or Refraction will be found ſomewhere in the Plane of the Angle of *Incidence a c p* produced: I let fall the Sine of that Angle (*viz. a d*) on the Perpendicular *p c*; and then if the Reflected Ray be ſought, I produce *a d* to *b*, ſo that *d b* = *a d*, and draw *c b*, which ſhall be the Reflected Ray, becauſe the Angle of Reflexion and its Sine, are equal to the Angle and Sine of *Incidence*, as they ought to be. But if the Refracted Ray had been ſought, I produce *a d* to *h*; ſo that *d h* may be to *a d*, As the Sine of Refraction To that of *Incidence*; *i. e.* As 3 To 4. Then with the Radius *a c*, deſcribing the Circle *a b e*, and in the Plane *a c p*, I draw the Line *h e* parallel to *p q*, and cutting the Circumference in *e*: Then drawing *c e*, that ſhall *be the Refracted Ray*. For if *e f* be let fall perpendicularly on the Line *p q*, it ſhall be the Sine of the Angle of Refraction of the Ray *c e*; and this Sine is equal *d h*, and conſequently in proportion to the Sine of the Angle of *Incidence a d*, As 3 To 4.




INCIDENT, in the Law, ſignifies a thing neceſſarily depending upon another, as more principal. Thus a *Court Baron* is ſo *Incident* to a Mannor, and a Court of *Pie-Powdre*, that they cannot be ſevered in a Grant of a Mannor or *Fair*, but muſt go along with it.

INCLINED *Plane*. If a Body, as *B*, be partly ſupported by the Inclined Plane *A C*, and partly by the Power *R* acting on a Direction parallel to the Plane *A C*. Then that Power *R*: Is to the Body or Weight *B*:: As the Sine of the Angle of the Plane's Inclination *A C B*: Is to the Radius *C A*. *C D*, *A D*, *G F*, *E D*, and *H F*, being drawn as in the Figure. The Body *B* will be ſuſtain'd as it were by three Forces or Powers, all acting according to different Directions, and in *Æquilibrio* to one another. The Firſt of which is the *Force of Gravity*; expreſſed by *B E* perpendicular to the Horizon *C D*. The Second, the Power *R*, according to the Direction *B R* parallel to the Plane *A C*. And the Third is ſupply'd by the Reſiſtance or Contranitence of the Plane *A C*; and is expreſs'd by *B H* perpendicular thereunto. For Action and Re-action being equal, and one acting directly contrary to the other; the Plane which is preſſed by the Body or Weight *B*, according to the Direction of the Perpendicnlar *H B*, muſt act on that Body by a contrary Direction, *viz.* that of *F B* or *B H*. And ſince theſe three Powers are all mutually *in Æquilibrio*, and that the Body *B* is ſuſtained by them, 'tis plain (when *G F* is drawn perpendicular to *C D*, or parallel to *B E*) that the Force of Gravity will be expreſſed



by $G F$; and that the Power $R$ : To the Power of Gravity :: Will be as $G B$: To $G F$: But in the Right-angled Triangle $C F G$ ($F B$ being a Perpendicular to the Baſe $C G$) $B G : G F :: G F : G C$; and as $F G : G C :: A D : A C$: (by Similar Triangles;) wherefore the Power $R$: Is to the Force of Gravity :: As $A D$: To $A C$; or as the Sine of the Angle of Inclination to the Radius. *Q. E. D.*

### *COROLLARY* I.

Wherefore the Force by which any heavy Body wou'd deſcend on any Inclined Plane to the Force of the Deſcent in the Perpendicular, is as the Sine of the Angle of the Plane's Inclination to the Radius.

### *COROLLARY* II.

Frome hence alſo it follows, that the Inclination of the Plane may be ſo little, that the greateſt Weight may be ſuſtain'd on it by the leaſt Power.

For Practice therefore, Let the Weight of any Body be $W$, and $P$ the Power wanted to ſuſtain it on an Inclined Plane.

I ſay, by this Theorem, $R : W :: S$ Incl. : $P$. That is, As Radius is to the Weight : : So is the Sine of the Angle of the Plane's Inclination to the Horizon : To the Power ſought. The three firſt of which are given : Wherefore the Fourth is known. *Trigon. Calculation. E. G.* Let a Body weigh 9999 Pound; What Power will ſuſtain it from deſcending on a Plane inclined to the Horizon with an Angle of 34 Degrees? Anſwer, 5590 Pound weight.

See the Work.

$R = 10.$

| | |
|---|---|
| Weight 9999. | 3.999957 |
| $S$, $\angle$ Incl. $= 34°$. | 9.747562 |

$Z - R = 3.747419 = 5590$ *Ferè.*

INCOMBUSTIBLE *Cloth*, is a ſort of very odd Linen, made from a Stone in the form of a Talk; and call'd *Lapis Ammanthus* and *Asbeſto's*, *Alumen Plumoſum*, *Polia*, *Corsbides*, *Sparta Polia*, *&c.* 'Tis found in many Places in *China*, *Italy*, and *Wales*; and I have had a very clean ſort, which would part into pretty long Threads, which was found in *Scotland*. The *Incombuſtible Cloth* made from this Mineral, is called *Linum Vivum*, *Linum Foſſile*, *Linum Indicum*, *Creticum*, *Cypricum*, *&c.* from the Places where 'tis found. This was of ſuch eſteem among the Ancients, as to be rank'd (as Dr. *Plot* tells us) with the moſt precious Pearls: And in *China* a piece of it but $23\frac{1}{4}$ Inches long was valued at 80 *Tale*, *i. e.* 36 *l.* 13 *s.* 4 *d.* *Pliny* tells us expreſly, and of his own Knowledge, That Napkins of this Cloth being taken foul from the Table at a great Feaſt, where he was a Gueſt, were caſt into the Fire, and by that means came out fairer and cleaner than if they had been waſh'd in Water. *Marco Antonio Caſtagna*, Superintendent of ſome Mines in *Italy*, ſaith (in *Phil. Tranſ.* N. 72.) that cauſing a kind of Paper to be made of ſome of the *Amianthus* which he found there; it would abide longer in the Fire without being conſumed than Plates of the hardeſt and moſt ſolid Metal; which would have ſcaled off in Flakes with a much leſs Heat. Mr. *Edward Lloyd* alſo, in *Numb.* 166. gives an Account of ſome that he found in *Wales*, which remain'd in the Fire above a Quarter of an Hour without any Signs of being conſumed.

But in two Trials which were made before the Royal Society of a Piece of this Cloth of a Foot long, and half a Foot broad, and weighing about an Ounce and half; it was found to loſe in a ſtrong Fire, where it continued for ſeveral Minutes, above a Dram of its Weight at a time.

Of this Cloth, as *Pliny* informs us, Shrouds were anciently made, and uſed at *Royal Obſequies*, to wrap up the Corps in, that the Aſhes of their Bodies might be preſerved diſtinct from thoſe of the Wood, which conſtituted the Funeral Pile. And we are aſſured, that the Princes of *Tartary* uſe it for the ſame purpoſe to this Day. And ſome of the antient *Indian Brachmans* are ſaid to have made themſelves Cloaths of it. They tell us alſo, that the *Wicks* for the Antients *Perpetual Lamps* (if there were any ſuch thing) were made of the Threads of this *Alumen Plumoſum*, or *Asbeſton*.

*Marcus Paulus Venetus* acquaints us, That one *Curficar* a *Turk*, a Superintendent of the Mines in the *Tartarian* Province of *Chinchinthalas*, aſſured him that they firſt dried this Mineral (found there in a certain Mountain) in the Sun; then pounded it in a Braſs Mortar, to ſeparate the Earthy part from it; and that afterwards it was alſo waſhed from all remaining Filth; and then was ſpun into Threads like Wool, and afterwards woven into Cloth; which, ſaid he, when ſpotted or foul they cleanſe by throwing it into the Fire for an Hour's time, whence it comes out unhurt, and as white as Snow.

INCOMPOSITE *Numbers*, are the ſame with thoſe *Euclid* calls *Prime Numbers*. In Dr. *Pell's* Edition of *Brancker's Algebra*, there is a Table, as it's there called, of *Incompoſite Numbers*, leſs than 100000; tho' it contains far more *Compoſite* than *Incompoſite Numbers*: For it doth not only give an orderly Enumeration of all Odd Numbers which are *not Compoſite*; but it ſhews alſo that none of the reſt are ſo. This Table being of very great uſe, I have here placed. It hath 21 Columns throughout; whereof the firſt contains 40 *Odd Numbers* in their natural Order. The following Columns are diſtinguiſhed on their Tops, by their Numbers, in their natural Order; as 0, 1, 2, 3, *&c.* and ſo on to 99999. Theſe *Top Numbers* are *Hundreds*; and the 40 Marginal Numbers are Unites adhering to thoſe Hundreds. A Line running from any of the *Marginal*, as he calls them (or Numbers in the firſt Column) acroſs the Page, ſhews in any intermediate Column, the Place of the Number made up of the Top Number and that *Marginal*. In every ſuch place of Concourſe, you ſhall either find the Letter p, or ſome Prime Number leſs than 317. If p be there, it ſhews the Number to be a Prime or Incompoſite. The whole Table conſiſts of 50 Pages, or ſo many ſeveral Tables, number'd: In ſome *one* of which, if any Number be leſs than 100000, and do end either in 1, 3, 7, or 9, you may find its Place; and then ſee whether it be a Prime or not. If it be not a *Prime*, but *Compoſite*, you will there find its *leaſt Diviſor*. Thus for inſtance, in Table I. where the Lin'd mark'd with the Marginal

Marginal 67, croſſes the Column which hath 16 at the Top, there you find the Letter p, which ſhews you that 1667 is a Prime or *Incompoſite Number*. But where that Line croſſes the next Column, you find 3, which ſhews you that 1767 is not a *Prime* but *Compoſite* Number; and that 3 is its leaſt Diviſor. So alſo in *Table* XXV. you ſee that 49031, 49033, and 49037 are all Prime or Incompoſite Numbers: But 49039 is a Compoſite, and 19 is its *leaſt Diviſor*.

It will oſtentimes be of very great uſe to have, as you may have here, a compleat orderly Enumeration of all Prime or Incompoſite Numbers between 0, and 100.000, without any mixture of Compoſites; as the p's in theſe Tables will give you, leaving out 9, 21, *&c.* and all other Compoſites. 'Tis true that 2 and 5 are Incompoſite Numbers, as well as 1 and 3; but they are not put into the Tables, becauſe no other Incompoſite Numbers can terminate in them: For if any Number end in 12, it may be halved; if in 5, it may be divided by 5.

If to each of theſe Primes you ſet the *Briggian Logarithm*, you may find the Logarithm for all the reſt of the Numbers in the firſt Hundred Chiliads, by addition of the Logarithms of their Incompoſite Factors.

In perplex'd Queſtions in Algebra it is oftentimes neceſſary to be able to determine how many *aliquot Parts* and *Diviſors* any propoſed Quantity or Number may have, for which Purpoſe theſe Tables are of excellent uſe.

Every Aliquot Part of a Number is one of its juſt Diviſors; but the *greateſt Diviſor* being equal to the *whole* Dividend, cannot be called a Part.

If you have the leaſt Diviſor of any Number in theſe Tables of Incompoſites, you may find all its other Incompoſites Co-efficients.

For if the Diviſor end in 1 or 9, and have a black Stroke *under* it, in the Dividend's place in the Tables; or if the Diviſor end in 3 or 7, and have ſuch a Stroke *over* it in the Dividend's place; then the Dividend is the *Square* of an Incompoſite, and conſequently the *Quotient* is given, being *equal* to the Diviſor.

If the leaſt Diviſor hath no ſuch Stroke by it, let it divide the Number propoſed; ſo ſhall the Quotient be the greateſt *Aliquot Part* of that Dividend. Then ſeek that Quotient it ſelf alſo in the Tables; if you find it there marked with p, it is a *Prime* or *Incompoſite*, and you can proceed no further; your Enquiry is at an end.

Thus the Number 53191 is found in *Table* XXVII. with its ſmalleſt Diviſor 43; and being divided by that 43, the Quotient is 1237. And in *Table* I. finding 1237 to be a Prime Number, I proceed no further.

But had the Number been 93611, you will find in *Table* XLVII. that 7 is its leaſt Diviſor; and that the Quotient will be 13373. This ſtands in *Table* VII. with 43 for its leaſt Diviſor, and the Quotient will be 311; which in *Table* I. I find to be an Incompoſite: I conclude therefore, that the prime Co-efficients of 93611 are 7, 43, and 311.

If you divide any Odd Number by all the Primes in order, beginning with 3: Then the firſt Diviſor that finds a Quotient without Fraction, is the leaſt Diviſor that Dividend can have. If no ſuch Diviſor find an Integer Quotient, before the Quotient becomes leſs than the Diviſor, you may pronounce your Dividend to be *Incompoſite*; and that that laſt Diviſor is greater than the Square Root alſo of the Dividend.

Frequent occaſion of dividing by Incompoſites requires a *Tariffa* of as many *Primes* as ſhall be needful; but for reſolving of Numbers leſs than 100000, it ſufficeth if it be extended to 313. And ſuch an one you have at the Beginning of theſe Tables of *Incompoſite Numbers*.

# A
# TABLE
OF
# Incompoſit Numbers,
## Leſs than 100000.

## *The* TARIFFA *or* Table *of all* INCOMPOSITS, *less than* √ 10000, *Multiplied by* 2, 3, 4, 5, 6, 7, 8, 9.

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 5 | 7 | 11 | 13 | 17 | 19 | 23 | 29 | 31 | 37 | 41 | 43 | 47 | 53 | 59 | 61 | 67 | 71 | 73 |
| 2 | 4 | 6 | 10 | 14 | 22 | 26 | 34 | 38 | 46 | 58 | 62 | 74 | 82 | 86 | 94 | 106 | 118 | 122 | 134 | 142 | 146 |
| 3 | 6 | 9 | 15 | 21 | 33 | 39 | 51 | 57 | 69 | 87 | 93 | 111 | 123 | 129 | 141 | 159 | 177 | 183 | 201 | 213 | 219 |
| 4 | 8 | 12 | 20 | 28 | 44 | 52 | 68 | 76 | 92 | 116 | 224 | 148 | 164 | 172 | 188 | 212 | 236 | 244 | 268 | 284 | 292 |
| 5 | 10 | 15 | 25 | 35 | 55 | 65 | 85 | 95 | 115 | 145 | 155 | 185 | 205 | 215 | 235 | 265 | 295 | 305 | 335 | 355 | 365 |
| 6 | 12 | 18 | 30 | 42 | 66 | 78 | 102 | 114 | 138 | 174 | 186 | 222 | 246 | 258 | 282 | 318 | 354 | 366 | 402 | 426 | 438 |
| 7 | 14 | 21 | 35 | 49 | 77 | 91 | 119 | 133 | 161 | 203 | 217 | 259 | 287 | 301 | 329 | 371 | 413 | 427 | 469 | 497 | 511 |
| 8 | 16 | 24 | 40 | 56 | 88 | 104 | 136 | 152 | 184 | 232 | 248 | 296 | 328 | 344 | 376 | 424 | 472 | 488 | 536 | 568 | 584 |
| 9 | 18 | 27 | 45 | 63 | 99 | 117 | 153 | 171 | 207 | 261 | 279 | 333 | 369 | 387 | 423 | 477 | 531 | 549 | 603 | 639 | 657 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 79 | 83 | 89 | 97 | 101 | 103 | 107 | 109 | 113 | 127 | 131 | 137 | 139 | 149 | 151 | 157 |
| 2 | 158 | 166 | 178 | 194 | 202 | 206 | 214 | 218 | 226 | 254 | 262 | 274 | 278 | 298 | 302 | 314 |
| 3 | 237 | 249 | 267 | 291 | 303 | 309 | 321 | 327 | 339 | 381 | 393 | 411 | 417 | 447 | 453 | 471 |
| 4 | 316 | 332 | 256 | 388 | 404 | 412 | 428 | 436 | 452 | 508 | 524 | 548 | 556 | 596 | 604 | 628 |
| 5 | 395 | 415 | 445 | 485 | 505 | 515 | 535 | 545 | 565 | 635 | 655 | 685 | 695 | 745 | 755 | 785 |
| 6 | 474 | 498 | 534 | 582 | 606 | 618 | 642 | 654 | 678 | 762 | 786 | 822 | 834 | 894 | 906 | 942 |
| 7 | 553 | 581 | 623 | 679 | 707 | 721 | 749 | 763 | 791 | 889 | 917 | 959 | 973 | 1043 | 1057 | 1099 |
| 8 | 632 | 664 | 712 | 776 | 808 | 824 | 856 | 872 | 904 | 1016 | 1048 | 1096 | 1112 | 1192 | 1208 | 1256 |
| 9 | 711 | 747 | 801 | 873 | 909 | 927 | 963 | 981 | 1017 | 1143 | 1179 | 1233 | 1251 | 1341 | 1359 | 1413 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 163 | 167 | 173 | 179 | 181 | 191 | 193 | 197 | 199 | 211 | 223 | 227 | 229 | 233 |
| 2 | 326 | 334 | 346 | 358 | 362 | 382 | 386 | 394 | 398 | 422 | 446 | 454 | 458 | 466 |
| 3 | 489 | 501 | 519 | 537 | 543 | 573 | 579 | 591 | 597 | 633 | 669 | 681 | 687 | 699 |
| 4 | 652 | 668 | 692 | 716 | 724 | 764 | 772 | 788 | 796 | 844 | 892 | 908 | 916 | 932 |
| 5 | 815 | 835 | 865 | 895 | 905 | 955 | 965 | 985 | 995 | 1055 | 1115 | 1135 | 1145 | 1165 |
| 6 | 978 | 1002 | 1038 | 1074 | 1086 | 1146 | 1158 | 1182 | 1194 | 1266 | 1338 | 1362 | 1374 | 1398 |
| 7 | 1141 | 1169 | 1211 | 1253 | 1267 | 1337 | 1351 | 1379 | 1393 | 1477 | 1561 | 1589 | 1603 | 1631 |
| 8 | 1304 | 1336 | 1384 | 1432 | 1448 | 1528 | 1544 | 1576 | 1592 | 1688 | 1784 | 1816 | 1832 | 1864 |
| 9 | 1467 | 1503 | 1557 | 1611 | 1629 | 1719 | 1737 | 1773 | 1791 | 1899 | 2007 | 2043 | 1061 | 2097 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 239 | 241 | 251 | 257 | 263 | 269 | 271 | 277 | 281 | 283 | 293 | 307 | 311 | 313 |
| 2 | 478 | 482 | 502 | 544 | 526 | 538 | 542 | 554 | 562 | 566 | 586 | 614 | 622 | 626 |
| 3 | 717 | 723 | 753 | 771 | 789 | 807 | 813 | 831 | 843 | 849 | 879 | 921 | 933 | 939 |
| 4 | 956 | 964 | 1004 | 1028 | 1052 | 1076 | 1084 | 1108 | 1124 | 1132 | 1172 | 1228 | 1244 | 1252 |
| 5 | 1195 | 1205 | 1255 | 1285 | 1315 | 1345 | 1355 | 1385 | 1405 | 1415 | 1465 | 1535 | 5555 | 1565 |
| 6 | 1434 | 1446 | 1506 | 1542 | 1578 | 1614 | 1626 | 1662 | 1686 | 1698 | 1758 | 1842 | 1866 | 1878 |
| 7 | 1673 | 1687 | 1757 | 1799 | 1841 | 1883 | 1897 | 1939 | 1967 | 1981 | 2051 | 2149 | 2177 | 2191 |
| 8 | 1912 | 1928 | 2008 | 2056 | 2104 | 2152 | 2168 | 2216 | 2248 | 2264 | 2344 | 2456 | 2488 | 2504 |
| 9 | 2151 | 2169 | 2259 | 2313 | 2367 | 2421 | 2439 | 2493 | 2529 | 2547 | 2637 | 2763 | 2799 | 2817 |

# INCOMPOSITS.

## TAB. I.

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 1. p | p | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | p | p | 3 | 19 | p | 3 | p | p |
| 03 | p | p | 7 | 3 | 13 | p | 3 | 19 | 11 | 3 | 17 | p | 3 | p | 23 | 3 | 7 | 13 | 3 | 11 |
| 07 | p | p | 3 | p | 11 | 3 | p | 7 | 3 | p | 19 | 3 | 17 | p | 3 | 11 | p | 3 | 13 | p |
| 09 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 23 |
| 11 | p | 3 | p | p | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 17 | p | 3 | 29 | p | 3 |
| 13 | p | p | 3 | p | 7 | 3 | p | 23 | 3 | 11 | p | 3 | p | 13 | 3 | 17 | p | 3 | 7 | p |
| 17 | p | 3 | 7 | p | 3 | 11 | p | 3 | 19 | 7 | 3 | p | p | 3 | 13 | 37 | 3 | 17 | 23 | 3 |
| 19 | p | 7 | 3 | 11 | p | 3 | p | p | 3 | p | p | 3 | 23 | p | 3 | 7 | p | 3 | 17 | 19 |
| 21 | 3 | 11 | 13 | 3 | p | p | 3 | 7 | p | 3 | p | 19 | 3 | p | 7 | 3 | p | p | 3 | 17 |
| 23 | p | 3 | p | 17 | 3 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | p | p | 3 | p | p | 3 |
| 27 | 3 | p | p | 3 | 7 | 17 | 3 | p | p | 3 | 13 | 7 | 3 | p | p | 3 | p | 11 | 3 | 41 |
| 29 | p | 3 | p | 7 | 3 | 23 | 17 | 3 | p | p | 3 | p | p | 3 | p | 11 | 3 | 7 | 31 | 3 |
| 31 | p | p | p | p | p | 3 | p | 17 | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | p | p |
| 33 | 3 | 7 | 3 | 3 | p | 13 | 3 | p | 7 | 3 | p | 11 | 3 | 31 | p | 3 | 23 | p | 3 | p |
| 37 | p | p | p | p | 19 | 3 | 7 | 11 | 3 | p | 17 | 3 | p | 7 | 3 | 29 | p | 3 | 11 | 13 |
| 39 | 3 | p | 3 | 3 | p | 7 | 3 | p | p | 3 | p | 17 | 3 | 13 | p | 3 | 11 | 37 | 3 | 7 |
| 41 | p | 3 | p | 11 | 3 | p | p | 3 | 29 | p | 3 | 7 | 17 | 3 | 11 | 23 | 3 | p | 7 | 3 |
| 43 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | 23 | 7 | 3 | 11 | 17 | 3 | p | 31 | 3 | 19 | 29 |
| 47 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | p | 3 | 31 | 29 | 3 | p | 7 | 3 | p | p | 3 |
| 49 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | 13 | p | 3 | p | 19 | 3 | p | 17 | 3 | 43 | p |
| 51 | 3 | p | p | 3 | 11 | 19 | 3 | p | 23 | 3 | p | p | 3 | 7 | p | 3 | 13 | 17 | 3 | p |
| 53 | p | 3 | 11 | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | p | p | 3 | p | 17 | 3 |
| 57 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 7 | 13 | 3 | 23 | 31 | 3 | p | 7 | 3 | 19 |
| 59 | p | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 19 | p | 3 | p | p | 3 | p | 11 | 3 |
| 61 | p | 7 | 3 | 19 | p | 3 | p | p | 3 | 31 | p | 3 | 13 | p | 3 | 7 | 11 | 3 | p | 37 |
| 63 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 29 | 7 | 3 | p | 41 | 3 | 13 |
| 67 | p | p | 3 | p | p | 3 | 23 | 13 | 3 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 69 | 3 | 13 | p | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 37 | 13 | 3 | p | 29 | 3 | 11 |
| 71 | p | 3 | p | 7 | 3 | p | 11 | 3 | 13 | p | 3 | p | 31 | 3 | p | p | 3 | 7 | p | 3 |
| 73 | p | p | 3 | p | 11 | 3 | p | p | 3 | 7 | 29 | 3 | 19 | p | 3 | 11 | 7 | 3 | p | p |
| 77 | 7 | 3 | p | 13 | 3 | p | p | 7 | p | p | 3 | 11 | p | 3 | 7 | 19 | 3 | p | p | 3 |
| 79 | p | p | 3 | p | p | 3 | 7 | 19 | 3 | 11 | 13 | 3 | p | 7 | 3 | p | 23 | 3 | p | p |
| 81 | 3 | p | p | 3 | 13 | 7 | 3 | 11 | p | 3 | 23 | p | 3 | p | p | 3 | 41 | 13 | 3 | 7 |
| 83 | p | 3 | p | p | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 87 | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 19 | p | 3 | 7 | p | 3 | p |
| 89 | p | 3 | 17 | p | 3 | 19 | 13 | 3 | 7 | 23 | 3 | 29 | p | 3 | p | 7 | 3 | p | p | 3 |
| 91 | 7 | p | 3 | 17 | p | 3 | p | 7 | 3 | p | p | 3 | p | 13 | 3 | 37 | 19 | 3 | 31 | 11 |
| 93 | 3 | p | p | 3 | 17 | p | 3 | 13 | 19 | 3 | p | p | 3 | 7 | p | 3 | p | 11 | 3 | p |
| 97 | p | p | 3 | p | 7 | 3 | 17 | p | 3 | p | p | 3 | p | 11 | 3 | p | p | 3 | 7 | p |
| 99 | 3 | p | 13 | 3 | p | p | 3 | 17 | 29 | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p |

# INCOMPOSITS.

## TAB. II.

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 11 | 31 | 3 | 7 | 41 | 3 | 37 | P | 3 | P | 7 | 3 | P | 19 | 3 | 13 | P | 3 | 47 |
| 03 | P | 3 | P | 7 | 3 | P | 19 | 3 | P | P | 3 | 29 | P | 3 | 41 | 31 | 3 | 7 | P | 3 |
| 07 | 3 | 7 | P | 3 | 29 | 23 | 3 | P | 7 | 3 | 31 | 13 | 3 | P | P | 3 | P | 11 | 3 | P |
| 09 | 7 | 3 | 47 | P | 3 | 13 | P | 3 | 53 | P | 3 | P | P | 3 | 7 | 11 | 3 | P | 13 | 3 |
| 11 | P | P | 3 | P | P | 3 | 7 | P | 3 | 41 | P | 3 | 13 | 7 | 3 | P | 23 | 3 | 37 | P |
| 13 | 3 | P | P | 3 | 19 | 7 | 3 | P | 29 | 3 | 23 | 11 | 3 | P | P | 3 | P | 47 | 3 | 7 |
| 17 | P | 29 | 3 | 7 | P | 3 | P | 11 | 3 | P | 7 | 3 | P | 31 | 3 | P | P | 3 | 11 | P |
| 19 | 3 | 13 | 7 | 3 | 41 | 11 | 3 | P | P | 3 | P | P | 3 | P | 13 | 3 | 7 | P | 3 | P |
| 21 | 43 | 3 | P | 11 | 3 | P | P | 3 | 7 | 23 | 3 | P | P | 3 | 11 | 7 | 3 | 61 | P | 3 |
| 23 | 7 | 11 | 3 | 23 | P | 3 | 43 | 7 | 3 | 37 | P | 3 | 11 | P | 3 | 13 | P | 3 | P | P |
| 27 | P | 3 | 17 | 13 | 3 | 7 | 37 | 3 | 11 | P | 3 | 53 | 7 | 3 | 23 | P | 3 | P | 43 | 3 |
| 29 | P | P | 3 | 17 | 7 | 3 | 11 | P | 3 | 29 | 13 | 3 | P | P | 3 | P | 19 | 3 | 7 | P |
| 31 | 3 | P | 23 | 3 | 11 | P | 3 | P | 19 | 3 | 7 | 31 | 3 | P | 47 | 3 | P | 7 | 3 | P |
| 33 | 19 | 3 | 7 | P | 3 | 17 | P | 3 | P | 7 | 3 | 13 | 53 | 3 | P | P | 3 | P | P | 3 |
| 37 | 3 | P | P | 3 | P | 43 | 3 | 7 | P | 3 | P | P | 3 | 47 | 7 | 3 | P | 37 | 3 | 31 |
| 39 | P | 3 | P | P | 3 | P | 7 | 3 | 17 | P | 3 | 43 | 41 | 3 | 19 | P | 3 | P | 11 | 3 |
| 41 | 13 | P | 3 | P | P | 3 | 19 | P | 3 | 17 | P | 3 | 7 | 13 | 3 | P | 11 | 3 | 23 | 7 |
| 43 | 3 | P | P | 3 | 7 | P | 3 | 13 | P | 3 | 17 | 7 | 3 | P | 11 | 3 | P | 19 | 3 | P |
| 47 | 23 | 19 | 3 | P | P | 3 | P | 41 | 3 | 7 | 11 | 3 | 17 | P | 3 | P | 7 | 3 | P | P |
| 49 | 3 | 7 | 13 | 3 | 31 | P | 3 | P | 7 | 3 | P | 47 | 3 | 17 | P | 3 | 41 | 23 | 3 | 11 |
| 51 | 7 | 3 | P | P | 3 | P | 11 | 3 | P | 13 | 3 | 23 | P | 3 | 7 | 53 | 3 | 11 | P | 3 |
| 53 | P | P | 3 | 13 | 11 | 3 | 7 | P | 3 | P | 43 | 3 | P | 7 | 3 | 11 | 13 | 3 | P | 59 |
| 57 | 11 | 3 | 37 | P | 3 | P | P | 3 | P | P | 3 | 7 | P | 3 | P | P | 3 | 13 | 7 | 3 |
| 59 | 29 | 17 | 3 | 7 | P | 3 | P | 31 | 3 | 11 | 7 | 3 | P | P | 3 | P | P | 3 | 17 | 37 |
| 61 | 3 | P | 7 | 3 | 23 | 13 | 3 | 11 | P | 3 | P | 29 | 3 | P | P | 3 | 7 | P | 3 | 17 |
| 63 | P | 3 | 31 | 17 | 3 | 11 | P | 3 | 7 | P | 3 | P | 13 | 3 | P | 7 | 3 | 53 | P | 3 |
| 67 | 3 | 11 | P | 3 | P | 17 | 3 | P | 47 | 3 | P | P | 3 | 7 | P | 3 | 19 | P | 3 | P |
| 69 | P | 3 | P | 23 | 3 | 7 | 17 | 3 | 19 | P | 3 | P | 7 | 3 | P | 43 | 3 | P | 53 | 3 |
| 71 | 19 | 13 | 3 | P | 7 | 3 | P | 17 | 3 | P | 37 | 3 | P | P | 3 | P | P | 3 | 7 | 11 |
| 73 | 3 | 41 | P | 3 | P | 31 | 3 | 47 | 13 | 3 | 7 | 19 | 3 | P | 23 | 3 | P | 7 | 3 | 29 |
| 77 | 31 | 7 | 3 | P | P | 3 | P | P | 3 | 13 | 17 | 3 | 29 | 11 | 3 | 7 | P | 3 | P | 41 |
| 79 | 3 | P | 43 | 3 | 37 | P | 3 | 7 | P | 3 | P | 11 | 3 | 31 | 7 | 3 | 13 | P | 3 | 23 |
| 81 | P | 3 | P | P | 3 | 29 | 7 | 3 | 43 | 11 | 3 | P | 17 | 3 | 59 | P | 3 | 19 | P | 3 |
| 83 | P | 37 | 3 | P | 13 | 3 | P | 11 | 3 | 19 | P | 3 | 7 | 17 | 3 | P | 29 | 3 | 11 | 7 |
| 87 | P | 3 | P | 7 | 3 | 13 | P | 3 | P | 29 | 3 | P | 19 | 3 | 11 | 17 | 3 | 7 | 13 | 3 |
| 89 | P | 11 | 3 | P | 19 | 3 | P | P | 3 | 7 | P | 3 | 11 | P | 3 | 37 | 7 | 3 | P | P |
| 91 | 3 | 7 | 29 | 3 | 47 | P | 3 | P | 7 | 3 | 11 | P | 3 | P | P | 3 | P | 17 | 3 | 13 |
| 93 | 7 | 3 | P | P | 3 | P | P | 3 | 11 | 41 | 3 | 31 | 37 | 3 | 7 | P | 3 | P | 17 | 3 |
| 97 | 3 | 13 | P | 3 | 11 | 7 | 3 | P | P | 3 | 19 | 23 | 3 | 43 | 13 | 3 | 1 | P | 3 | 7 |
| 99 | P | 3 | 11 | P | 3 | 23 | P | 3 | 13 | P | 3 | 7 | P | 3 | P | 59 | 3 | 29 | 7 | 3 |

# INCOMPOSITS.

## TAB. III.

| | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 3 | p | 11 | 3 | 7 | 43 | 3 | p | 13 | 3 | p | 7 | 3 | 11 | p | 3 | p | p | 3 |
| 03 | p | 11 | 3 | 13 | 7 | 3 | p | p | 3 | p | p | 3 | 11 | p | 3 | p | 13 | 3 | 7 | p |
| 07 | p | 3 | 7 | 59 | 3 | p | 17 | 3 | 11 | 7 | 3 | p | 41 | 3 | p | p | 3 | 13 | p | 3 |
| 09 | 19 | 7 | 3 | 31 | p | 3 | 11 | 17 | 3 | p | p | 3 | p | p | 3 | 7 | 71 | 3 | 37 | 19 |
| 11 | 3 | p | p | 3 | 11 | 13 | 3 | 7 | 17 | 3 | p | 19 | 3 | 47 | 7 | 3 | 31 | p | 3 | 23 |
| 13 | p | 3 | 11 | 19 | 3 | p | 7 | 3 | p | 17 | 3 | p | 13 | 3 | p | 37 | 3 | 29 | p | 3 |
| 17 | 3 | 23 | p | 3 | 7 | p | 3 | 53 | p | 3 | 29 | 7 | 3 | 13 | p | 3 | 41 | p | 3 | 61 |
| 19 | p | 3 | p | 7 | 3 | p | 31 | 3 | 61 | p | 3 | p | 17 | 3 | p | p | 3 | 7 | 11 | 3 |
| 21 | p | 13 | 3 | 29 | p | 3 | p | p | 3 | 7 | p | 3 | 23 | 17 | 3 | p | 7 | 3 | p | 31 |
| 23 | 3 | 7 | 41 | 3 | p | p | 3 | p | 7 | 3 | p | 47 | 3 | p | 11 | 3 | p | 59 | 3 | p |
| 27 | p | p | 3 | p | 19 | 3 | 7 | 29 | 3 | 13 | 11 | 3 | p | 7 | 3 | p | 17 | 3 | p | p |
| 29 | 3 | p | p | 3 | 43 | 7 | 3 | p | 11 | 3 | 47 | 23 | 3 | 73 | 61 | 3 | 13 | 17 | 3 | 7 |
| 31 | 29 | 3 | p | 61 | 3 | 23 | 11 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 |
| 33 | 37 | p | 3 | 7 | 11 | 3 | 41 | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 43 | 3 | 19 | 17 |
| 37 | 11 | 3 | 19 | p | 3 | 13 | p | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | p | 13 | 3 |
| 39 | 7 | p | 3 | p | 23 | 3 | p | 7 | 3 | 11 | p | 3 | 13 | 19 | 3 | 29 | p | 3 | p | p |
| 41 | 3 | 41 | p | 3 | p | 19 | 3 | 11 | 47 | 3 | 71 | 53 | 3 | 7 | p | 3 | p | p | 3 | 13 |
| 43 | 13 | 3 | p | 43 | 3 | 7 | p | 3 | 29 | p | 3 | 37 | 7 | 3 | p | 23 | 3 | p | p | 3 |
| 47 | 3 | 11 | 31 | 3 | p | p | 3 | 47 | 37 | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | 19 |
| 49 | p | 3 | 7 | p | 3 | p | p | 3 | 13 | 7 | 3 | 19 | 29 | 3 | p | 31 | 3 | p | p | 3 |
| 51 | p | 7 | 3 | 19 | p | 3 | p | p | 3 | p | p | 3 | 59 | p | 3 | 7 | p | 3 | p | 11 |
| 53 | 3 | p | p | 3 | 61 | 29 | 3 | 7 | 23 | 3 | 31 | p | 3 | 53 | 7 | 3 | p | 11 | 3 | p |
| 57 | p | p | 3 | p | p | 3 | p | 67 | 3 | p | 13 | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 |
| 59 | 3 | p | p | 3 | 7 | 47 | 3 | p | 43 | 3 | p | 7 | 3 | 23 | 53 | 3 | p | 13 | 3 | 59 |
| 61 | 31 | 3 | p | 7 | 3 | p | 59 | 3 | p | 11 | 3 | 13 | p | 3 | 43 | 67 | 3 | 7 | p | 3 |
| 63 | 17 | 23 | 3 | p | p | 3 | p | 11 | 3 | 7 | 61 | 3 | 19 | 31 | 3 | p | 7 | 3 | 11 | 67 |
| 67 | 7 | 3 | 17 | 11 | 3 | p | 13 | 3 | 31 | p | 3 | p | 23 | 3 | 7 | 19 | 3 | 73 | p | 3 |
| 69 | 13 | 11 | 3 | 17 | 41 | 3 | 7 | 19 | 3 | p | 37 | 3 | 11 | 7 | 3 | p | p | 3 | p | 47 |
| 71 | 3 | 43 | p | 3 | 17 | 7 | 3 | 13 | p | 3 | 11 | p | 3 | 41 | p | 3 | 53 | 29 | 3 | 7 |
| 73 | p | 3 | p | p | 3 | 17 | p | 3 | 11 | p | 3 | 7 | p | 3 | 13 | p | 3 | 23 | 7 | 3 |
| 77 | 3 | p | 7 | 3 | 11 | 23 | 3 | 17 | p | 3 | p | 31 | 3 | 19 | p | 3 | 7 | 53 | 3 | 43 |
| 79 | p | 3 | 11 | 29 | 3 | 19 | p | 3 | 7 | 13 | 3 | p | p | 3 | p | p | 3 | p | p | 3 |
| 81 | 7 | 37 | 3 | 13 | p | 3 | 31 | 7 | 3 | 17 | p | 3 | p | p | 3 | p | 13 | 3 | p | p |
| 83 | 3 | 47 | p | 3 | p | p | 3 | p | 19 | 3 | 13 | 71 | 3 | 7 | p | 3 | p | p | 3 | 31 |
| 87 | 61 | 53 | 3 | 41 | 7 | 3 | 43 | p | 3 | p | p | 3 | 17 | p | 3 | 37 | 11 | 3 | 7 | p |
| 89 | 3 | 59 | p | 3 | 67 | 13 | 3 | p | p | 3 | 7 | p | 3 | 17 | 11 | 3 | p | 7 | 3 | 53 |
| 91 | p | 3 | 7 | p | 3 | p | p | 3 | 67 | 7 | 3 | 29 | 11 | 3 | 17 | p | 3 | p | 43 | 3 |
| 93 | p | 7 | p | 23 | p | 3 | 13 | p | 3 | p | 11 | 3 | 67 | p | 3 | 7 | p | 3 | 71 | 13 |
| 97 | 17 | 3 | 3 | p | 3 | p | 7 | 3 | 59 | 19 | 3 | p | p | 3 | 23 | 29 | 3 | 11 | p | 3 |
| 99 | p | 13 | p | 53 | 11 | 3 | 37 | p | 3 | p | p | 3 | 7 | p | 3 | 11 | 41 | 3 | 17 | 7 |

# INCOMPOSITS.

## TAB. IV.

| | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 17 | p | 3 | p | 37 | 3 | 7 | p | 3 | 67 | p | 3 | 19 | 7 | 3 | 13 | 11 | 3 | 29 | p |
| 03 | 3 | 17 | p | 3 | 19 | 7 | 3 | p | p | 3 | 47 | p | 3 | 69 | 11 | 3 | p | p | 3 | 7 |
| 07 | p | 31 | 3 | 7 | 43 | 3 | p | 19 | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 37 | p |
| 09 | 3 | 41 | 7 | 3 | 13 | 23 | 3 | p | 11 | 3 | 43 | p | 3 | p | 31 | 3 | 7 | 13 | 3 | 11 |
| 11 | p | 3 | p | p | 3 | 17 | 11 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 11 | 73 | 3 |
| 13 | 7 | p | 3 | 59 | 11 | 3 | 17 | 7 | 3 | 31 | p | 3 | p | 71 | 3 | 11 | 23 | 3 | 13 | 41 |
| 17 | 11 | 3 | p | p | 3 | 7 | 13 | 3 | 17 | p | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 |
| 19 | 13 | 29 | 3 | 71 | 7 | 3 | p | p | 3 | 11 | p | 3 | p | 13 | 3 | 73 | 19 | 3 | 7 | p |
| 21 | 3 | p | p | 3 | p | p | 3 | 11 | 19 | 3 | 7 | p | 3 | p | 41 | 3 | p | 7 | 3 | 89 |
| 23 | 19 | 3 | 7 | p | 3 | 11 | 37 | 3 | p | 7 | 3 | 17 | 31 | 3 | 13 | p | 3 | p | p | 3 |
| 27 | 3 | 11 | 13 | 3 | p | 61 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 29 | p | 3 | p |
| 29 | p | 3 | p | p | 3 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | 17 | p | 3 | 59 | p | 3 |
| 31 | 37 | p | 3 | 13 | 59 | 3 | 19 | 53 | 3 | 29 | 79 | 3 | 7 | p | 3 | 17 | 13 | 3 | 41 | 7 |
| 33 | 3 | p | 23 | 3 | 7 | 47 | 3 | p | p | 3 | 13 | 7 | 3 | p | p | 3 | 17 | 11 | 3 | p |
| 37 | p | 17 | 3 | p | 41 | 3 | p | p | 3 | 7 | 31 | 3 | p | 11 | 3 | p | 7 | 3 | 17 | p |
| 39 | 3 | 7 | 17 | 3 | 47 | 13 | 3 | 23 | 7 | 3 | p | 11 | 3 | 41 | 43 | 3 | p | 71 | 3 | 17 |
| 41 | 7 | 3 | 79 | 17 | 3 | 31 | 29 | 3 | p | 11 | 3 | 37 | 13 | 3 | 7 | p | 3 | p | p | 3 |
| 43 | p | p | 3 | p | 17 | 3 | 7 | 11 | 3 | 53 | p | 3 | p | 7 | 3 | 19 | p | 3 | 11 | 13 |
| 47 | p | 3 | p | 11 | 3 | p | 17 | 3 | 41 | p | 3 | 7 | p | 3 | 11 | p | 3 | 61 | 7 | 3 |
| 49 | 23 | 11 | 3 | 7 | p | 3 | 61 | 17 | 3 | p | 7 | 3 | 11 | p | 3 | p | p | 3 | 47 | p |
| 51 | 3 | p | 7 | 3 | p | p | 3 | 43 | 13 | 3 | 11 | p | 3 | p | p | 3 | 7 | 23 | 3 | p |
| 53 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | 17 | 3 | 23 | p | 3 | 29 | 7 | 3 | p | p | 3 |
| 57 | 3 | 47 | p | 3 | 11 | 79 | 3 | 29 | p | 3 | p | 17 | 3 | 7 | p | 3 | 13 | p | 3 | 73 |
| 59 | 73 | 3 | 11 | p | 3 | 7 | p | 3 | 19 | p | 3 | p | 7 | 3 | p | p | 3 | p | 29 | 3 |
| 61 | 11 | 61 | 3 | p | 7 | 3 | p | p | 3 | p | 23 | 3 | 53 | 17 | 3 | p | 47 | 3 | 7 | 19 |
| 63 | 3 | p | p | 3 | 23 | p | 3 | p | p | 3 | 7 | 13 | 3 | 37 | 17 | 3 | 79 | 7 | 3 | p |
| 67 | p | 7 | 3 | p | 29 | 3 | 59 | 67 | 3 | p | 37 | 3 | 13 | 53 | 3 | 7 | 11 | 3 | p | 31 |
| 69 | 3 | 31 | p | 3 | p | p | 3 | 7 | p | 3 | p | 67 | 3 | p | 7 | 3 | p | 17 | 3 | 13 |
| 71 | 13 | 3 | p | 23 | 3 | p | 7 | 3 | p | p | 3 | 71 | 11 | 3 | 31 | 67 | 3 | 19 | 17 | 3 |
| 73 | p | p | 3 | p | p | 3 | p | 13 | 3 | 19 | 11 | 3 | 7 | 73 | 3 | p | p | 3 | p | 7 |
| 77 | 59 | 3 | p | 7 | 3 | p | 11 | 3 | 13 | p | 3 | p | 19 | 3 | p | p | 3 | 7 | p | 3 |
| 79 | p | 37 | 3 | p | 11 | 3 | p | p | 3 | 7 | p | 3 | 29 | 47 | 3 | 11 | 7 | 3 | p | 79 |
| 81 | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | 73 | 43 | 3 | 11 | p | 3 | p | 31 | 3 | 23 |
| 83 | 7 | 3 | 61 | 13 | 3 | 29 | 41 | 3 | p | p | 3 | 11 | p | 3 | 7 | p | 3 | 43 | p | 3 |
| 87 | 3 | 23 | p | 3 | 13 | 7 | 3 | 11 | 71 | 3 | 19 | p | 3 | 83 | p | 3 | p | 13 | 3 | 7 |
| 89 | p | 3 | 19 | p | 3 | 11 | p | 3 | 83 | 29 | 3 | 7 | 37 | 3 | p | p | 3 | p | 7 | 3 |
| 91 | p | 41 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 23 | 19 | 3 | p | p | 3 | 13 | 61 |
| 93 | 3 | 11 | 7 | 3 | 43 | 19 | 3 | p | 61 | 3 | 41 | p | 3 | p | 59 | 3 | 7 | p | 3 | p |
| 97 | 7 | p | 3 | p | 73 | 3 | 37 | 7 | 3 | p | 47 | 3 | p | 13 | 3 | 71 | 43 | 3 | 53 | 11 |
| 99 | 3 | p | p | 3 | 67 | p | 3 | 13 | p | 3 | 31 | 23 | 3 | 7 | p | 3 | p | 11 | 3 | 19 |

# INCOMPOSITS.

## TAB. V.

| | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | 59 | 3 | 31 | p | 3 | 7 | 13 | 3 | p | 19 | 3 | 71 | 7 | 3 | p | 89 | 3 | p |
| 03 | 53 | 3 | 13 | 19 | 3 | 11 | 7 | 3 | p | 29 | 3 | p | p | 3 | p | 13 | 3 | 31 | p | 3 |
| 07 | 3 | 11 | 29 | 3 | 7 | 47 | 3 | p | p | 3 | p | 7 | 3 | 41 | 23 | 3 | 13 | 17 | 3 | p |
| 09 | p | 3 | p | 7 | 3 | 67 | p | 3 | 23 | 59 | 3 | p | p | 3 | 97 | 37 | 3 | 7 | 17 | 3 |
| 11 | p | p | 3 | p | 13 | 3 | 79 | 31 | 3 | 7 | p | 3 | 61 | p | 3 | p | 7 | 3 | p | 11 |
| 13 | 3 | 7 | 43 | 3 | 47 | p | 3 | p | 7 | 3 | p | 13 | 3 | 67 | p | 3 | p | 11 | 3 | 23 |
| 17 | p | p | 3 | p | 19 | 3 | 7 | 23 | 3 | 37 | 71 | 3 | 13 | 7 | 3 | 31 | 59 | 3 | p | 47 |
| 19 | 3 | 23 | p | 3 | p | 7 | 3 | p | p | 3 | 29 | 11 | 3 | p | p | 3 | p | p | 3 | 7 |
| 21 | 13 | 3 | p | 53 | 3 | p | 37 | 3 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 23 | 71 | p | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 23 | p | 3 | 89 | p | 3 | 11 | p |
| 27 | 23 | 3 | 19 | 11 | 3 | p | p | 3 | 7 | 79 | 3 | p | p | 3 | 11 | 7 | 3 | 71 | 31 | 3 |
| 29 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | 3 | p | 3 | 11 | 19 | 3 | 13 | p | 3 | p | p |
| 31 | 3 | 47 | p | 3 | p | 19 | 3 | p | p | 3 | 11 | 23 | 3 | 7 | p | 3 | p | 37 | 3 | p |
| 33 | 29 | 3 | p | 13 | 3 | 7 | 89 | 3 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 |
| 37 | 3 | 79 | p | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 23 | 7 | 3 | 19 |
| 39 | p | 3 | 7 | 31 | 3 | p | 53 | 3 | p | 7 | 3 | 13 | p | 3 | p | p | 3 | p | p | 3 |
| 41 | 11 | 7 | 3 | 19 | 23 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 7 | 31 | 3 | 13 | p |
| 43 | 3 | 17 | p | 3 | p | p | 3 | 7 | 37 | 3 | p | 41 | 3 | p | 7 | 3 | p | p | 3 | 61 |
| 47 | 13 | p | 3 | 17 | p | 3 | p | p | 3 | 23 | 83 | 3 | 7 | 13 | 3 | p | 11 | 3 | 43 | 7 |
| 49 | 3 | 29 | 73 | 3 | 7 | 83 | 3 | 13 | p | 3 | p | 7 | 3 | p | 11 | 3 | p | p | 3 | p |
| 51 | 83 | 3 | 37 | 7 | 3 | 17 | 41 | 3 | 53 | p | 3 | p | 11 | 3 | 13 | p | 3 | 7 | p | 3 |
| 53 | p | 31 | 3 | p | 79 | 3 | 17 | p | 3 | 7 | 11 | 3 | 19 | 47 | 3 | 41 | 7 | 3 | 59 | 37 |
| 57 | 7 | 3 | 23 | 61 | 3 | 43 | 11 | 3 | 17 | 13 | 3 | p | p | 3 | 7 | 19 | 3 | 11 | p | 3 |
| 59 | p | 41 | 3 | 13 | 11 | 3 | 7 | 19 | 3 | 17 | p | 3 | 47 | 7 | 3 | 11 | 13 | 3 | p | 23 |
| 61 | 3 | p | 11 | 3 | p | 7 | 3 | p | p | 3 | 13 | p | 3 | 11 | p | 3 | p | 43 | 3 | 7 |
| 63 | 11 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 7 | 59 | 3 | p | 73 | 3 | 13 | 7 | 3 |
| 67 | 3 | p | 7 | 3 | p | 13 | 3 | 11 | p | 3 | p | 89 | 3 | 17 | p | 3 | 7 | p | 3 | p |
| 69 | p | 3 | p | p | 3 | 11 | p | 3 | 7 | p | 3 | 53 | 13 | 3 | 17 | 7 | 3 | p | 71 | 3 |
| 71 | 7 | p | 3 | 11 | 43 | 3 | 13 | 7 | 3 | p | 47 | 3 | 73 | p | 3 | 17 | 19 | 3 | p | 13 |
| 73 | 3 | 11 | p | 3 | 37 | p | 3 | 31 | 19 | 3 | 43 | p | 3 | 7 | p | 3 | 17 | 29 | 3 | p |
| 77 | 41 | 13 | 3 | p | 7 | 3 | p | 67 | 3 | 47 | 29 | 3 | p | p | 3 | 61 | p | 3 | 7 | 11 |
| 79 | 3 | p | 17 | 3 | 61 | 23 | 3 | p | 13 | 3 | 7 | 67 | 3 | 83 | p | 3 | p | 7 | 3 | 17 |
| 81 | p | 3 | 7 | 17 | 3 | p | p | 3 | 83 | 7 | 3 | p | p | 3 | 19 | 11 | 3 | p | 41 | 3 |
| 83 | 59 | 7 | 3 | 83 | 17 | 3 | 19 | p | 3 | 13 | 31 | 3 | p | 11 | 3 | 7 | 23 | 3 | p | 67 |
| 87 | p | 3 | p | p | 3 | 31 | 7 | 3 | p | 11 | 3 | p | 19 | 3 | 53 | p | 3 | p | p | 3 |
| 89 | p | 19 | 3 | p | 13 | 3 | p | 11 | 3 | 89 | 61 | 3 | 7 | 41 | 3 | 43 | p | 3 | 11 | 7 |
| 91 | 3 | p | p | 3 | 7 | 11 | 3 | 59 | 17 | 3 | p | 7 | 3 | p | p | 3 | 11 | p | 3 | 97 |
| 93 | p | 3 | p | 7 | 3 | 13 | p | 3 | p | 17 | 3 | 29 | p | 3 | 11 | 53 | 3 | 7 | 13 | 3 |
| 97 | 3 | 7 | p | 3 | 29 | p | 3 | 19 | 7 | 3 | 11 | 17 | 3 | 1 | p | 3 | p | 97 | 3 | 13 |
| 99 | 7 | 3 | 43 | 37 | 3 | p | p | 3 | 11 | p | 3 | p | 17 | 3 | 7 | 29 | 3 | 41 | 19 | 3 |

# INCOMPOSITS.

## TAB. VI.

| | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 73 | 3 | 101 | p | 3 | p | p | 3 | 7 | 11 | 3 | 17 | 23 | 3 | 13 | 7 | 3 | p | p | 3 |
| 03 | 7 | p | 3 | p | 101 | 3 | 23 | 7 | 3 | p | p | 3 | 17 | 89 | 3 | p | 41 | 3 | 11 | p |
| 07 | p | 3 | 59 | 11 | 3 | 7 | p | 3 | 101 | 13 | 3 | 29 | 7 | 3 | 11 | 37 | 3 | 23 | p | 3 |
| 09 | p | 11 | 3 | 13 | 7 | 3 | 103 | p | 3 | p | 101 | 3 | 11 | 43 | 3 | 17 | 13 | 3 | 7 | p |
| 11 | 3 | p | p | 3 | 29 | 23 | 3 | p | 19 | 3 | 7 | 41 | 3 | p | p | 3 | 17 | 7 | 3 | 43 |
| 13 | 17 | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | 101 | 29 | 3 | 13 | p | 3 |
| 17 | 3 | 67 | 17 | 3 | 11 | 13 | 3 | 7 | 29 | 3 | 23 | p | 3 | p | 7 | 3 | p | p | 3 | 17 |
| 19 | 43 | 3 | 11 | 17 | 3 | 67 | 7 | 3 | 31 | 61 | 3 | p | 13 | 3 | 19 | p | 3 | p | 53 | 3 |
| 21 | 11 | 29 | 3 | p | 17 | 3 | 13 | 71 | 3 | 67 | 103 | 3 | 7 | p | 3 | 41 | p | 3 | p | 7 |
| 23 | 3 | 53 | p | 3 | 7 | 17 | 3 | p | 79 | 3 | 73 | 7 | 3 | 13 | p | 3 | 59 | 19 | 3 | p |
| 27 | 37 | 13 | 3 | 23 | p | 3 | p | 17 | 3 | 7 | p | 3 | 103 | 47 | 3 | p | 7 | 3 | p | p |
| 29 | 3 | 7 | 53 | 3 | p | p | 3 | p | 7 | 3 | 41 | 31 | 3 | p | 11 | 3 | 29 | 37 | 3 | 79 |
| 31 | 7 | 3 | 13 | p | 3 | p | p | 3 | p | 17 | 3 | p | 11 | 3 | 7 | 13 | 3 | p | p | 3 |
| 33 | 79 | p | 3 | p | p | 3 | 7 | p | 3 | 13 | 11 | 3 | 47 | 7 | 3 | 19 | p | 3 | p | p |
| 37 | p | 3 | 29 | p | 3 | 41 | 11 | 3 | p | p | 3 | 7 | 17 | 3 | p | 83 | 3 | 11 | 7 | 3 |
| 39 | p | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | 17 | 3 | 11 | 103 | 3 | p | p |
| 41 | 3 | p | 7 | 3 | 53 | 83 | 3 | 23 | 37 | 3 | 61 | 13 | 3 | 11 | 17 | 3 | 7 | 59 | 3 | p |
| 43 | 11 | 3 | p | p | 3 | 13 | 29 | 3 | 7 | 31 | 3 | 11 | p | 3 | p | 7 | 3 | p | 13 | 3 |
| 47 | 3 | 73 | p | 3 | 31 | 53 | 3 | 11 | p | 3 | p | 71 | 3 | 7 | p | 3 | 19 | 17 | 3 | 13 |
| 49 | 13 | 3 | 37 | 79 | 3 | 7 | 23 | 3 | 19 | p | 3 | p | 7 | 3 | 107 | p | 3 | 31 | 17 | 3 |
| 51 | 19 | p | 3 | 11 | 7 | 3 | p | 13 | 3 | 47 | 43 | 3 | p | p | 3 | p | 61 | 3 | 7 | 17 |
| 53 | 3 | 11 | p | 3 | p | 61 | 3 | p | p | 3 | 7 | 19 | 3 | p | 13 | 3 | 43 | 7 | 3 | p |
| 57 | 89 | 7 | 3 | p | p | 3 | p | 31 | 3 | p | p | 3 | p | 41 | 3 | 7 | p | 3 | 71 | 11 |
| 59 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 37 | 7 | 3 | 89 | 11 | 3 | p |
| 61 | p | 3 | 31 | 13 | 3 | 59 | 7 | 3 | p | 97 | 3 | p | p | 3 | 73 | 11 | 3 | 19 | 29 | 3 |
| 63 | 29 | p | 3 | 43 | p | 3 | p | 47 | 3 | 19 | 13 | 3 | 7 | 11 | 3 | 31 | 107 | 3 | p | 7 |
| 67 | p | 3 | p | 7 | 3 | p | p | 3 | p | 11 | 3 | 13 | 19 | 3 | p | 43 | 3 | 7 | p | 3 |
| 69 | p | p | 3 | p | 19 | 3 | 47 | 11 | 3 | 7 | p | 3 | 59 | p | 3 | 23 | 7 | 3 | 11 | p |
| 71 | 3 | 7 | p | 3 | 37 | 11 | 3 | p | 7 | 3 | p | p | 3 | 83 | p | 3 | 11 | 79 | 3 | p |
| 73 | 7 | 3 | p | 11 | 3 | 97 | 13 | 3 | 83 | p | 3 | p | p | 3 | 7 | 71 | 3 | 61 | 31 | 3 |
| 77 | 3 | p | 43 | 3 | p | 7 | 3 | 13 | 73 | 3 | 11 | p | 3 | 31 | 23 | 3 | p | p | 3 | 7 |
| 79 | p | 3 | 19 | 97 | 3 | 71 | 59 | 3 | 11 | p | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 |
| 81 | 17 | p | 3 | 7 | 47 | 3 | 11 | p | 3 | 79 | 7 | 3 | 29 | 19 | 3 | 37 | p | 3 | 109 | p |
| 83 | 3 | 17 | 7 | 3 | 11 | 19 | 3 | 41 | p | 3 | p | 53 | 3 | p | p | 3 | 7 | p | 3 | 23 |
| 87 | 7 | 61 | 3 | 13 | p | 3 | p | 7 | 3 | p | p | 3 | p | 59 | 3 | p | 13 | 3 | p | p |
| 89 | 3 | 23 | p | 3 | 17 | p | 3 | p | p | 3 | 13 | 67 | 3 | 7 | p | 3 | p | p | 3 | 19 |
| 91 | p | 3 | 41 | p | 3 | 7 | p | 3 | p | 29 | 3 | 19 | 7 | 3 | p | 67 | 3 | 13 | 11 | 3 |
| 93 | p | p | 3 | 19 | 7 | 3 | 17 | 43 | 3 | p | p | 3 | 23 | p | 3 | p | 11 | 3 | 7 | 67 |
| 97 | 23 | 3 | 7 | 37 | 3 | p | 19 | 3 | 17 | 7 | 3 | p | 11 | 3 | p | p | 3 | 47 | p | 3 |
| 99 | p | 7 | 3 | p | p | 3 | 13 | p | 3 | 17 | 11 | 3 | p | p | 3 | 7 | p | 3 | 73 | 13 |

# INCOMPOSITS.

## TAB. VII.

| | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 11 | p | 3 | p | p | 3 | p | 13 | 3 | 7 | p | 3 | 43 | 47 | 3 | 23 | 7 | 3 | 37 | p |
| 03 | 3 | 7 | p | 3 | 79 | p | 3 | p | 7 | 3 | p | p | 3 | 53 | 13 | 3 | 61 | 71 | 3 | p |
| 07 | p | p | 3 | 31 | 19 | 3 | 7 | 97 | 3 | p | p | 3 | 47 | 7 | 3 | 13 | 11 | 3 | p | p |
| 09 | 3 | p | 29 | 3 | p | 7 | 3 | 71 | p | 3 | p | p | 3 | p | 11 | 3 | 31 | p | 3 | 7 |
| 11 | p | 3 | p | 13 | 3 | p | p | 3 | 23 | p | 3 | 7 | 11 | 3 | p | 59 | 3 | p | 7 | 3 |
| 13 | 41 | p | 3 | 7 | p | 3 | p | p | 3 | 37 | 7 | 3 | 73 | p | 3 | p | p | 3 | 19 | p |
| 17 | 61 | 3 | 19 | 109 | 3 | p | 11 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 11 | 41 | 3 |
| 19 | 7 | p | 3 | 97 | 11 | 3 | p | 7 | 3 | p | 47 | 3 | p | 19 | 3 | 11 | p | 3 | 13 | 31 |
| 21 | 3 | 17 | 11 | 3 | p | 19 | 3 | p | p | 3 | 29 | p | 3 | 7 | p | 3 | 53 | p | 3 | p |
| 23 | 11 | 3 | 17 | p | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 31 | p | 3 | p | 23 | 3 |
| 27 | 3 | 67 | p | 3 | 17 | p | 3 | 11 | 101 | 3 | 7 | p | 3 | p | 29 | 3 | p | 7 | 3 | 19 |
| 29 | 23 | 3 | 7 | p | 3 | 11 | 73 | 3 | p | 7 | 3 | 19 | p | 3 | 13 | 83 | 3 | p | p | 3 |
| 31 | 53 | 7 | 3 | 11 | 31 | 3 | 17 | 29 | 3 | 67 | 83 | 3 | 101 | p | 3 | 7 | 43 | 3 | p | p |
| 33 | 3 | 11 | 13 | 3 | p | 83 | 3 | 7 | 41 | 3 | p | 23 | 3 | 67 | 7 | 3 | p | 31 | 3 | p |
| 37 | p | 53 | 3 | 13 | p | 3 | p | 47 | 3 | 17 | p | 3 | 7 | p | 3 | p | 13 | 3 | 101 | 7 |
| 39 | 3 | 61 | p | 3 | 7 | p | 3 | p | 37 | 3 | 13 | 7 | 3 | p | 89 | 3 | 23 | 11 | 3 | 53 |
| 41 | p | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 17 | p | 3 | p | 11 | 3 | 7 | p | 3 |
| 43 | p | p | 3 | p | 23 | 3 | 47 | p | 3 | 7 | p | 3 | 17 | 11 | 3 | 29 | 7 | 3 | 109 | 73 |
| 47 | 7 | 3 | 37 | p | 3 | p | p | 3 | 29 | 11 | 3 | p | 13 | 3 | 7 | 19 | 3 | 59 | 61 | 3 |
| 49 | p | p | 3 | 53 | 59 | 3 | 7 | 11 | 3 | 23 | p | 3 | p | 7 | 3 | 17 | p | 3 | 11 | 13 |
| 51 | 3 | 29 | p | 3 | p | 7 | 3 | 41 | 71 | 3 | 31 | p | 3 | 13 | p | 3 | 11 | p | 3 | 7 |
| 53 | 17 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | 7 | 29 | 3 | 11 | p | 3 | 17 | 7 | 3 |
| 57 | 3 | p | 7 | 3 | p | 29 | 3 | p | 13 | 3 | 11 | 59 | 3 | 19 | p | 3 | 7 | p | 3 | 17 |
| 59 | 31 | 3 | 13 | 17 | 3 | 19 | p | 3 | 7 | p | 3 | p | p | 3 | 43 | 7 | 3 | p | p | 3 |
| 61 | 7 | p | 3 | 47 | 17 | 3 | 11 | 7 | 3 | 13 | 37 | 3 | 89 | 31 | 3 | 71 | 19 | 3 | 83 | 23 |
| 63 | 3 | p | p | 3 | 11 | 17 | 3 | p | 19 | 3 | p | p | 3 | 7 | p | 3 | 13 | p | 3 | p |
| 67 | 11 | 23 | 3 | 83 | 7 | 3 | 53 | 17 | 3 | p | 73 | 3 | p | p | 3 | p | 79 | 3 | 7 | p |
| 69 | 3 | 43 | p | 3 | 37 | p | 3 | 113 | 17 | 3 | 7 | 13 | 3 | 29 | p | 3 | p | 7 | 3 | 61 |
| 71 | p | 3 | 7 | 89 | 3 | 13 | p | 3 | 61 | 7 | 3 | p | 23 | 3 | 19 | 41 | 3 | 47 | 11 | 3 |
| 73 | p | 7 | 3 | p | p | 3 | 19 | 53 | 3 | p | 17 | 3 | 13 | 43 | 3 | 7 | 11 | 3 | p | 89 |
| 77 | 13 | 3 | p | p | 3 | p | 7 | 3 | 79 | 19 | 3 | p | 11 | 3 | p | p | 3 | 23 | p | 3 |
| 79 | 47 | 19 | 3 | p | p | 3 | 31 | 13 | 3 | p | 11 | 3 | 7 | 17 | 3 | 37 | p | 3 | p | 7 |
| 81 | 3 | 13 | p | 3 | 7 | 23 | 3 | p | 11 | 3 | 103 | 7 | 3 | 3 | 13 | 3 | p | p | 3 | 11 |
| 83 | 43 | 3 | 71 | 7 | 3 | p | 11 | 3 | 13 | p | 3 | p | 37 | p | 97 | 17 | 3 | 7 | p | 3 |
| 87 | 3 | 7 | 11 | 3 | p | 41 | 3 | 19 | 7 | 3 | 23 | p | 3 | 11 | p | 3 | p | 17 | 3 | 71 |
| 89 | 7 | 3 | p | 13 | 3 | p | p | 3 | p | 31 | 3 | 11 | 97 | 3 | 7 | 107 | 3 | p | 17 | 3 |
| 91 | 107 | 73 | 3 | p | p | 3 | 7 | p | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | 29 | 17 |
| 93 | 3 | 89 | 19 | 3 | 13 | 7 | 3 | 11 | p | 3 | p | 79 | 3 | 59 | 103 | 3 | p | 13 | 3 | 7 |
| 97 | p | p | 3 | 7 | p | 3 | p | 67 | 3 | 41 | 7 | 3 | p | p | 3 | p | p | 3 | 13 | p |
| 99 | 3 | 11 | 7 | 3 | 29 | 43 | 3 | p | p | 3 | p | 67 | 3 | p | p | 3 | 7 | p | 3 | p |

# INCOMPOSITS.

## TAB. VIII.

| | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 59 | 11 | 3 | p | 17 | 3 | 61 | 19 | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | p |
| 03 | 11 | 3 | 7 | p | 3 | p | 17 | 3 | 113 | 7 | 3 | 11 | 23 | 3 | 73 | 37 | 3 | 41 | p | 3 |
| 07 | 3 | p | p | 3 | p | 89 | 3 | 7 | 13 | 3 | 43 | p | 3 | p | 7 | 3 | p | 113 | 3 | p |
| 09 | p | 3 | 13 | 41 | 3 | 11 | 7 | 3 | 59 | 17 | 3 | 29 | 67 | 3 | 19 | 13 | 3 | 23 | p | 3 |
| 11 | p | 103 | 3 | 11 | p | 3 | 19 | 47 | 3 | 13 | 17 | 3 | 7 | 61 | 3 | p | 67 | 3 | 97 | 7 |
| 13 | 3 | 11 | 61 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | p | p | 3 | 13 | 19 | 3 | p |
| 17 | 107 | 19 | 3 | 103 | 13 | 3 | 47 | p | 3 | 7 | p | 3 | p | 17 | 3 | 59 | 7 | 3 | p | 11 |
| 19 | 3 | 7 | 59 | 3 | p | p | 3 | 41 | 7 | 3 | 23 | 13 | 3 | p | 17 | 3 | p | 11 | 3 | p |
| 21 | 7 | 3 | p | p | 3 | 13 | p | 3 | p | 43 | 3 | p | 31 | 3 | 7 | 11 | 3 | 79 | 13 | 3 |
| 23 | 37 | 29 | 3 | p | p | 3 | 7 | p | 3 | p | 83 | 3 | 13 | 7 | 3 | 19 | 17 | 3 | p | p |
| 27 | 13 | 3 | 41 | p | 3 | 73 | p | 3 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 29 | p | 71 | 3 | 7 | 47 | 3 | p | 11 | 3 | p | 7 | 3 | 97 | p | 3 | 53 | p | 3 | 11 | 17 |
| 31 | 3 | 13 | 7 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | p | 13 | 3 | 7 | p | 3 | 89 |
| 33 | p | 3 | 43 | 11 | 3 | p | p | 3 | 7 | 109 | 3 | 37 | p | 3 | 11 | 7 | 3 | p | 71 | 3 |
| 37 | 3 | 67 | 23 | 3 | p | p | 3 | p | 37 | 3 | 11 | p | 3 | 7 | 43 | 3 | 19 | p | 3 | p |
| 39 | 101 | 3 | 29 | 13 | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | p | 41 | 3 | p | 47 | 3 |
| 41 | 19 | 79 | 3 | p | 7 | 3 | 11 | p | 3 | 67 | 13 | 3 | p | 23 | 3 | p | p | 3 | 7 | 19 |
| 43 | 3 | p | p | 3 | 11 | p | 3 | 23 | p | 3 | 7 | 19 | 3 | 67 | p | 3 | p | 7 | 3 | 107 |
| 47 | 11 | 7 | 3 | p | p | 3 | 97 | p | 3 | p | 41 | 3 | 79 | 103 | 3 | 7 | p | 3 | 13 | 37 |
| 49 | 3 | p | p | 3 | p | p | 3 | 7 | 31 | 3 | 101 | p | 3 | p | 7 | 3 | p | p | 3 | 41 |
| 51 | p | 3 | p | 113 | 3 | p | 7 | 3 | p | p | 3 | 109 | 101 | 3 | p | p | 3 | 19 | 11 | 3 |
| 53 | 13 | p | 3 | 31 | 97 | 3 | p | p | 3 | 19 | p | 3 | 7 | 13 | 3 | 103 | 11 | 3 | 83 | 7 |
| 57 | p | 3 | 53 | 7 | 3 | p | p | 3 | 83 | p | 3 | 23 | 11 | 3 | 13 | 47 | 3 | 7 | 101 | 3 |
| 59 | 17 | p | 3 | 83 | 19 | 3 | 107 | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | p |
| 61 | 3 | 7 | 13 | 3 | p | p | 3 | 29 | 7 | 3 | p | p | 3 | p | p | 3 | p | p | 3 | 11 |
| 63 | 7 | 3 | 17 | 53 | 3 | p | 11 | 3 | 89 | 13 | 3 | 59 | p | 3 | 7 | 79 | 3 | 11 | 29 | 3 |
| 67 | 3 | 31 | 11 | 3 | 17 | 7 | 3 | p | p | 3 | 13 | 29 | 3 | 11 | p | 3 | p | p | 3 | 7 |
| 69 | 11 | 3 | 19 | p | 3 | 17 | p | 3 | p | p | 3 | 7 | p | 3 | 31 | p | 3 | 13 | 7 | 3 |
| 71 | p | 37 | 3 | 7 | 29 | 3 | 17 | p | 3 | 11 | 7 | 3 | p | 19 | 3 | 23 | p | 3 | 59 | p |
| 73 | 3 | p | 7 | 3 | 41 | 13 | 3 | 11 | 73 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p |
| 77 | 7 | p | 3 | 11 | 31 | 3 | 13 | 7 | 3 | 17 | p | 3 | p | p | 3 | 37 | 61 | 3 | p | 13 |
| 79 | 3 | 11 | 109 | 3 | p | 61 | 3 | p | p | 3 | 17 | 43 | 3 | 7 | 23 | 3 | p | 31 | 3 | 19 |
| 81 | p | 3 | p | 73 | 3 | 7 | 53 | 3 | 23 | 71 | 3 | 17 | 7 | 3 | 113 | p | 3 | 43 | p | 3 |
| 83 | p | 13 | 3 | 19 | 7 | 3 | p | p | 3 | p | p | 3 | 17 | p | 3 | p | p | 3 | 7 | 11 |
| 87 | p | 3 | 7 | p | 3 | 29 | 19 | 3 | p | 7 | 3 | p | p | 3 | 17 | 11 | 3 | p | p | 3 |
| 89 | 73 | 7 | 3 | p | p | 3 | 37 | 23 | 3 | 13 | 79 | 3 | p | 11 | 3 | 7 | 29 | 3 | p | 59 |
| 91 | 3 | 23 | 31 | 3 | 43 | p | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 13 | p | 3 | p |
| 93 | 17 | 3 | p | 37 | 3 | p | 7 | 3 | 53 | 11 | 3 | p | 41 | 3 | p | 31 | 3 | 17 | 23 | 3 |
| 97 | 3 | p | 17 | 3 | 7 | 11 | 3 | p | p | 3 | 31 | 7 | 3 | 89 | p | 3 | 11 | p | 3 | 17 |
| 99 | 23 | 3 | 79 | 7 | 3 | 13 | p | 3 | 47 | 53 | 3 | p | p | 3 | 11 | 19 | 3 | 7 | 13 | 3 |

# INCOMPOSITS.

## TAB. IX.

| | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | P | 3 | 17 | P | 3 | 29 | 13 | 3 | 53 | P | 3 | 7 | 103 | 3 | P | 11 | 3 | 31 | 7 | 3 |
| 03 | 13 | P | 3 | 7 | 47 | 3 | P | P | 3 | P | 7 | 3 | P | 11 | 3 | 23 | 29 | 3 | 19 | P |
| 07 | P | 3 | 19 | 23 | 3 | 17 | P | 3 | 7 | 11 | 3 | P | P | 3 | 13 | 7 | 3 | P | P | 3 |
| 09 | 7 | 89 | 3 | 47 | 61 | 3 | 17 | 7 | 3 | 37 | 73 | 3 | P | 19 | 3 | P | P | 3 | 11 | P |
| 11 | 3 | P | 13 | 3 | P | 11 | 3 | 17 | P | 3 | P | 71 | 3 | 7 | 23 | 3 | 11 | 89 | 3 | P |
| 13 | 67 | 3 | 31 | 11 | 3 | 7 | 37 | 3 | 17 | 13 | 3 | 109 | 7 | 3 | 11 | 83 | 3 | P | 47 | 3 |
| 17 | 3 | 71 | P | 3 | P | 83 | 3 | 73 | 67 | 3 | 7 | P | 3 | P | P | 3 | 79 | 7 | 3 | 19 |
| 19 | 83 | 3 | 7 | P | 3 | P | P | 3 | 11 | 7 | 3 | 17 | 67 | 3 | P | P | 3 | 13 | 103 | 3 |
| 21 | 37 | 7 | 3 | 19 | P | 3 | 11 | 23 | 3 | P | P | 3 | 17 | P | 3 | 7 | 67 | 3 | 71 | P |
| 23 | 3 | 23 | P | 3 | 11 | 13 | 3 | 7 | P | 3 | 29 | P | 3 | 17 | 7 | 3 | P | 37 | 3 | P |
| 27 | 11 | P | 3 | 29 | P | 3 | 13 | 43 | 3 | P | P | 3 | 7 | P | 3 | 17 | P | 3 | P | 7 |
| 29 | 3 | 127 | P | 3 | 7 | P | 3 | P | P | 3 | P | 7 | 3 | 13 | 29 | 3 | 17 | P | 3 | P |
| 31 | 17 | 3 | P | 7 | 3 | 61 | P | 3 | P | P | 3 | 37 | P | 3 | P | 47 | 3 | 7 | 11 | 3 |
| 33 | P | 13 | 3 | P | P | 3 | P | 29 | 3 | 7 | P | 3 | 19 | P | 3 | 89 | 7 | 3 | 17 | 79 |
| 37 | 7 | 3 | 13 | 17 | 3 | 23 | 127 | 3 | 113 | P | 3 | P | 11 | 3 | 7 | 13 | 3 | P | P | 3 |
| 39 | 43 | P | 3 | P | 17 | 3 | 7 | 19 | 3 | 13 | 11 | 3 | P | 7 | 3 | P | 31 | 3 | P | P |
| 41 | 3 | P | 109 | 3 | 41 | 7 | 3 | P | 11 | 3 | P | 61 | 3 | P | 107 | 3 | 13 | 113 | 3 | 7 |
| 43 | 61 | 3 | 37 | 59 | 3 | 71 | 11 | 3 | P | P | 3 | 7 | 43 | 3 | P | 53 | 3 | 11 | 7 | 3 |
| 47 | 3 | 67 | 7 | 3 | P | P | 3 | P | 17 | 3 | P | 13 | 3 | 11 | 73 | 3 | 7 | P | 3 | 131 |
| 49 | 11 | 3 | P | P | 3 | 13 | P | 3 | 7 | 17 | 3 | 11 | 47 | 3 | P | 7 | 3 | P | 13 | 3 |
| 51 | 7 | 31 | 3 | 83 | P | 3 | P | 7 | 3 | 11 | 17 | 3 | 13 | P | 3 | P | 19 | 3 | P | 29 |
| 53 | 3 | 29 | P | 3 | P | P | 3 | 11 | 19 | 3 | P | 17 | 3 | 7 | 31 | 3 | 127 | 41 | 3 | 13 |
| 57 | P | 107 | 3 | 11 | 7 | 3 | P | 13 | 3 | 31 | 7 | 3 | P | 17 | 3 | 97 | P | 3 | 7 | P |
| 59 | 3 | 11 | 71 | 3 | 109 | 29 | 3 | P | 23 | 3 | 37 | P | 3 | P | 13 | 3 | P | 7 | 3 | P |
| 61 | P | 3 | 7 | P | 3 | P | P | 3 | 13 | 7 | 3 | 131 | 41 | 3 | 19 | 17 | 3 | P | 53 | 3 |
| 63 | P | 7 | 3 | P | 101 | 3 | 19 | P | 3 | P | 113 | 3 | 61 | 97 | 3 | 7 | 17 | 3 | P | 11 |
| 67 | P | 3 | P | 13 | 3 | P | 7 | 3 | 101 | 19 | 3 | P | 31 | 3 | P | 11 | 3 | 109 | 17 | 3 |
| 69 | P | 19 | 3 | P | 43 | 3 | 79 | 41 | 3 | 71 | 13 | 3 | 7 | 11 | 3 | P | P | 3 | 107 | 7 |
| 71 | 3 | 103 | 53 | 3 | 7 | 73 | 3 | 31 | P | 3 | 43 | 7 | 3 | 29 | P | 3 | 41 | 13 | 3 | P |
| 73 | P | 3 | P | 7 | 3 | P | P | 3 | 47 | 11 | 3 | 13 | 23 | 3 | 101 | P | 3 | 7 | 61 | 3 |
| 77 | 3 | 7 | 41 | 3 | P | 11 | 3 | 19 | 7 | 3 | P | 89 | 3 | P | P | 3 | 11 | 29 | 3 | P |
| 79 | 7 | 3 | 73 | 11 | 3 | 59 | 13 | 3 | P | P | 3 | 41 | 37 | 3 | 7 | P | 3 | 23 | 19 | 3 |
| 81 | 13 | 11 | 3 | P | P | 3 | 7 | 97 | 3 | P | 19 | 3 | 11 | 7 | 3 | P | P | 3 | P | P |
| 83 | 3 | P | 19 | 3 | 53 | 7 | 3 | 13 | P | 3 | 11 | P | 3 | P | P | 3 | P | P | 3 | 7 |
| 87 | P | P | 3 | 7 | P | 3 | 11 | P | 3 | P | 7 | 3 | 59 | P | 3 | 43 | 23 | 3 | 31 | P |
| 89 | 3 | P | 7 | 3 | 11 | 53 | 3 | 103 | P | 3 | 23 | P | 3 | P | P | 3 | 7 | P | 3 | P |
| 91 | P | 3 | 11 | 37 | 3 | 47 | P | 3 | 7 | 13 | 3 | P | P | 3 | P | 7 | 3 | P | P | 3 |
| 93 | 7 | P | 3 | 13 | P | 3 | 7 | 7 | 3 | P | P | 3 | P | P | 3 | 73 | 13 | 3 | 29 | 19 |
| 97 | P | 3 | 43 | 19 | 3 | 7 | 59 | 3 | 61 | 23 | 3 | 29 | 7 | 3 | P | P | 3 | 13 | 11 | 3 |
| 99 | 17 | 97 | 3 | 23 | 7 | 3 | P | 107 | 3 | 89 | P | 3 | P | 127 | 3 | P | 11 | 3 | 7 | 41 |

# INCOMPOSITS.

## TAB. XI.

| | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 47 | 23 | 3 | P | P | 3 | 11 | P | 3 | 41 | P | 3 | 7 | P | 3 | P | 17 | 3 | P | 7 |
| 03 | 3 | 43 | 109 | 3 | 7 | P | 3 | 59 | P | 3 | 31 | 7 | 3 | 97 | P | 3 | P | 17 | 3 | 13 |
| 07 | 11 | 19 | 3 | P | 79 | 3 | 23 | 13 | 3 | 7 | 83 | 3 | P | 43 | 3 | P | 7 | 3 | 29 | 17 |
| 09 | 3 | 7 | 131 | 3 | 41 | 83 | 3 | 53 | 7 | 3 | P | 97 | 3 | P | 13 | 3 | P | P | 3 | 43 |
| 11 | 7 | 3 | P | P | 3 | 107 | 37 | 3 | 13 | P | 3 | 29 | P | 13 | 7 | 109 | 3 | 23 | 11 | 3 |
| 13 | P | 59 | 3 | P | P | 3 | 7 | P | 3 | P | P | 3 | P | 7 | 3 | 13 | 11 | 3 | P | P |
| 17 | 43 | 3 | P | 13 | 3 | P | P | 3 | 31 | P | 3 | 7 | 11 | 3 | P | 29 | 3 | P | 7 | 3 |
| 19 | 37 | P | 3 | 7 | 113 | 3 | 43 | P | 3 | P | 17 | 3 | P | P | 3 | 131 | 23 | 3 | P | P |
| 21 | 3 | P | 7 | 3 | 13 | P | 3 | 97 | 11 | 3 | 23 | P | 3 | 139 | P | 3 | 7 | 13 | 3 | 11 |
| 23 | 67 | 3 | P | 73 | 3 | P | 11 | 3 | 7 | 127 | 3 | 13 | 47 | 3 | P | 7 | 3 | 11 | 43 | 3 |
| 27 | 3 | P | 11 | 3 | P | 97 | 3 | 61 | 67 | 3 | 53 | 31 | 3 | 7 | P | 3 | 19 | P | 3 | P |
| 29 | 11 | 3 | P | P | 3 | 7 | 13 | 3 | 19 | 23 | 3 | 11 | 7 | 13 | P | 59 | 3 | 109 | 79 | 3 |
| 31 | 13 | P | 3 | 23 | 7 | 3 | 31 | P | 3 | 11 | P | 3 | P | 13 | 3 | P | 67 | 3 | 7 | 19 |
| 33 | 3 | P | P | 3 | P | 43 | 3 | 11 | 37 | 3 | 7 | 19 | 3 | P | P | 3 | 29 | 7 | 3 | 31 |
| 37 | 17 | 7 | 3 | 11 | 103 | 3 | P | 41 | 3 | 29 | P | 3 | P | 61 | 3 | 7 | 73 | 3 | 83 | P |
| 39 | 3 | 11 | 13 | 3 | P | P | 3 | 7 | P | 3 | 79 | P | 3 | 83 | 7 | 3 | 41 | P | 3 | 127 |
| 41 | P | 3 | 17 | P | 3 | P | 7 | 3 | 83 | 13 | 3 | P | 71 | 3 | P | P | 3 | 19 | P | 3 |
| 43 | P | P | 3 | 13 | P | 3 | 103 | P | 3 | 19 | 137 | 3 | 7 | 23 | 3 | P | 13 | 3 | P | 7 |
| 47 | P | 3 | 71 | 7 | 3 | 17 | 29 | 3 | 47 | P | 3 | 41 | 19 | 3 | P | 11 | 3 | 7 | 89 | 3 |
| 49 | P | P | 3 | 59 | 19 | 3 | 17 | P | 3 | 7 | 43 | 3 | P | 11 | 3 | 113 | 7 | 3 | 23 | P |
| 51 | 3 | 7 | P | 3 | P | 13 | 3 | 17 | 7 | 3 | P | 11 | 3 | 37 | 53 | 3 | 43 | P | 3 | 71 |
| 53 | 7 | 3 | P | P | 3 | P | 23 | 3 | 17 | 11 | 3 | 107 | 13 | 3 | 7 | P | 3 | P | P | 3 |
| 57 | 3 | 67 | P | 3 | P | 7 | 3 | P | 109 | 3 | 17 | P | 3 | 13 | P | 3 | 11 | 23 | 3 | 7 |
| 59 | P | 3 | 19 | 11 | 3 | 67 | 47 | 3 | P | P | 3 | 7 | P | 3 | 11 | P | 3 | P | 7 | 3 |
| 61 | P | 11 | 3 | 7 | P | 3 | P | 73 | 3 | 67 | 7 | 3 | 11 | 19 | 3 | 31 | P | 3 | P | P |
| 63 | 3 | 41 | 7 | 3 | 37 | 19 | 3 | 29 | 13 | 3 | 11 | P | 3 | 17 | P | 3 | 7 | P | 3 | P |
| 67 | 7 | 37 | 3 | P | 59 | 3 | 11 | 7 | 3 | 13 | 23 | 3 | P | 107 | 3 | 17 | 71 | 3 | P | 41 |
| 69 | 3 | P | P | 3 | 11 | 31 | 3 | 137 | P | 3 | P | 29 | 3 | 7 | P | 3 | 13 | 53 | 3 | 19 |
| 71 | 17 | 3 | 11 | P | 3 | 7 | P | 3 | 113 | 61 | 3 | 19 | 7 | 3 | P | P | 3 | 17 | 31 | 3 |
| 73 | 11 | 17 | 3 | 19 | 7 | 3 | 71 | P | 3 | P | P | 3 | P | P | 3 | 23 | 103 | 3 | 7 | P |
| 77 | P | 3 | 7 | 17 | 3 | 13 | 19 | 3 | 43 | 7 | 3 | 127 | 37 | 3 | P | P | 3 | P | 11 | 3 |
| 79 | 101 | 7 | 3 | P | 17 | 3 | P | 89 | 3 | P | P | 3 | 13 | P | 3 | 7 | 11 | 3 | 103 | P |
| 81 | 3 | P | 101 | 3 | P | 17 | 3 | 7 | 79 | 3 | P | P | 3 | P | 7 | 3 | P | 131 | 3 | 13 |
| 83 | 13 | 3 | 47 | 31 | 3 | P | 7 | 3 | 23 | 41 | 3 | P | 11 | 3 | P | P | 3 | 73 | 59 | 3 |
| 87 | 3 | 13 | P | 3 | 7 | P | 3 | P | 11 | 3 | P | 7 | 3 | P | 13 | 3 | P | 47 | 3 | 11 |
| 89 | P | 3 | P | 7 | 3 | 29 | 11 | 3 | 13 | 17 | 3 | 31 | P | 3 | P | 19 | 3 | 7 | P | 3 |
| 91 | 79 | P | 3 | 53 | 11 | 3 | P | 19 | 3 | 7 | 17 | 3 | 101 | P | 3 | 11 | 7 | 3 | P | P |
| 93 | 3 | 7 | 11 | 3 | P | P | 3 | P | 7 | 3 | 61 | 17 | 3 | 11 | 101 | 3 | 47 | P | 3 | P |
| 97 | P | 31 | 3 | P | 53 | 3 | 7 | P | 3 | 11 | 13 | 3 | 23 | 7 | 3 | P | P | 3 | 101 | P |
| 99 | 3 | P | 19 | 3 | 13 | 7 | 3 | 11 | P | 3 | 71 | 73 | 3 | 19 | 17 | 3 | P | 13 | 3 | 7 |

# INCOMPOSITS.

## TAB. XI.

| | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | p | 3 | 23 | 13 | 3 | 127 | 11 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 11 |
| 03 | 83 | 3 | 89 | 79 | 3 | 7 | 11 | 3 | 71 | p | 3 | 47 | 7 | 3 | 17 | p | 3 | 11 | p | 3 |
| 07 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | 11 | p | 3 | 17 | 7 | 3 | 19 |
| 09 | 11 | 3 | 7 | 23 | 3 | p | 37 | 3 | p | 7 | 3 | 11 | 127 | 3 | 79 | 137 | 3 | 17 | 113 | 3 |
| 11 | p | 3 | 7 | 19 | p | 3 | p | 139 | 3 | 11 | p | 3 | p | 101 | 3 | 7 | p | 3 | 17 | p |
| 13 | 3 | p | 17 | 3 | 137 | 73 | 3 | 7 | 13 | 3 | p | 43 | 3 | p | 7 | 3 | p | p | 3 | 17 |
| 17 | 37 | p | 3 | 11 | 17 | 3 | 53 | p | 3 | 13 | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 19 | 3 | 11 | p | 3 | 7 | 17 | 3 | p | 109 | 3 | p | 7 | 3 | p | p | 3 | 13 | 37 | 3 | 23 |
| 21 | p | 3 | 73 | 7 | 3 | p | 17 | 3 | 47 | p | 3 | p | p | 3 | 31 | p | 3 | 7 | p | 3 |
| 23 | p | p | 3 | p | 13 | 3 | 41 | 17 | 3 | 7 | p | 3 | 19 | p | 3 | p | 7 | 3 | 139 | 11 |
| 27 | 7 | 3 | 113 | p | 3 | 13 | p | 3 | 59 | 17 | 3 | 37 | p | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 29 | p | p | 3 | 29 | 31 | 3 | 7 | 19 | 3 | p | 17 | 3 | 13 | 7 | 3 | p | 43 | 3 | 83 | p |
| 31 | 3 | 41 | p | 3 | p | 7 | 3 | p | 37 | 3 | p | 11 | 3 | 83 | 29 | 3 | 97 | 31 | 3 | 7 |
| 33 | 13 | 3 | p | p | 3 | p | 47 | 3 | 83 | 11 | 3 | 7 | 17 | 3 | p | 61 | 3 | 103 | 7 | 3 |
| 37 | 3 | 13 | 7 | 3 | 107 | 11 | 3 | 89 | 67 | 3 | 109 | 23 | 3 | 19 | 13 | 3 | 7 | p | 3 | p |
| 39 | 29 | 3 | 37 | 11 | 3 | 19 | p | 3 | 7 | p | 3 | p | 67 | 3 | 11 | 7 | 3 | p | p | 3 |
| 41 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | 43 | 53 | 3 | 11 | p | 3 | 13 | 17 | 3 | p | 37 |
| 43 | 3 | 3 | 31 | 3 | p | p | 3 | p | 19 | 3 | 11 | p | 3 | 7 | 41 | 3 | 23 | 17 | 3 | p |
| 47 | p | p | 3 | p | 7 | 3 | 11 | p | 3 | p | 13 | 3 | p | p | 3 | 29 | p | 3 | 7 | 17 |
| 49 | 3 | 3 | p | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 37 | 89 | 3 | p | 7 | 3 | 47 |
| 51 | p | 3 | 7 | 47 | 3 | p | 107 | 3 | 29 | 7 | 3 | 13 | 79 | 3 | 19 | 23 | 3 | p | p | 3 |
| 53 | 11 | 7 | 3 | p | 113 | 3 | 19 | p | 3 | 23 | 37 | 3 | 53 | 131 | 3 | 7 | 59 | 3 | 13 | 29 |
| 57 | 31 | 3 | 47 | p | 3 | 61 | 7 | 3 | p | 19 | 3 | p | 29 | 3 | 43 | p | 3 | p | 11 | 3 |
| 59 | 13 | 19 | 3 | p | 41 | 3 | 73 | p | 3 | p | p | 3 | 7 | 13 | 3 | p | 11 | 3 | p | 7 |
| 61 | 3 | p | p | 3 | 7 | 29 | 3 | 13 | 23 | 3 | p | 7 | 3 | 41 | 11 | 3 | p | 47 | 3 | p |
| 63 | p | 3 | 23 | 7 | 3 | p | p | 3 | 31 | p | 3 | p | 11 | 3 | 13 | p | 3 | 7 | p | 3 |
| 67 | 3 | 7 | 13 | 3 | 97 | 131 | 3 | 19 | 7 | 3 | p | 61 | 3 | 23 | p | 3 | 47 | p | 3 | 11 |
| 69 | 7 | 3 | p | p | 3 | 67 | 11 | 3 | 41 | 13 | 3 | p | p | 3 | 7 | p | 3 | 11 | 19 | 3 |
| 71 | p | 23 | 3 | 13 | 11 | 3 | 3 | p | 3 | 67 | 19 | 3 | 89 | 7 | 3 | 11 | 13 | 3 | p | 127 |
| 73 | 3 | p | 11 | 3 | 59 | 7 | 7 | p | p | 3 | 13 | 31 | 3 | 11 | 109 | 3 | p | p | 3 | 7 |
| 77 | 17 | p | 3 | 7 | p | 3 | 23 | 79 | 3 | 11 | 7 | 3 | p | p | 3 | p | 53 | 3 | 131 | p |
| 79 | 3 | 17 | 7 | 3 | p | 13 | 3 | 11 | p | 3 | 107 | p | 3 | p | 47 | 3 | 7 | 29 | 3 | 31 |
| 81 | 43 | 3 | 17 | 89 | 3 | 11 | p | 3 | 7 | p | 3 | 59 | 13 | 3 | p | 7 | 3 | 23 | p | 3 |
| 83 | 7 | p | 3 | 11 | p | 3 | 13 | 7 | 3 | 3 | 29 | 3 | p | p | 3 | 113 | p | 3 | 79 | 13 |
| 87 | 53 | 3 | p | 19 | 3 | 7 | 137 | 3 | p | 31 | 3 | p | 7 | 3 | p | p | 3 | p | 43 | 3 |
| 89 | p | 13 | 3 | p | 7 | 3 | 17 | p | 3 | 139 | p | 3 | 61 | 73 | 3 | p | 23 | 3 | 7 | 11 |
| 91 | 3 | 61 | 103 | 3 | 31 | 59 | 3 | 17 | 13 | 3 | 7 | p | 3 | p | p | 3 | 109 | 7 | 3 | p |
| 93 | 71 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | p | 107 | 3 | p | 11 | 3 | 19 | p | 3 |
| 97 | 3 | 19 | p | 3 | 103 | 43 | 3 | 7 | p | 3 | 17 | 11 | 3 | p | 7 | 3 | 13 | 71 | 3 | p |
| 99 | 101 | 3 | 53 | p | 3 | p | 7 | 3 | p | 11 | 3 | 17 | 19 | 3 | p | p | 3 | p | 61 | 3 |

# INCOMPOSITS.

## TAB. XII.

| | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7 | 3 | 149 | 29 | 3 | p | 97 | 3 | 151 | p | 3 | 13 | p | 3 | 7 | 71 | 3 | 137 | p | 3 |
| 03 | p | 23 | 3 | p | 43 | 3 | 7 | 73 | 3 | 37 | p | 3 | p | 7 | 3 | 19 | p | 3 | 13 | 11 |
| 07 | 59 | 3 | 53 | p | 3 | 71 | 13 | 3 | p | p | 3 | 7 | 23 | 3 | 89 | 11 | 3 | 151 | 7 | 3 |
| 09 | 13 | p | 3 | 7 | p | 3 | 23 | p | 3 | 31 | 7 | 3 | p | 11 | 3 | p | p | 3 | 29 | p |
| 11 | 3 | p | 7 | 3 | 73 | p | 3 | 13 | p | 3 | p | 11 | 3 | p | 41 | 3 | 7 | 131 | 3 | p |
| 13 | p | 3 | 97 | 53 | 3 | 47 | p | 3 | 7 | 11 | 3 | 29 | 139 | 3 | 13 | 7 | 3 | 23 | p | 3 |
| 17 | 3 | 17 | 13 | 3 | 29 | 11 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | 11 | 37 | 3 | p |
| 19 | 97 | 3 | 17 | 11 | 3 | 7 | p | 3 | 19 | 13 | 3 | 61 | 7 | 3 | 11 | 29 | 3 | p | p | 3 |
| 21 | 19 | 11 | 3 | 13 | 7 | 3 | p | p | 3 | p | p | 3 | 11 | p | 3 | 43 | 13 | 3 | 7 | 19 |
| 23 | 3 | p | 71 | 3 | 17 | 101 | 3 | 31 | 29 | 3 | 7 | 19 | 3 | 83 | 59 | 3 | p | 7 | 3 | 47 |
| 27 | p | 7 | 3 | 83 | 41 | 3 | 11 | p | 3 | 101 | p | 3 | p | p | 3 | 7 | p | 3 | p | 71 |
| 29 | 3 | p | p | 3 | 11 | 13 | 3 | 7 | 37 | 3 | p | 101 | 3 | 41 | 7 | 3 | p | 61 | 3 | p |
| 31 | p | 3 | 11 | 137 | 3 | p | 7 | 3 | 17 | 23 | 3 | p | 13 | 3 | p | p | 3 | 19 | p | 3 |
| 33 | 11 | p | 3 | 23 | p | 3 | 13 | 127 | 3 | 17 | 31 | 3 | 7 | p | 3 | 101 | p | 3 | p | 7 |
| 37 | p | 3 | 37 | 7 | 3 | 31 | p | 3 | 41 | p | 3 | 17 | 19 | 3 | 23 | p | 3 | 7 | 11 | 3 |
| 39 | p | 13 | 3 | 89 | 19 | 3 | p | p | 3 | 7 | p | 3 | 17 | p | 3 | p | 7 | 3 | 31 | 37 |
| 41 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | p | 73 | 3 | 17 | 11 | 3 | 47 | p | 3 | 89 |
| 43 | 7 | 3 | 13 | p | 3 | p | p | 3 | 53 | p | 3 | p | 11 | 3 | 7 | 13 | 3 | p | 113 | 3 |
| 47 | 3 | p | p | 3 | p | 7 | 3 | 23 | 11 | 3 | 19 | 79 | 3 | 37 | p | 3 | 13 | p | 3 | 7 |
| 49 | 17 | 3 | 19 | p | 3 | p | 11 | 3 | 73 | 53 | 3 | 7 | 67 | 3 | 131 | p | 3 | 11 | 7 | 3 |
| 51 | p | 17 | 3 | 7 | 11 | 3 | p | p | 3 | 59 | 7 | 3 | p | 19 | 3 | 11 | 67 | 3 | 17 | 43 |
| 53 | 3 | p | 7 | 3 | p | 19 | 3 | 61 | p | 3 | p | 13 | 3 | 11 | 47 | 3 | 7 | p | 3 | 17 |
| 57 | 7 | p | 3 | 79 | 17 | 3 | 139 | 7 | 3 | 11 | p | 3 | 13 | p | 3 | p | 41 | 3 | p | p |
| 59 | 3 | p | p | 3 | 37 | 17 | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 59 | 23 | 3 | 13 |
| 61 | 13 | 3 | 113 | 59 | 3 | 7 | 17 | 3 | p | p | 3 | 19 | 7 | 3 | 29 | p | 3 | p | 107 | 3 |
| 63 | p | 37 | 3 | 11 | 7 | 3 | 131 | 13 | 3 | p | p | 3 | 43 | 61 | 3 | p | p | 3 | 7 | 31 |
| 67 | p | 3 | 7 | p | 3 | p | 19 | 3 | 13 | 7 | 3 | p | 53 | 3 | 31 | p | 3 | p | 29 | 3 |
| 69 | 29 | 7 | 3 | p | p | 3 | p | p | 3 | 103 | 17 | 3 | p | p | 3 | 7 | p | 3 | p | 11 |
| 71 | 3 | p | p | 3 | 23 | p | 3 | 7 | p | 3 | p | 17 | 3 | p | 7 | 3 | p | 11 | 3 | p |
| 73 | p | 3 | p | 13 | 3 | p | 7 | 3 | 89 | p | 3 | p | 17 | 3 | p | 11 | 3 | p | p | 3 |
| 77 | 3 | 67 | p | 3 | 7 | 107 | 3 | p | p | 3 | 47 | 7 | 3 | 97 | 17 | 3 | p | 13 | 3 | p |
| 79 | p | 3 | p | 7 | 3 | 67 | p | 3 | 137 | 11 | 3 | 13 | p | 3 | 53 | 17 | 3 | 7 | p | 3 |
| 81 | 71 | 41 | 3 | p | p | 3 | 37 | 11 | 3 | 7 | p | 3 | 31 | 103 | 3 | p | 7 | 3 | 11 | p |
| 83 | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 41 | 97 | 3 | 67 | 23 | 3 | 11 | 17 | 3 | 29 |
| 87 | 13 | 11 | 3 | 61 | 113 | 3 | 7 | p | 3 | 127 | p | 3 | 11 | 7 | 3 | 103 | p | 3 | p | 17 |
| 89 | 3 | p | 31 | 3 | 43 | 7 | 3 | 13 | 47 | 3 | 11 | p | 3 | 19 | 83 | 3 | p | p | 3 | 7 |
| 91 | p | 3 | p | p | 3 | 19 | p | 3 | 11 | 83 | 3 | 7 | p | 3 | 13 | 31 | 3 | 37 | 7 | 3 |
| 93 | p | p | 3 | 7 | 83 | 3 | 11 | 23 | 3 | p | 7 | 3 | p | 149 | 3 | p | 19 | 3 | p | p |
| 97 | 19 | 3 | 11 | p | 3 | 59 | p | 3 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 | 53 | 23 | 3 |
| 99 | 7 | 79 | 3 | 13 | 149 | 3 | p | 7 | 3 | 109 | p | 3 | 23 | p | 3 | p | 13 | 3 | p | 103 |

# INCOMPOSITS.

## TAB. XIII.

| | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 7 | 3 | 19 | 13 | 3 | 73 | 17 | 3 | 37 | 23 | 3 | 11 | p | 3 | 7 | p | 3 | p | 59 |
| 03 | 3 | p | p | 3 | 23 | 107 | 3 | 7 | 17 | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | p |
| 07 | p | p | 3 | 109 | p | 3 | 11 | 31 | 3 | p | 17 | 3 | 7 | p | 3 | 23 | 29 | 3 | 131 | 7 |
| 09 | 3 | p | 43 | 3 | 7 | p | 3 | p | p | 3 | 89 | 7 | 3 | p | p | 3 | p | 47 | 3 | 13 |
| 11 | 73 | 3 | 11 | 7 | 3 | 127 | p | 3 | 43 | 29 | 3 | p | 17 | 3 | p | 97 | 3 | 7 | 53 | 3 |
| 13 | 11 | p | 3 | 41 | p | 3 | 151 | 13 | 3 | 7 | p | 3 | 19 | 17 | 3 | 31 | 7 | 3 | 83 | p |
| 17 | 7 | 3 | 61 | p | 3 | p | 103 | 3 | 13 | p | 3 | p | 151 | 3 | p | 17 | 3 | p | 11 | 3 |
| 19 | p | 89 | 3 | 83 | p | 3 | 7 | 19 | 3 | p | 127 | 3 | p | 7 | 3 | 13 | 11 | 3 | p | p |
| 21 | 3 | p | 53 | 3 | p | 7 | 3 | 59 | p | 3 | 131 | p | 3 | p | 11 | 3 | p | 17 | 3 | 7 |
| 23 | p | 3 | p | 13 | 3 | 137 | p | 3 | 103 | p | 3 | 7 | 11 | 3 | p | p | 3 | 29 | 7 | 3 |
| 27 | 3 | 23 | 7 | 3 | 13 | p | 3 | 79 | 11 | 3 | 29 | p | 3 | 19 | 47 | 3 | 7 | 13 | 3 | 11 |
| 29 | p | 3 | p | p | 3 | 19 | 11 | 3 | 7 | 97 | 3 | 13 | p | 3 | 59 | 7 | 3 | 11 | 23 | 3 |
| 31 | 7 | 59 | 3 | 29 | 11 | 3 | p | 7 | 3 | 107 | p | 3 | 23 | 73 | 3 | 11 | 19 | 3 | 13 | p |
| 33 | 3 | p | 11 | 3 | 53 | p | 3 | p | 19 | 3 | p | 41 | 3 | 7 | 29 | 3 | p | p | 3 | p |
| 37 | 13 | p | 3 | p | 7 | 3 | 71 | 29 | 3 | 11 | p | 3 | p | 13 | 3 | p | 31 | 3 | 7 | 37 |
| 39 | 3 | 101 | p | 3 | p | 53 | 3 | 11 | 59 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | p |
| 41 | 29 | 3 | 7 | 101 | 3 | 11 | 41 | 3 | p | 7 | 3 | 31 | 43 | 3 | 13 | p | 3 | p | p | 3 |
| 43 | p | 7 | 3 | 11 | p | 3 | 19 | 109 | 3 | p | 79 | 3 | p | p | 3 | 7 | p | 3 | 43 | p |
| 47 | 139 | 3 | p | 97 | 3 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | p | 59 | 3 | p | p | 3 |
| 49 | p | 19 | 3 | 13 | 23 | 3 | 157 | p | 3 | 61 | 37 | 3 | 7 | p | 3 | 29 | 13 | 3 | p | 7 |
| 51 | 3 | p | p | 3 | 7 | p | 3 | 53 | p | 3 | 13 | 7 | 3 | 101 | 31 | 3 | 113 | 11 | 3 | p |
| 53 | 67 | 3 | 79 | 7 | 3 | 43 | 89 | 3 | 29 | p | 3 | p | p | 3 | p | 11 | 3 | 7 | 103 | 3 |
| 57 | 3 | 7 | 127 | 3 | 37 | 13 | 3 | 19 | 7 | 3 | p | 11 | 3 | p | p | 3 | p | 43 | 3 | 101 |
| 59 | 7 | 3 | 17 | p | 3 | 41 | p | 3 | p | 11 | 3 | 139 | 13 | 3 | 7 | 61 | 3 | p | 19 | 3 |
| 61 | p | 37 | 3 | 17 | 61 | 3 | 7 | 11 | 3 | 109 | 19 | 3 | p | 7 | 3 | p | 67 | 3 | 11 | 13 |
| 63 | 3 | 73 | 19 | 3 | 17 | 7 | 3 | p | 23 | 3 | 71 | p | 3 | 13 | p | 3 | 11 | p | 3 | 7 |
| 67 | 41 | 11 | 3 | 7 | 43 | 3 | 17 | p | 3 | p | 7 | 3 | 11 | p | 3 | 37 | p | 3 | p | 23 |
| 69 | 3 | p | 7 | 3 | p | 79 | 3 | 17 | 13 | 3 | 11 | p | 3 | 23 | p | 3 | 7 | 73 | 3 | p |
| 71 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | p | 3 | p | 37 | 3 | p | 7 | 3 | p | 41 | 3 |
| 73 | 7 | 23 | 3 | p | p | 3 | 11 | 7 | 3 | 13 | p | 3 | 127 | p | 3 | 107 | p | 3 | p | 19 |
| 77 | p | 3 | 11 | 19 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 73 | p | 3 | 149 | 113 | 3 |
| 79 | 11 | p | 3 | p | 7 | 3 | 23 | 71 | 3 | p | 31 | 3 | 17 | 41 | 3 | p | p | 3 | 7 | 83 |
| 81 | 3 | p | p | 3 | p | 47 | 3 | p | 139 | 3 | 7 | 13 | 3 | 17 | 83 | 3 | 61 | 7 | 3 | p |
| 83 | p | 3 | 7 | 37 | 3 | 13 | p | 3 | 149 | 7 | 3 | p | 131 | 3 | 17 | p | 3 | 19 | 11 | 3 |
| 87 | 3 | 19 | 149 | 3 | 47 | 23 | 3 | 7 | 41 | 3 | p | 89 | 3 | 53 | 7 | 3 | 17 | 107 | 3 | 13 |
| 89 | 13 | 3 | 107 | 29 | 3 | 67 | 7 | 3 | p | p | 3 | p | 11 | 3 | 71 | p | 3 | 17 | p | 3 |
| 91 | p | 17 | 3 | p | 19 | 3 | p | 13 | 3 | 67 | 11 | 3 | 7 | p | 3 | 157 | 23 | 3 | 17 | 7 |
| 93 | 3 | 13 | 17 | 3 | 7 | p | 3 | p | 11 | 3 | 23 | 7 | 3 | 67 | 13 | 3 | p | p | 3 | 11 |
| 97 | p | p | 3 | 31 | 11 | 3 | p | 137 | 3 | 7 | p | 3 | 41 | 109 | 3 | 11 | 7 | 3 | 19 | p |
| 99 | 3 | 7 | 11 | 3 | p | 17 | 3 | p | 7 | 3 | 19 | 113 | 3 | 11 | 43 | 3 | 31 | p | 3 | p |

# INCOMPOSITS.

## TAB. XII.

| | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7 | 3 | 149 | 29 | 3 | p | 97 | 3 | 151 | p | 3 | 13 | p | 3 | 7 | 71 | 3 | 137 | p | 3 |
| 03 | p | 23 | 3 | p | 43 | 3 | 7 | 73 | 3 | 37 | p | 3 | p | 7 | 3 | 19 | p | 3 | 13 | 11 |
| 07 | 59 | 3 | 53 | p | 3 | 71 | 13 | 3 | p | p | 3 | 7 | 23 | 3 | 89 | 11 | 3 | 151 | 7 | 3 |
| 09 | 13 | p | 3 | 7 | p | 3 | 23 | p | 3 | 31 | 7 | 3 | p | 11 | 3 | p | p | 3 | 29 | p |
| 11 | 3 | p | 7 | 3 | 73 | p | 3 | 13 | p | 3 | p | 11 | 3 | p | 41 | 3 | 7 | 131 | 3 | p |
| 13 | p | 3 | 97 | 53 | 3 | 47 | p | 3 | 7 | 11 | 3 | 29 | 139 | 3 | 13 | 7 | 3 | 23 | p | 3 |
| 17 | 3 | 17 | 13 | 3 | 29 | 11 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | 11 | 37 | 3 | p |
| 19 | 97 | 3 | 17 | 11 | 3 | 7 | p | 3 | 19 | 13 | 3 | 61 | 7 | 3 | 11 | 29 | 3 | p | p | 3 |
| 21 | 19 | 11 | 3 | 13 | 7 | 3 | p | p | 3 | p | p | 3 | 11 | p | 3 | 43 | 13 | 3 | 7 | 19 |
| 23 | 3 | p | 71 | 3 | 17 | 101 | 3 | 31 | 29 | 3 | 7 | 19 | 3 | 83 | 59 | 3 | p | 7 | 3 | 47 |
| 27 | p | 7 | 3 | 83 | 41 | 3 | 11 | p | 3 | 101 | p | 3 | p | p | 3 | 7 | p | 3 | p | 71 |
| 29 | 3 | p | p | 3 | 11 | 13 | 3 | 7 | 37 | 3 | p | 101 | 3 | 41 | 7 | 3 | p | 61 | 3 | p |
| 31 | p | 3 | 11 | 137 | 3 | p | 7 | 3 | 17 | 23 | 3 | p | 13 | 3 | p | p | 3 | 19 | p | 3 |
| 33 | 11 | p | 3 | 23 | p | 3 | 13 | 127 | 3 | 17 | 31 | 3 | 7 | p | 3 | 101 | p | 3 | p | 7 |
| 37 | p | 3 | 37 | 7 | 3 | 31 | p | 3 | 41 | p | 3 | 17 | 19 | 3 | 23 | p | 3 | 7 | 11 | 3 |
| 39 | p | 13 | 3 | 89 | 19 | 3 | p | p | 3 | 7 | p | 3 | 17 | p | 3 | p | 7 | 3 | 31 | 37 |
| 41 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | p | 73 | 3 | 17 | 11 | 3 | 47 | p | 3 | 89 |
| 43 | 7 | 3 | 13 | p | 3 | p | p | 3 | 53 | p | 3 | p | 11 | 3 | 7 | 13 | 3 | p | 113 | 3 |
| 47 | 3 | p | p | 3 | p | 7 | 3 | 23 | 11 | 3 | 19 | 79 | 3 | 37 | p | 3 | 13 | p | 3 | 7 |
| 49 | 17 | 3 | 19 | p | 3 | p | 11 | 3 | 73 | 53 | 3 | 7 | 67 | 3 | 131 | p | 3 | 11 | 7 | 3 |
| 51 | p | 17 | 3 | 7 | 11 | 3 | p | p | 3 | 59 | 7 | 3 | p | 19 | 3 | 11 | 67 | 3 | 17 | 43 |
| 53 | 3 | p | 7 | 3 | p | 19 | 3 | 61 | p | 3 | p | 13 | 3 | 11 | 47 | 3 | 7 | p | 3 | 17 |
| 57 | 7 | p | 3 | 79 | 17 | 3 | 139 | 7 | 3 | 11 | p | 3 | 13 | p | 3 | p | 41 | 3 | p | p |
| 59 | 3 | p | p | 3 | 37 | 17 | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 59 | 23 | 3 | 13 |
| 61 | 13 | 3 | 113 | 59 | 3 | 7 | 17 | 3 | p | p | 3 | 19 | 7 | 3 | 29 | p | 3 | p | 107 | 3 |
| 63 | p | 37 | 3 | 11 | 7 | 3 | 131 | 13 | 3 | p | p | 3 | 43 | 61 | 3 | p | p | 3 | 7 | 31 |
| 67 | p | 3 | 7 | p | 3 | p | 19 | 3 | 13 | 7 | 3 | p | 53 | 3 | 31 | p | 3 | p | 29 | 3 |
| 69 | 29 | 7 | 3 | p | p | 3 | p | p | 3 | 103 | 17 | 3 | p | p | 3 | 7 | p | 3 | p | 11 |
| 71 | 3 | p | p | 3 | 23 | p | 3 | 7 | p | 3 | p | 17 | 3 | p | 7 | 3 | p | 11 | 3 | p |
| 73 | p | 3 | p | 13 | 3 | p | 7 | 3 | 89 | p | 3 | p | 17 | 3 | p | 11 | 3 | p | p | 3 |
| 77 | 3 | 67 | p | 3 | 7 | 107 | 3 | p | p | 3 | 47 | 7 | 3 | 97 | 17 | 3 | p | 13 | 3 | p |
| 79 | p | 3 | p | 7 | 3 | 67 | p | 3 | 137 | 11 | 3 | 13 | p | 3 | 53 | 17 | 3 | 7 | p | 3 |
| 81 | 71 | 41 | 3 | p | p | 3 | 37 | 11 | 3 | 7 | p | 3 | 31 | 103 | 3 | p | 7 | 3 | 11 | p |
| 83 | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 41 | 97 | 3 | 67 | 23 | 3 | 11 | 17 | 3 | 29 |
| 87 | 13 | 11 | 3 | 61 | 113 | 3 | 7 | p | 3 | 127 | p | 3 | 11 | 7 | 3 | 103 | p | 3 | p | 17 |
| 89 | 3 | p | 31 | 3 | 43 | 7 | 3 | 13 | 47 | 3 | 11 | p | 3 | 19 | 83 | 3 | p | p | 3 | 7 |
| 91 | p | 3 | p | p | 3 | 19 | p | 3 | 11 | 83 | 3 | 7 | p | 3 | 13 | 31 | 3 | 37 | 7 | 3 |
| 93 | p | p | 3 | 7 | 83 | 3 | 11 | 23 | 3 | p | 7 | 3 | p | 149 | 3 | p | 19 | 3 | p | p |
| 97 | 19 | 3 | 11 | p | 3 | 59 | p | 3 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 | 53 | 23 | 3 |
| 99 | 7 | 79 | 3 | 13 | 149 | 3 | p | 7 | 3 | 109 | p | 3 | 23 | p | 3 | p | 13 | 3 | p | 103 |

# INCOMPOSITS.

## TAB. XIII.

| | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 7 | 3 | 19 | 13 | 3 | 73 | 17 | 3 | 37 | 23 | 3 | 11 | p | 3 | 7 | p | 3 | p | 59 |
| 03 | 3 | p | p | 3 | 23 | 107 | 3 | 7 | 17 | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | p |
| 07 | p | p | 3 | 109 | p | 3 | 11 | 31 | 3 | p | 17 | 3 | 7 | p | 3 | 23 | 29 | 3 | 131 | 7 |
| 09 | 3 | p | 43 | 3 | 7 | p | 3 | p | p | 3 | 89 | 7 | 3 | p | p | 3 | p | 47 | 3 | 13 |
| 11 | 73 | 3 | 11 | 7 | 3 | 127 | p | 3 | 43 | 29 | 3 | p | 17 | 3 | p | 97 | 3 | 7 | 53 | 3 |
| 13 | 11 | p | 3 | 41 | p | 3 | 151 | 13 | 3 | 7 | p | 3 | 19 | 17 | 3 | 31 | 7 | 3 | 83 | p |
| 17 | 7 | 3 | 61 | p | 3 | p | 103 | 3 | 13 | p | 3 | p | 151 | 3 | p | 17 | 3 | p | 11 | 3 |
| 19 | p | 89 | 3 | 83 | p | 3 | 7 | 19 | 3 | p | 127 | 3 | p | 7 | 3 | 13 | 11 | 3 | p | p |
| 21 | 3 | p | 53 | 3 | p | 7 | 3 | 59 | p | 3 | 131 | p | 3 | p | 11 | 3 | p | 17 | 3 | 7 |
| 23 | p | 3 | p | 13 | 3 | 137 | p | 3 | 103 | p | 3 | 7 | 11 | 3 | p | p | 3 | 29 | 7 | 3 |
| 27 | 3 | 23 | 7 | 3 | 13 | p | 3 | 79 | 11 | 3 | 29 | p | 3 | 19 | 47 | 3 | 7 | 13 | 3 | 11 |
| 29 | p | 3 | p | p | 3 | 19 | 11 | 3 | 7 | 97 | 3 | 13 | p | 3 | 59 | 7 | 3 | 11 | 23 | 3 |
| 31 | 7 | 59 | 3 | 29 | 11 | 3 | p | 7 | 3 | 107 | p | 3 | 23 | 73 | 3 | 11 | 19 | 3 | 13 | p |
| 33 | 3 | p | 11 | 3 | 53 | p | 3 | p | 19 | 3 | p | 41 | 3 | 7 | 29 | 3 | p | p | 3 | p |
| 37 | 13 | p | 3 | p | 7 | 3 | 71 | 29 | 3 | 11 | p | 3 | p | 13 | 3 | p | 31 | 3 | 7 | 37 |
| 39 | 3 | 101 | p | 3 | p | 53 | 3 | 11 | 59 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | p |
| 41 | 29 | 3 | 7 | 101 | 3 | 11 | 41 | 3 | p | 7 | 3 | 31 | 43 | 3 | 13 | p | 3 | p | p | 3 |
| 43 | p | 7 | 3 | 11 | p | 3 | 19 | 109 | 3 | p | 79 | 3 | p | p | 3 | 7 | p | 3 | 43 | p |
| 47 | 139 | 3 | p | 97 | 3 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | p | 59 | 3 | p | p | 3 |
| 49 | p | 19 | 3 | 13 | 23 | 3 | 157 | p | 3 | 61 | 37 | 3 | 7 | p | 3 | 29 | 13 | 3 | p | 7 |
| 51 | 3 | p | p | 3 | 7 | p | 3 | 53 | p | 3 | 13 | 7 | 3 | 101 | 31 | 3 | 113 | 11 | 3 | p |
| 53 | 67 | 3 | 79 | 7 | 3 | 43 | 89 | 3 | 29 | p | 3 | p | p | 3 | p | 11 | 3 | 7 | 103 | 3 |
| 57 | 3 | 7 | 127 | 3 | 37 | 13 | 3 | 19 | 7 | 3 | p | 11 | 3 | p | p | 3 | p | 43 | 3 | 101 |
| 59 | 7 | 3 | 17 | p | 3 | 41 | p | 3 | p | 11 | 3 | 139 | 13 | 3 | 7 | 61 | 3 | p | 19 | 3 |
| 61 | p | 37 | 3 | 17 | 61 | 3 | 7 | 11 | 3 | 109 | 19 | 3 | p | 7 | 3 | p | 67 | 3 | 11 | 13 |
| 63 | 3 | 73 | 19 | 3 | 17 | 7 | 3 | p | 23 | 3 | 71 | p | 3 | 13 | p | 3 | 11 | p | 3 | 7 |
| 67 | 41 | 11 | 3 | 7 | 43 | 3 | 17 | p | 3 | p | 7 | 3 | 11 | p | 3 | 37 | p | 3 | p | 23 |
| 69 | 3 | p | 7 | 3 | p | 79 | 3 | 17 | 13 | 3 | 11 | p | 3 | 23 | p | 3 | 7 | 73 | 3 | p |
| 71 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | p | 3 | p | 37 | 3 | p | 7 | 3 | p | 41 | 3 |
| 73 | 7 | 23 | 3 | p | p | 3 | 11 | 7 | 3 | 13 | p | 3 | 127 | p | 3 | 107 | p | 3 | p | 19 |
| 77 | p | 3 | 11 | 19 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 73 | p | 3 | 149 | 113 | 3 |
| 79 | 11 | p | 3 | p | 7 | 3 | 23 | 71 | 3 | p | 31 | 3 | 17 | 41 | 3 | p | p | 3 | 7 | 83 |
| 81 | 3 | p | p | 3 | p | 47 | 3 | p | 139 | 3 | 7 | 13 | 3 | 17 | 83 | 3 | 61 | 7 | 3 | p |
| 83 | p | 3 | 7 | 37 | 3 | 13 | p | 3 | 149 | 7 | 3 | p | 131 | 3 | 17 | p | 3 | 19 | 11 | 3 |
| 87 | 3 | 19 | 149 | 3 | 47 | 23 | 3 | 7 | 41 | 3 | p | 89 | 3 | 53 | 7 | 3 | 17 | 107 | 3 | 13 |
| 89 | 13 | 3 | 107 | 29 | 3 | 67 | 7 | 3 | p | p | 3 | p | 11 | 3 | 71 | p | 3 | 17 | p | 3 |
| 91 | p | 17 | 3 | p | 19 | 3 | p | 13 | 3 | 67 | 11 | 3 | 7 | p | 3 | 157 | 23 | 3 | 17 | 7 |
| 93 | 3 | 13 | 17 | 3 | 7 | p | 3 | p | 11 | 3 | 23 | 7 | 3 | 67 | 13 | 3 | p | p | 3 | 11 |
| 97 | p | p | 3 | 31 | 11 | 3 | p | 137 | 3 | 7 | p | 3 | 41 | 109 | 3 | 11 | 7 | 3 | 19 | p |
| 99 | 3 | 7 | 11 | 3 | p | 17 | 3 | p | 7 | 3 | 19 | 113 | 3 | 11 | 43 | 3 | 31 | p | 3 | p |

# INCOMPOSITS.

## TAB. XIV.

| | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 43 | 7 | 3 | 17 | p | 3 | p | p | 3 | 13 | 41 | 3 | 23 | 11 | 3 | 7 | p | 3 | p |
| 03 | p | 3 | p | 29 | 3 | 17 | 37 | 3 | 7 | p | 3 | p | 11 | 3 | 67 | 7 | 3 | 13 | p | 3 |
| 07 | 3 | p | 73 | 3 | p | 13 | 3 | 17 | 11 | 3 | 113 | p | 3 | 7 | p | 3 | 19 | 103 | 3 | 11 |
| 09 | 31 | 3 | p | p | 3 | 7 | 11 | 3 | 17 | 71 | 3 | p | 7 | 3 | p | p | 3 | 11 | p | 3 |
| 11 | 19 | p | 3 | 83 | 7 | 3 | 13 | p | 3 | 17 | p | 3 | p | 31 | 3 | 11 | p | 3 | 7 | 13 |
| 13 | 3 | p | 11 | 3 | 61 | p | 3 | p | p | 3 | 7 | 19 | 3 | 11 | 79 | 3 | 53 | 7 | 3 | 103 |
| 17 | p | 7 | 3 | p | p | 3 | 43 | p | 3 | 11 | p | 3 | 17 | 59 | 3 | 7 | p | 3 | p | p |
| 19 | 3 | p | 157 | 3 | 29 | 23 | 3 | 7 | 13 | 3 | 41 | 47 | 3 | 17 | p | 3 | 71 | 53 | 3 | p |
| 21 | p | 3 | 13 | p | 3 | 11 | 7 | 3 | p | p | 3 | 37 | 163 | 3 | 17 | 13 | 3 | 19 | 43 | 3 |
| 23 | 53 | 151 | 3 | 11 | p | 3 | 79 | p | 3 | 13 | 61 | 3 | 7 | 89 | 3 | 17 | 23 | 3 | p | 7 |
| 27 | 17 | 3 | p | 7 | 3 | 41 | p | 3 | 139 | p | 3 | p | 19 | 3 | p | p | 3 | 7 | p | 3 |
| 29 | p | 17 | 3 | 113 | 13 | 3 | 31 | p | 3 | 7 | 151 | 3 | 73 | p | 3 | p | 7 | 3 | 17 | 11 |
| 31 | 3 | 7 | 17 | 3 | p | 43 | 3 | p | 7 | 3 | p | 13 | 3 | 151 | p | 3 | p | 11 | 3 | 17 |
| 33 | 7 | 3 | 37 | 17 | 3 | 13 | p | 3 | p | 23 | 3 | 43 | 131 | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 37 | 3 | 59 | p | 3 | p | 7 | 3 | p | 47 | 3 | 19 | 11 | 3 | p | p | 3 | 29 | p | 3 | 7 |
| 39 | 13 | 3 | 19 | p | 3 | p | 17 | 3 | p | 11 | 3 | 7 | p | 3 | 23 | p | 3 | p | 7 | 3 |
| 41 | p | p | 3 | 7 | 137 | 3 | p | 11 | 3 | 29 | 7 | 3 | p | 19 | 3 | p | 131 | 3 | 11 | p |
| 43 | 3 | 13 | 7 | 3 | 31 | 11 | 3 | 47 | 17 | 3 | p | p | 3 | 37 | 13 | 3 | 7 | p | 3 | p |
| 47 | 7 | 11 | 3 | p | 53 | 3 | p | 7 | 3 | p | 17 | 3 | 11 | 23 | 3 | 13 | p | 3 | p | p |
| 49 | 3 | 79 | p | 3 | p | 139 | 3 | 23 | p | 3 | 11 | 17 | 3 | 7 | p | 3 | 43 | p | 3 | 19 |
| 51 | 109 | 3 | p | 13 | 3 | 7 | 29 | 3 | 11 | p | 3 | 19 | 7 | 3 | 97 | p | 3 | p | p | 3 |
| 53 | p | p | 3 | 19 | 7 | 3 | 11 | 31 | 3 | p | 13 | 3 | p | 17 | 3 | 59 | p | 3 | 7 | p |
| 57 | 71 | 3 | 7 | p | 3 | p | 19 | 3 | 107 | 7 | 3 | 13 | 97 | 3 | p | 17 | 3 | 41 | 89 | 3 |
| 59 | 11 | 7 | 3 | 43 | p | 3 | 53 | p | 3 | p | p | 3 | p | 109 | 3 | 7 | 17 | 3 | 13 | 73 |
| 61 | 3 | p | p | 3 | 47 | p | 3 | 7 | p | 3 | p | 157 | 3 | p | 7 | 3 | 139 | 17 | 3 | p |
| 63 | 67 | 3 | p | 41 | 3 | 101 | 7 | 3 | p | 59 | 3 | 23 | 137 | 3 | 29 | 43 | 3 | p | 11 | 3 |
| 67 | 3 | 137 | p | 3 | 7 | 31 | 3 | 13 | 67 | 3 | p | 7 | 3 | p | 11 | 3 | 73 | p | 3 | p |
| 69 | 131 | 3 | 109 | 7 | 3 | 163 | p | 3 | 97 | 149 | 3 | 101 | 11 | 3 | 13 | 19 | 3 | 7 | 29 | 3 |
| 71 | 29 | p | 3 | p | 103 | 3 | 149 | 19 | 3 | 7 | 11 | 3 | p | 101 | 3 | 79 | 7 | 3 | 47 | 83 |
| 73 | 3 | 7 | 13 | 3 | 23 | p | 3 | 41 | 7 | 3 | p | 29 | 3 | 31 | 83 | 3 | p | p | 3 | 11 |
| 77 | 89 | p | 3 | 13 | 11 | 3 | 7 | p | 3 | 53 | p | 3 | p | 7 | 3 | 11 | 13 | 3 | 61 | 101 |
| 79 | 3 | 47 | 11 | 3 | p | 7 | 3 | 61 | p | 3 | 13 | p | 3 | 11 | p | 3 | 89 | p | 3 | 7 |
| 81 | 11 | 3 | 41 | 23 | 3 | 19 | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 13 | 7 | 3 |
| 83 | p | p | 3 | 7 | 71 | 3 | p | p | 3 | 11 | 7 | 3 | p | 139 | 3 | p | 19 | 3 | p | p |
| 87 | 19 | 3 | 97 | p | 3 | 11 | p | 3 | 7 | p | 3 | 31 | 13 | 3 | p | 7 | 3 | 37 | 79 | 3 |
| 89 | 7 | p | 3 | 11 | p | 3 | 13 | 7 | 3 | 137 | 103 | 3 | 29 | 61 | 3 | 47 | p | 3 | 167 | 13 |
| 91 | 3 | 11 | 61 | 3 | 59 | p | 3 | 73 | p | 3 | p | p | 3 | 7 | 37 | 3 | p | p | 3 | 23 |
| 93 | 97 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 71 | 7 | 3 | 19 | 41 | 3 | p | p | 3 |
| 97 | 3 | 17 | p | 3 | p | p | 3 | 127 | 13 | 3 | 7 | p | 3 | p | 31 | 3 | p | 7 | 3 | p |
| 99 | p | 3 | 7 | p | 3 | 67 | p | 3 | 37 | 7 | 3 | 59 | p | 3 | 107 | 11 | 3 | p | 23 | 3 |

# INCOMPOSITS.

## TAB. XV.

| | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 3 | p | 7 | 3 | 11 | 37 | 3 | 83 | p | 3 | p | p | 3 | p | p | 3 | 7 | 17 | 3 |
| 03 | 41 | 157 | 3 | 11 | p | 3 | p | p | 3 | 7 | 13 | 3 | 19 | p | 3 | 163 | 7 | 3 | p | 17 |
| 07 | 7 | 3 | 67 | p | 3 | 29 | p | 3 | p | 137 | 3 | 13 | p | 3 | 7 | 19 | 3 | 61 | 41 | 3 |
| 09 | 73 | p | 3 | p | p | 3 | 7 | 19 | 3 | p | p | 3 | p | 7 | 3 | 23 | 29 | 3 | 13 | 11 |
| 11 | 3 | p | p | 3 | p | 7 | 3 | p | 47 | 3 | 67 | 43 | 3 | p | p | 3 | p | 11 | 3 | 7 |
| 13 | 109 | 3 | 89 | 23 | 3 | p | 13 | 3 | p | 29 | 3 | 7 | 131 | 3 | 67 | 11 | 3 | 43 | 7 | 3 |
| 17 | 3 | 31 | 7 | 3 | 157 | p | 3 | 13 | p | 3 | p | 11 | 3 | 19 | 23 | 3 | 7 | p | 3 | p |
| 19 | p | 3 | p | p | 3 | 19 | p | 3 | 7 | 11 | 3 | 37 | 61 | 3 | 13 | 7 | 3 | 113 | p | 3 |
| 21 | 7 | 61 | 3 | 127 | 67 | 3 | p | 7 | 3 | p | p | 3 | p | 109 | 3 | 53 | 19 | 3 | 11 | p |
| 23 | 3 | p | 13 | 3 | 43 | 11 | 3 | p | 19 | 3 | p | p | 3 | 7 | p | 3 | 11 | p | 3 | 23 |
| 27 | p | 11 | 3 | 13 | 7 | 3 | p | 23 | 3 | p | p | 3 | 11 | p | 3 | p | 13 | 3 | 7 | p |
| 29 | 3 | 23 | p | 3 | p | 47 | 3 | p | 127 | 3 | 7 | p | 3 | 139 | p | 3 | p | 7 | 3 | 173 |
| 31 | p | 3 | 7 | 41 | 3 | 103 | p | 3 | 11 | 7 | 3 | p | p | 3 | 19 | p | 3 | 13 | 23 | 3 |
| 33 | 17 | 7 | 3 | 29 | p | 3 | 11 | 59 | 3 | p | p | 3 | 23 | p | 3 | 7 | p | 3 | p | 37 |
| 37 | 23 | 3 | 11 | 43 | 3 | p | 7 | 3 | p | 19 | 3 | p | 13 | 3 | p | p | 3 | 131 | p | 3 |
| 39 | 11 | 19 | 3 | 17 | p | 3 | 13 | 29 | 3 | 43 | 71 | 3 | 7 | p | 3 | 109 | 107 | 3 | 53 | 7 |
| 41 | 3 | 107 | 31 | 3 | 7 | p | 3 | 41 | 151 | 3 | 113 | 7 | 3 | 13 | 59 | 3 | p | p | 3 | 79 |
| 43 | 29 | 3 | 61 | 7 | 3 | 17 | p | 3 | p | 103 | 3 | 151 | p | 3 | p | 31 | 3 | 7 | 11 | 3 |
| 47 | 3 | 7 | 47 | 3 | p | p | 3 | 17 | 7 | 3 | 31 | p | 3 | p | 11 | 3 | 23 | 151 | 3 | p |
| 49 | 7 | 3 | 13 | p | 3 | p | p | 3 | 17 | p | 3 | 103 | 11 | 3 | 7 | 13 | 3 | 71 | 19 | 3 |
| 51 | p | p | 3 | p | 23 | 3 | 7 | p | 3 | 13 | 11 | 3 | p | 7 | 3 | 29 | 149 | 3 | p | 61 |
| 53 | 3 | 47 | 19 | 3 | 37 | 7 | 3 | p | 11 | 3 | 17 | p | 3 | 149 | p | 3 | 13 | p | 3 | 7 |
| 57 | p | 37 | 3 | 7 | 11 | 3 | p | 149 | 3 | 23 | 7 | 3 | 17 | 31 | 3 | 11 | 47 | 3 | 73 | 29 |
| 59 | 3 | 29 | 7 | 3 | 149 | p | 3 | p | p | 3 | p | 13 | 3 | 11 | 89 | 3 | 7 | p | 3 | p |
| 61 | 11 | 3 | 59 | 79 | 3 | 13 | p | 3 | 7 | p | 3 | 11 | 29 | 3 | 17 | 7 | 3 | p | 13 | 3 |
| 63 | 7 | p | 3 | 113 | p | 3 | p | 7 | 3 | 11 | p | 3 | 13 | p | 3 | 17 | p | 3 | p | 19 |
| 67 | 13 | 3 | 23 | 19 | 3 | 7 | 109 | 3 | p | 83 | 3 | p | 7 | 3 | 79 | p | 3 | 17 | p | 3 |
| 69 | p | 17 | 3 | 11 | 7 | 3 | p | 13 | 3 | 59 | 41 | 3 | p | 43 | 3 | p | p | 3 | 7 | 23 |
| 71 | 3 | 11 | 17 | 3 | 71 | p | 3 | p | p | 3 | 7 | 31 | 3 | 23 | 13 | 3 | p | 7 | 3 | 17 |
| 73 | 67 | 3 | 7 | 17 | 3 | p | 53 | 3 | 13 | 7 | 3 | p | 73 | 3 | p | p | 3 | 19 | p | 3 |
| 77 | 3 | 19 | p | 3 | p | 17 | 3 | 7 | 67 | 3 | p | 163 | 3 | 29 | 7 | 3 | 59 | 11 | 3 | 31 |
| 79 | 43 | 3 | p | 13 | 3 | p | 7 | 3 | p | p | 3 | p | 19 | 3 | 41 | 11 | 3 | 97 | p | 3 |
| 81 | p | p | 3 | 101 | 19 | 3 | 23 | 17 | 3 | 73 | 13 | 3 | 7 | 11 | 3 | p | 67 | 3 | p | 7 |
| 83 | 3 | p | p | 3 | 7 | 101 | 3 | 107 | 17 | 3 | 127 | 7 | 3 | p | p | 3 | p | 13 | 3 | p |
| 87 | p | 71 | 3 | p | 61 | 3 | p | 11 | 3 | 7 | 17 | 3 | p | p | 3 | p | 7 | 3 | 11 | 157 |
| 89 | 3 | 7 | p | 3 | 31 | 11 | 3 | p | 7 | 3 | 19 | 17 | 3 | p | 37 | 3 | 11 | p | 3 | p |
| 91 | 7 | 3 | 19 | 11 | 3 | p | 13 | 3 | 167 | 53 | 3 | p | 17 | 3 | 7 | 127 | 3 | 31 | 71 | 3 |
| 93 | 13 | 11 | 3 | p | p | 3 | 7 | p | 3 | 79 | 47 | 3 | 11 | 7 | 3 | 101 | 23 | 3 | 167 | 89 |
| 97 | p | 3 | p | 73 | 3 | p | p | 3 | 11 | 107 | 3 | 7 | p | 3 | 13 | 17 | 3 | 83 | 7 | 3 |
| 99 | p | 163 | 3 | 7 | p | 3 | 11 | 31 | 3 | 47 | 7 | 3 | 83 | p | 3 | p | 17 | 3 | 29 | 131 |

# INCOMPOSITS.

## TAB. XVI.

| | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 19 | 31 | 3 | 157 | 7 | 3 | 71 | 11 | 3 | 13 | 29 | 3 | 41 | 113 | 3 | 17 | p | 3 | 7 | 19 |
| 03 | 3 | p | p | 3 | p | 11 | 3 | p | p | 3 | 7 | 19 | 3 | 23 | 31 | 3 | 11 | 7 | 3 | 61 |
| 07 | 37 | 7 | 3 | p | 13 | 3 | 127 | p | 3 | 31 | 101 | 3 | 11 | p | 3 | 7 | p | 3 | 17 | p |
| 09 | 3 | p | 17 | 3 | 47 | p | 3 | 7 | p | 3 | 11 | 13 | 3 | 131 | 7 | 3 | 73 | 37 | 3 | 17 |
| 11 | p | 3 | p | 17 | 3 | 13 | 7 | 3 | 11 | p | 3 | 53 | 23 | 3 | 101 | p | 3 | 19 | 13 | 3 |
| 13 | p | p | 3 | p | 17 | 3 | 11 | p | 3 | 19 | p | 3 | 7 | 173 | 3 | p | 101 | 3 | 29 | 7 |
| 17 | 13 | 3 | 11 | 7 | 3 | p | 17 | 3 | p | 43 | 3 | 29 | 19 | 3 | 89 | p | 3 | 7 | p | 3 |
| 19 | 11 | p | 3 | p | 19 | 3 | 67 | 13 | 3 | 7 | p | 3 | p | p | 3 | 43 | 7 | 3 | 47 | 59 |
| 21 | 3 | 7 | 47 | 3 | 29 | 23 | 3 | 31 | 7 | 3 | 67 | p | 3 | p | 13 | 3 | 103 | p | 3 | 137 |
| 23 | 7 | 3 | p | p | 3 | 131 | 113 | 3 | 13 | 17 | 3 | p | p | 3 | 7 | 29 | 3 | p | 11 | 3 |
| 27 | 3 | 47 | 167 | 3 | p | 7 | 3 | p | 29 | 3 | 19 | 17 | 3 | p | 11 | 3 | p | p | 3 | 7 |
| 29 | p | 3 | 19 | 13 | 3 | p | 109 | 3 | p | 157 | 3 | 7 | 11 | 3 | 53 | 41 | 3 | p | 7 | 3 |
| 31 | 59 | 29 | 3 | 7 | p | 3 | p | 79 | 3 | p | 7 | 3 | p | 17 | 3 | p | 47 | 3 | 139 | 37 |
| 33 | 3 | p | 7 | 3 | 13 | 19 | 3 | 73 | 11 | 3 | p | 163 | 3 | p | 17 | 3 | 7 | 13 | 3 | 11 |
| 37 | 7 | p | 3 | 23 | 11 | 3 | p | 7 | 3 | p | 41 | 3 | p | p | 3 | 11 | 17 | 3 | 13 | 109 |
| 39 | 3 | p | 11 | 3 | 61 | p | 3 | 59 | p | 3 | p | p | 3 | 7 | 149 | 3 | 29 | 17 | 3 | 19 |
| 41 | 11 | 3 | p | p | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 23 | p | 3 | p | 17 | 3 |
| 43 | 13 | 43 | 3 | 19 | 7 | 3 | p | 71 | 3 | 11 | 37 | 3 | 157 | 13 | 3 | p | p | 3 | 7 | 17 |
| 47 | p | 3 | 7 | p | 3 | 11 | 19 | 3 | 109 | 7 | 3 | p | p | 3 | 13 | p | 3 | 53 | p | 3 |
| 49 | 151 | 7 | 3 | 11 | p | 3 | p | 97 | 3 | p | 61 | 3 | p | 23 | 3 | 7 | p | 3 | p | 43 |
| 51 | 3 | 11 | 13 | 3 | 37 | 137 | 3 | 7 | p | 3 | p | p | 3 | 107 | 7 | 3 | 31 | p | 3 | 89 |
| 53 | 41 | 3 | p | 127 | 3 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | 71 | 139 | 3 | 113 | 53 | 3 |
| 57 | 3 | 53 | 79 | 3 | 7 | p | 3 | p | 59 | 3 | 13 | 7 | 3 | p | 83 | 3 | p | 11 | 3 | p |
| 59 | p | 3 | p | 7 | 3 | p | 23 | 3 | p | 83 | 3 | p | p | 3 | 163 | 11 | 3 | 7 | p | 3 |
| 61 | 23 | p | 3 | 97 | 83 | 3 | p | 19 | 3 | 7 | 89 | 3 | 43 | 11 | 3 | 37 | 7 | 3 | 151 | 31 |
| 63 | 3 | 7 | 53 | 3 | 41 | 13 | 3 | p | 7 | 3 | p | 11 | 3 | 79 | 73 | 3 | p | 23 | 3 | p |
| 67 | 107 | 71 | 3 | p | p | 3 | 7 | 11 | 3 | 173 | 47 | 3 | p | 7 | 3 | p | p | 3 | 11 | 13 |
| 69 | 3 | p | p | 3 | p | 7 | 3 | 29 | p | 3 | p | 71 | 3 | 13 | p | 3 | 11 | p | 3 | 7 |
| 71 | p | 3 | p | 11 | 3 | 19 | p | 3 | p | p | 3 | 7 | p | 3 | 11 | 131 | 3 | p | 7 | 3 |
| 73 | 17 | 11 | 3 | 7 | 31 | 3 | 37 | p | 3 | 47 | 7 | 3 | 11 | 137 | 3 | p | 19 | 3 | p | p |
| 77 | 19 | 3 | 13 | 37 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 43 | 127 | 3 |
| 79 | 7 | 103 | 3 | 17 | 29 | 3 | 11 | 7 | 3 | 13 | p | 3 | 31 | p | 3 | 23 | 79 | 3 | 71 | 113 |
| 81 | 3 | p | 107 | 3 | 11 | 53 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | 13 | 61 | 3 | p |
| 83 | 67 | 3 | 11 | 23 | 3 | 7 | 61 | 3 | 89 | p | 3 | p | 7 | 3 | 19 | p | 3 | 37 | p | 3 |
| 87 | 3 | p | 31 | 3 | 43 | 73 | 3 | 17 | 67 | 3 | 7 | 13 | 3 | p | 23 | 3 | p | 7 | 3 | 29 |
| 89 | p | 3 | 7 | p | 3 | 13 | p | 3 | 17 | 7 | 3 | p | 67 | 3 | p | 31 | 3 | 83 | 11 | 3 |
| 91 | p | 7 | 3 | p | p | 3 | 47 | 41 | 3 | 17 | p | 3 | 13 | p | 3 | 7 | 11 | 3 | p | p |
| 93 | 3 | 109 | p | 3 | p | p | 3 | 7 | p | 3 | 17 | p | 3 | p | 7 | 3 | 41 | p | 3 | 13 |
| 97 | p | p | 3 | 113 | p | 3 | p | 13 | 3 | 139 | 11 | 3 | 7 | p | 3 | 19 | 29 | 3 | 167 | 7 |
| 99 | 3 | 13 | 41 | 3 | 7 | 37 | 3 | 19 | 11 | 3 | 137 | 7 | 3 | 17 | 13 | 3 | p | p | 3 | 11 |

# INCOMPOSITS.

## TAB. XVII.

| | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 47 | 13 | 3 | p | 7 | 3 | 53 | p | 3 | 61 | 79 | 3 | p | 127 | 3 | p | 67 | 3 | 7 |
| 03 | p | 3 | p | p | 3 | p | p | 3 | p | 13 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 07 | 3 | 97 | 7 | 3 | 23 | p | 3 | p | 53 | 3 | 13 | p | 3 | 19 | 11 | 3 | 7 | 37 | 3 | 41 |
| 09 | p | 3 | 31 | p | 3 | 19 | p | 3 | 7 | p | 3 | 113 | 11 | 3 | 47 | 7 | 3 | 13 | p | 3 |
| 11 | 7 | 163 | 3 | 79 | p | 3 | p | 7 | 3 | p | 11 | 3 | p | p | 3 | 23 | 19 | 3 | p | p |
| 13 | 3 | 17 | p | 3 | p | 13 | 3 | p | 11 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 11 |
| 17 | 101 | p | 3 | 17 | 7 | 3 | 13 | p | 3 | p | 137 | 3 | 59 | p | 3 | 11 | p | 3 | 7 | 13 |
| 19 | 3 | p | 11 | 3 | 17 | 31 | 3 | p | 37 | 3 | 7 | p | 3 | 11 | 23 | 3 | p | 7 | 3 | 107 |
| 21 | 11 | 3 | 7 | p | 3 | 17 | p | 3 | 23 | 7 | 3 | 11 | 139 | 3 | 19 | p | 3 | p | 31 | 3 |
| 23 | 31 | 7 | 3 | p | p | 3 | 17 | 43 | 3 | 11 | p | 3 | p | 47 | 3 | 7 | p | 3 | 149 | p |
| 27 | p | 3 | 13 | p | 3 | 11 | 7 | 3 | 17 | 19 | 3 | 157 | 149 | 3 | p | 13 | 3 | 29 | p | 3 |
| 29 | p | 19 | 3 | 11 | p | 3 | 67 | 23 | 3 | 13 | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 31 | 3 | 11 | 167 | 3 | 7 | p | 3 | 71 | p | 3 | 17 | 7 | 3 | p | 101 | 3 | 13 | 89 | 3 | p |
| 33 | 103 | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 17 | 167 | 3 | 67 | p | 3 | 7 | 23 | 3 |
| 37 | 3 | 7 | p | 3 | 163 | p | 3 | 19 | 7 | 3 | p | 13 | 3 | 17 | 29 | 3 | p | 11 | 3 | p |
| 39 | 7 | 3 | 103 | 73 | 3 | 13 | 127 | 3 | p | p | 3 | 31 | 43 | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 41 | 179 | p | 3 | p | p | 3 | 7 | 29 | 3 | p | 19 | 3 | 13 | 7 | 3 | 17 | p | 3 | 43 | p |
| 43 | 3 | p | 19 | 3 | p | 7 | 3 | 137 | p | 3 | 173 | 11 | 3 | p | 53 | 3 | 17 | 41 | 3 | 7 |
| 47 | 73 | 17 | 3 | 7 | 71 | 3 | p | 11 | 3 | 47 | p | 3 | p | p | 3 | p | p | 3 | 11 | 83 |
| 49 | 3 | 13 | 7 | 3 | 37 | 11 | 3 | p | 107 | 3 | 7 | p | 3 | p | 13 | 3 | 7 | p | 3 | 17 |
| 51 | p | 3 | p | 11 | 3 | 43 | 103 | 3 | 7 | 83 | 3 | p | 41 | 3 | 11 | 7 | 3 | p | p | 3 |
| 53 | 7 | 11 | 3 | p | 17 | 3 | p | 7 | 3 | 31 | p | 3 | 11 | p | 3 | 13 | 73 | 3 | 97 | 19 |
| 57 | p | 3 | p | 13 | 3 | 7 | 17 | 3 | 11 | p | 3 | 71 | 7 | 3 | p | 23 | 3 | p | p | 3 |
| 59 | p | p | 3 | p | 7 | 3 | 11 | 17 | 3 | 23 | 13 | 3 | 9 | p | 3 | 37 | 97 | 3 | 7 | 29 |
| 61 | 3 | 29 | p | 3 | 11 | p | 3 | 181 | 17 | 3 | 7 | p | 3 | 73 | p | 3 | 41 | 7 | 3 | p |
| 63 | p | 3 | 7 | p | 3 | p | 89 | 3 | 59 | 7 | 3 | 13 | 29 | 3 | 109 | p | 3 | 19 | p | 3 |
| 67 | 3 | 19 | 41 | 3 | p | 29 | 3 | 7 | 23 | 3 | 43 | 17 | 3 | 61 | 7 | 3 | 131 | p | 3 | p |
| 69 | p | 3 | 23 | p | 3 | p | 7 | 3 | p | p | 3 | 41 | 17 | 3 | p | p | 3 | p | 11 | 3 |
| 71 | 13 | 53 | 3 | p | 19 | 3 | 37 | p | 3 | p | p | 3 | 7 | 13 | 3 | 59 | 11 | 3 | p | 7 |
| 73 | 3 | p | 59 | 3 | 7 | p | 3 | 13 | 71 | 3 | p | 7 | 3 | 23 | 11 | 3 | 151 | p | 3 | 53 |
| 77 | p | 23 | 3 | p | 47 | 3 | 41 | 73 | 3 | 7 | 11 | 3 | 107 | p | 3 | p | 7 | 3 | 19 | 61 |
| 79 | 3 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 | 19 | p | 3 | 29 | p | 3 | p | 17 | 3 | 11 |
| 81 | 7 | 3 | 19 | p | 3 | 31 | 11 | 3 | 131 | 13 | 3 | p | 23 | 3 | 7 | p | 3 | 11 | 17 | 3 |
| 83 | p | p | 3 | 13 | 11 | 3 | 7 | p | 3 | p | p | 3 | 83 | 7 | 3 | 11 | 13 | 3 | 31 | 17 |
| 87 | 11 | 3 | 83 | 139 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 13 | 7 | 3 |
| 89 | p | p | 3 | 7 | 53 | 3 | 97 | p | 3 | 11 | 7 | 3 | p | 173 | 3 | p | 59 | 3 | p | 41 |
| 91 | 3 | p | 7 | 3 | p | 13 | 3 | 11 | 31 | 3 | p | p | 3 | p | 107 | 7 | 3 | p | 3 | 19 |
| 93 | 67 | 3 | 43 | 29 | 3 | 11 | p | 3 | 7 | p | 3 | 19 | 13 | 3 | p | 3 | 3 | 47 | p | 3 |
| 97 | 3 | 11 | p | 3 | p | 37 | 3 | p | 67 | 3 | 23 | 89 | 3 | 7 | 19 | 3 | 31 | p | 3 | p |
| 99 | p | 3 | p | 179 | 3 | 7 | 19 | 3 | 167 | p | 3 | p | 7 | 3 | 139 | p | 3 | 73 | 109 | 3 |

# INCOMPOSITS.

## TAB. XVIII.

| | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 11 | 3 | 23 | p | 3 | p | 7 | 3 | 13 | 17 | 3 | 11 | p | 3 | p | 131 | 3 | 19 | p | 3 |
| 03 | 37 | 67 | 3 | p | p | 3 | p | p | 3 | 11 | 17 | 3 | 7 | 43 | 3 | 13 | p | 3 | p | 7 |
| 07 | 31 | 3 | 79 | 7 | 3 | 11 | p | 3 | p | 67 | 3 | p | 17 | 3 | p | p | 3 | 7 | 61 | 3 |
| 09 | 71 | 23 | 3 | 11 | 19 | 3 | 53 | 61 | 3 | 7 | 13 | 3 | 137 | 17 | 3 | p | 7 | 3 | p | 149 |
| 11 | 3 | 7 | p | 3 | 13 | p | 3 | 103 | 7 | 3 | 157 | p | 3 | p | 17 | 3 | 149 | 13 | 3 | p |
| 13 | 7 | 3 | p | p | 3 | p | p | 3 | 31 | p | 3 | 13 | 23 | 3 | 7 | 17 | 3 | 71 | 59 | 3 |
| 17 | 3 | 109 | p | 3 | 127 | 7 | 3 | 149 | 37 | 3 | 19 | p | 3 | p | 107 | 3 | p | 11 | 3 | 7 |
| 19 | p | 3 | 19 | p | 3 | p | 13 | 3 | p | p | 3 | 7 | 41 | 3 | p | 11 | 3 | 23 | 7 | 3 |
| 21 | 13 | 149 | 3 | 7 | p | 3 | 89 | p | 3 | 47 | 7 | 3 | p | 11 | 3 | p | 179 | 3 | 113 | 17 |
| 23 | 3 | p | 7 | 3 | 29 | 19 | 3 | 13 | 97 | 3 | p | 11 | 3 | p | p | 3 | 7 | 139 | 3 | p |
| 27 | 7 | p | 3 | p | 173 | 3 | 31 | 7 | 3 | 53 | p | 3 | p | p | 3 | p | 23 | 3 | 11 | 37 |
| 29 | 3 | p | 13 | 3 | p | 11 | 3 | p | 29 | 3 | 23 | p | 3 | 7 | 71 | 3 | 11 | p | 3 | 19 |
| 31 | p | 3 | p | 11 | 3 | 7 | p | 3 | 61 | 13 | 3 | 19 | p | 3 | 11 | p | 3 | p | p | 3 |
| 33 | p | 11 | 3 | 13 | 7 | 3 | 59 | 47 | 3 | 181 | 53 | 3 | 11 | 89 | 3 | p | 13 | 3 | 7 | p |
| 37 | 101 | 3 | 7 | p | 3 | p | 19 | 3 | 11 | 7 | 3 | 41 | 167 | 3 | p | p | 3 | 13 | p | 3 |
| 39 | p | 7 | 3 | 23 | p | 3 | 11 | p | 3 | p | 37 | 3 | 131 | p | 3 | 7 | 157 | 3 | p | 83 |
| 41 | 3 | p | 97 | 3 | 11 | 13 | 3 | 7 | p | 3 | 67 | p | 3 | 59 | 7 | 3 | 29 | 103 | 3 | 127 |
| 43 | 59 | 3 | 11 | 61 | 3 | p | 7 | 3 | p | 83 | 3 | 113 | 13 | 3 | 23 | p | 3 | 31 | 73 | 3 |
| 47 | 3 | p | 23 | 3 | 7 | 179 | 3 | p | p | 3 | 101 | 7 | 3 | 13 | p | 3 | 43 | p | 3 | 103 |
| 49 | 79 | 3 | 29 | 7 | 3 | p | p | 3 | p | p | 3 | p | 101 | 3 | p | 19 | 3 | 7 | 11 | 3 |
| 51 | 17 | 13 | 3 | p | 47 | 3 | p | 19 | 3 | 7 | p | 3 | p | 23 | 3 | 73 | 7 | 3 | p | p |
| 53 | 3 | 7 | p | 3 | 131 | 109 | 3 | 23 | 7 | 3 | p | p | 3 | p | 11 | 3 | 101 | p | 3 | 157 |
| 57 | p | p | 3 | 17 | p | 3 | 7 | p | 3 | 13 | 11 | 3 | p | 7 | 3 | 31 | 181 | 3 | 23 | 41 |
| 59 | 3 | p | p | 3 | 17 | 7 | 3 | p | 11 | 3 | p | p | 3 | 19 | 59 | 3 | 13 | p | 3 | 7 |
| 61 | p | 3 | p | p | 3 | 17 | 11 | 3 | 71 | p | 3 | 7 | 37 | 3 | p | 43 | 3 | 11 | 7 | 3 |
| 63 | 23 | 127 | 3 | 7 | 11 | 3 | 17 | p | 3 | p | 7 | 3 | 179 | p | 3 | 11 | 19 | 3 | p | p |
| 67 | 11 | 3 | p | p | 3 | 13 | p | 3 | 7 | 73 | 3 | 11 | p | 3 | 29 | 7 | 3 | 47 | 13 | 3 |
| 69 | 7 | 47 | 3 | p | p | 3 | 37 | 7 | 3 | 11 | p | 3 | 13 | 113 | 3 | p | 53 | 3 | p | p |
| 71 | 3 | p | 43 | 3 | p | 181 | 3 | 11 | p | 3 | 17 | p | 3 | 7 | 79 | 3 | p | p | 3 | 13 |
| 73 | 13 | 3 | p | 37 | 3 | 7 | p | 3 | 43 | 41 | 3 | 17 | 7 | 3 | 19 | p | 3 | 83 | 29 | 3 |
| 77 | 3 | 11 | 151 | 3 | 23 | 71 | 3 | 83 | p | 3 | 7 | 29 | 3 | 17 | 13 | 3 | p | 7 | 3 | p |
| 79 | 53 | 3 | 7 | 31 | 3 | 151 | p | 3 | 13 | 7 | 3 | 127 | p | 3 | 17 | 47 | 3 | 37 | p | 3 |
| 81 | 173 | 7 | 3 | p | 29 | 3 | 79 | p | 3 | p | p | 3 | p | p | 3 | 7 | 31 | 3 | 53 | 11 |
| 83 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 | p | 151 | 3 | 41 | 7 | 3 | 17 | 11 | 3 | p |
| 87 | 89 | 17 | 3 | 137 | p | 3 | p | 43 | 3 | 59 | 13 | 3 | 7 | 11 | 3 | 19 | 127 | 3 | 17 | 7 |
| 89 | 7 | 179 | 17 | 3 | 7 | p | 3 | 19 | 139 | 3 | p | 7 | 3 | 43 | 23 | 3 | 89 | 13 | 3 | 17 |
| 91 | 73 | 3 | 53 | 7 | 3 | p | 113 | 3 | 23 | 11 | 3 | 13 | p | 3 | p | p | 3 | 7 | 19 | 3 |
| 93 | 103 | 31 | 3 | 163 | 17 | 3 | p | 11 | 3 | 7 | 19 | 3 | 29 | p | 3 | p | 7 | 3 | 11 | p |
| 97 | 3 | 3 | p | 11 | 3 | 29 | 13 | 3 | p | 79 | 3 | 61 | 47 | 3 | 7 | p | 3 | p | p | 3 |
| 99 | 13 | 11 | 3 | 41 | p | 3 | 7 | 17 | 3 | 31 | p | 3 | 11 | 7 | 3 | 97 | 29 | 3 | p | p |

# INCOMPOSITS.

## TAB. XIX.

| | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7 | 13 | 3 | 31 | 89 | 3 | 17 | 7 | 3 | p | 163 | 3 | p | 11 | 3 | p | 19 | 3 | 103 | 151 |
| 03 | 3 | 79 | 41 | 3 | 59 | 173 | 3 | 17 | 13 | 3 | p | 11 | 3 | 7 | 113 | 3 | 31 | 37 | 3 | 29 |
| 07 | p | p | 3 | p | 7 | 3 | p | 11 | 3 | 13 | 23 | 3 | 29 | p | 3 | p | p | 3 | 7 | p |
| 09 | 3 | p | p | 3 | 23 | 11 | 3 | p | p | 3 | 7 | 43 | 3 | p | p | 3 | 11 | 7 | 3 | 167 |
| 11 | p | 3 | 7 | 11 | 3 | 29 | 31 | 3 | 131 | 7 | 3 | 17 | 127 | 3 | 11 | p | 3 | 43 | p | 3 |
| 13 | p | 7 | 3 | p | 13 | 3 | 19 | p | 3 | p | p | 3 | 11 | p | 3 | 7 | 29 | 3 | p | 31 |
| 17 | p | 3 | p | 23 | 3 | 13 | 7 | 3 | 11 | 19 | 3 | p | p | 3 | 17 | p | 3 | p | 13 | 3 |
| 19 | 181 | 19 | 3 | p | 79 | 3 | 11 | 73 | 3 | p | p | 3 | 7 | 67 | 3 | 17 | p | 3 | 59 | 7 |
| 21 | 3 | 41 | 29 | 3 | 7 | 59 | 3 | p | p | 3 | p | 7 | 3 | p | 23 | 3 | 17 | 67 | 3 | 13 |
| 23 | 13 | 3 | 11 | 7 | 3 | p | 53 | 3 | 23 | p | 3 | p | p | 3 | p | 157 | 3 | 7 | 109 | 3 |
| 27 | 3 | 7 | 17 | 3 | 73 | p | 3 | 19 | 7 | 3 | 61 | 137 | 3 | 163 | 13 | 3 | 191 | 31 | 3 | 17 |
| 29 | 7 | 3 | p | 17 | 3 | p | p | 3 | 13 | p | 3 | 107 | 59 | 3 | 7 | p | 3 | 29 | 11 | 3 |
| 31 | 137 | p | 3 | 47 | 17 | 3 | 7 | 23 | 3 | p | 19 | 3 | 31 | 7 | 3 | 13 | 11 | 3 | p | 83 |
| 33 | 3 | 23 | 19 | 3 | p | 7 | 3 | 109 | p | 3 | 29 | 71 | 3 | 37 | 11 | 3 | p | 97 | 3 | 7 |
| 37 | p | p | 3 | 7 | 83 | 3 | p | 17 | 3 | 43 | 7 | 3 | 23 | p | 3 | p | 61 | 3 | 157 | 59 |
| 39 | 3 | 71 | 7 | 3 | 13 | 61 | 3 | p | 11 | 3 | p | p | 3 | p | 29 | 3 | 7 | 13 | 3 | 11 |
| 41 | 23 | 3 | p | p | 3 | p | 11 | 3 | 7 | 17 | 3 | 13 | 167 | 3 | p | 7 | 3 | 11 | 79 | 3 |
| 43 | 7 | 47 | 3 | p | 11 | 3 | p | 7 | 3 | p | 17 | 3 | p | 107 | 3 | 11 | p | 3 | 13 | 19 |
| 47 | 11 | 3 | 67 | 19 | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 |
| 49 | 13 | 37 | 3 | 163 | 7 | 3 | 67 | p | 3 | 11 | p | 3 | 193 | 13 | 3 | p | p | 3 | 7 | 137 |
| 51 | 3 | p | p | 3 | p | p | 3 | 11 | 43 | 3 | 7 | 97 | 3 | 41 | 17 | 3 | 23 | 7 | 3 | p |
| 53 | 31 | 3 | 7 | p | 3 | 11 | p | 3 | 137 | 7 | 3 | 53 | p | 3 | 13 | 17 | 3 | 19 | p | 3 |
| 57 | 3 | 11 | 13 | 3 | p | 139 | 3 | 7 | p | 3 | p | 73 | 3 | p | 7 | 3 | p | 17 | 3 | p |
| 59 | 107 | 3 | 101 | 103 | 3 | p | 7 | 3 | 29 | 13 | 3 | p | 19 | 3 | 47 | 23 | 3 | 61 | 17 | 3 |
| 61 | p | p | 3 | 13 | 19 | 3 | 61 | p | 3 | 23 | p | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 |
| 63 | 3 | 29 | p | 3 | 7 | p | 3 | 97 | 191 | 3 | 13 | 7 | 3 | p | p | 3 | p | 11 | 3 | p |
| 67 | p | 59 | 3 | 41 | p | 3 | 37 | p | 3 | 7 | 101 | 3 | 83 | 11 | 3 | p | 7 | 3 | 19 | p |
| 69 | 3 | 7 | p | 3 | p | 13 | 3 | 83 | 7 | 3 | 19 | 11 | 3 | p | 89 | 3 | 139 | 179 | 3 | 43 |
| 71 | 7 | 3 | 19 | 37 | 3 | p | p | 3 | p | 11 | 3 | p | 13 | 3 | 7 | p | 3 | 107 | p | 3 |
| 73 | p | 61 | 3 | p | p | 3 | 7 | 11 | 3 | p | 131 | 3 | p | 7 | 3 | p | 101 | 3 | 11 | 13 |
| 77 | 43 | 3 | p | 11 | 3 | 79 | p | 3 | p | 103 | 3 | 7 | p | 3 | 11 | 53 | 3 | 37 | 7 | 3 |
| 79 | 109 | 11 | 3 | 7 | p | 3 | 43 | p | 3 | p | 7 | 3 | 11 | p | 3 | p | 41 | 3 | p | 163 |
| 81 | 3 | 97 | 7 | 3 | 191 | 157 | 3 | p | 13 | 3 | 11 | p | 3 | 29 | 37 | 3 | 7 | p | 3 | 19 |
| 83 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | 31 | 3 | 19 | 23 | 3 | p | 13 | 3 | p | 43 | 3 |
| 87 | 3 | p | 131 | 3 | 11 | p | 3 | p | p | 3 | p | 41 | 3 | 7 | 19 | 3 | 13 | 29 | 3 | p |
| 89 | 151 | 3 | 11 | p | 3 | 7 | 19 | 3 | 37 | 47 | 3 | p | 7 | 3 | p | p | 3 | 23 | p | 3 |
| 91 | 11 | p | 3 | 151 | 7 | 3 | p | p | 3 | 71 | 29 | 3 | 89 | 139 | 3 | p | p | 3 | 7 | p |
| 93 | 3 | 17 | p | 3 | p | 23 | 3 | p | 79 | 3 | 7 | 13 | 3 | 61 | p | 3 | p | 7 | 3 | p |
| 97 | p | 7 | 3 | 17 | p | 3 | p | 31 | 3 | p | p | 3 | 13 | p | 3 | 7 | 11 | 3 | p | p |
| 99 | 3 | 53 | p | 3 | 17 | p | 3 | 7 | p | 3 | 23 | p | 3 | 149 | 7 | 3 | p | p | 3 | 13 |

# INCOMPOSITS.

## TAB. XX.

| | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 7 | p | 3 | 11 | p | 3 | 13 | 7 | 3 | 43 | 61 | 3 | p | 31 | 3 | 199 | 29 | 3 | p |
| 03 | 7 | 3 | 11 | p | 3 | 139 | p | 3 | p | p | 3 | p | 197 | 3 | 7 | p | 3 | p | 53 | 3 |
| 07 | 3 | 53 | 13 | 3 | 193 | 7 | 3 | p | 151 | 3 | 19 | p | 3 | 23 | 157 | 3 | p | 59 | 3 | 7 |
| 09 | 191 | 3 | 19 | 29 | 3 | 97 | p | 3 | 197 | 13 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 11 | p | 23 | 3 | 7 | 71 | 3 | p | p | 3 | 167 | 7 | 3 | 113 | 19 | 3 | p | 11 | 3 | 41 | 107 |
| 13 | 3 | p | 7 | 3 | 107 | 19 | 3 | p | 37 | 3 | 13 | p | 3 | p | 11 | 3 | 7 | 151 | 3 | 167 |
| 17 | 7 | 47 | 3 | p | 41 | 3 | 23 | 7 | 3 | p | 11 | 3 | p | p | 3 | 43 | 173 | 3 | 29 | 179 |
| 19 | 3 | p | p | 3 | 103 | 13 | 3 | 31 | 11 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 11 |
| 21 | 193 | 3 | 37 | p | 3 | 7 | 11 | 3 | p | p | 3 | 19 | 7 | 3 | 79 | p | 3 | 11 | p | 3 |
| 23 | 47 | 67 | 3 | 19 | 7 | 3 | 13 | p | 3 | p | p | 3 | 61 | p | 3 | 11 | p | 3 | 7 | 13 |
| 27 | 11 | 3 | 7 | p | 3 | 59 | 19 | 3 | 41 | 7 | 3 | 11 | p | 3 | 89 | 29 | 3 | p | p | 3 |
| 29 | 17 | 7 | 3 | p | 83 | 3 | p | p | 3 | 11 | 31 | 3 | p | 67 | 3 | 7 | 23 | 3 | p | p |
| 31 | 3 | 17 | p | 3 | p | 53 | 3 | 7 | 13 | 3 | 23 | 109 | 3 | 37 | 7 | 3 | p | 67 | 3 | 73 |
| 33 | 73 | 3 | 13 | p | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 | 47 | 13 | 3 | p | 61 | 3 |
| 37 | 3 | 11 | p | 3 | 7 | 89 | 3 | p | 71 | 3 | 103 | 7 | 3 | 139 | 113 | 3 | 13 | 79 | 3 | p |
| 39 | p | 3 | p | 7 | 3 | 17 | p | 3 | p | 23 | 3 | p | p | 3 | p | 19 | 3 | 7 | p | 3 |
| 41 | 109 | 43 | 3 | 23 | 13 | 3 | 17 | 19 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | p | 11 |
| 43 | 3 | 7 | 167 | 3 | 37 | p | 3 | 17 | 7 | 3 | p | 13 | 3 | p | p | 3 | 29 | 11 | 3 | 59 |
| 47 | p | 37 | 3 | 31 | p | 3 | 7 | p | 3 | 17 | p | 3 | 13 | 7 | 3 | 71 | 41 | 3 | p | 43 |
| 49 | 3 | p | 23 | 3 | p | 7 | 3 | p | 53 | 3 | 17 | 11 | 3 | 19 | 103 | 3 | 31 | p | 3 | 7 |
| 51 | 13 | p | 29 | p | 3 | 19 | p | 3 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | 127 | 7 | 3 |
| 53 | p | 3 | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 17 | 23 | 3 | 37 | 19 | 3 | 11 | p |
| 57 | 19 | p | 67 | 11 | 3 | p | 29 | 3 | 7 | 163 | 3 | p | 37 | 3 | 11 | 7 | 3 | 83 | p | 3 |
| 59 | 7 | 11 | 3 | 89 | p | 3 | 67 | 7 | 3 | p | 139 | 3 | 11 | p | 3 | 13 | p | 3 | 23 | 31 |
| 61 | 3 | 31 | p | 3 | p | p | 3 | 83 | p | 3 | 11 | p | 3 | 7 | p | 3 | 17 | p | 3 | 89 |
| 63 | 17 | 3 | 83 | 13 | 3 | 7 | 23 | 3 | 11 | 47 | 3 | p | 7 | 3 | 19 | p | 3 | 17 | p | 3 |
| 67 | 3 | p | 17 | 3 | 11 | p | 3 | p | p | 3 | 7 | 53 | 3 | p | 61 | 3 | p | 7 | 3 | 17 |
| 69 | p | 3 | 7 | 17 | 3 | p | p | 3 | 47 | 7 | 3 | 13 | 107 | 3 | 29 | p | 3 | p | p | 3 |
| 71 | 11 | 7 | 3 | p | 17 | 3 | p | 137 | 3 | p | 89 | 3 | 173 | p | 3 | 7 | p | 3 | 13 | p |
| 73 | 3 | 59 | p | 3 | 79 | 17 | 3 | 7 | p | 3 | 41 | 43 | 3 | p | 7 | 3 | 97 | 31 | 3 | 71 |
| 77 | 13 | p | 3 | p | 109 | 3 | p | 17 | 3 | p | 23 | 3 | 7 | 13 | 3 | 19 | 11 | 3 | p | 7 |
| 79 | 3 | 73 | 101 | 3 | 7 | 173 | 3 | 13 | 17 | 3 | p | 7 | 3 | 53 | 11 | 3 | p | p | 3 | p |
| 81 | 113 | 3 | p | 7 | 3 | 41 | 47 | 3 | 59 | 17 | 3 | p | 11 | 3 | 13 | p | 3 | 7 | 19 | 3 |
| 83 | p | p | 3 | 131 | 29 | 3 | 101 | p | 3 | 7 | 11 | 3 | 163 | p | 3 | 23 | 7 | 3 | p | p |
| 87 | 7 | 3 | p | 23 | 3 | 47 | 11 | 3 | 37 | 13 | 3 | 149 | 17 | 3 | 7 | 31 | 3 | 11 | p | 3 |
| 89 | 41 | p | 3 | 13 | 11 | 3 | 7 | 79 | 3 | 127 | p | 3 | 101 | 7 | 3 | 11 | 13 | 3 | 113 | p |
| 91 | 3 | 181 | 11 | 3 | 61 | 7 | 3 | p | p | 3 | 13 | p | 3 | 11 | 17 | 3 | 19 | p | 3 | 7 |
| 93 | 11 | 3 | 149 | p | 3 | p | p | 3 | 19 | p | 3 | 7 | p | 3 | 73 | 17 | 3 | 13 | 7 | 3 |
| 97 | 3 | p | 7 | 3 | 137 | 13 | 3 | 11 | 97 | 3 | p | 19 | 3 | p | 127 | 3 | 7 | 17 | 3 | 23 |
| 99 | 31 | 3 | p | 19 | 3 | 11 | p | 3 | 7 | 59 | 3 | p | 13 | 3 | p | 7 | 3 | p | 17 | 3 |

# INCOMPOSITS.

## TAB. XXI.

| | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 13 | 3 | 7 | 191 | 3 | 101 | 11 | 3 | p | 7 | 3 | 23 | p | 3 | 19 | 47 | 3 | 11 | p | 3 |
| 03 | 109 | 7 | 3 | 41 | 11 | 3 | 19 | 13 | 3 | p | 131 | 3 | p | 103 | 3 | 7 | p | 3 | 17 | p |
| 07 | 11 | 3 | 31 | 17 | 3 | p | 7 | 3 | 13 | 19 | 3 | 11 | 89 | 3 | 47 | p | 3 | 179 | 97 | 3 |
| 09 | p | 19 | 3 | 173 | 17 | 3 | p | p | 3 | 11 | 23 | 3 | 7 | 101 | 3 | 13 | p | 3 | p | 7 |
| 11 | 3 | p | 75 | 3 | 7 | 17 | 3 | 11 | 37 | 3 | p | 7 | 3 | 109 | p | 3 | p | 53 | 3 | p |
| 13 | p | 3 | p | 7 | 3 | 11 | 17 | 3 | p | 163 | 3 | p | p | 3 | p | p | 3 | 7 | p | 3 |
| 17 | 3 | 7 | 131 | 3 | 13 | 31 | 3 | 19 | 7 | 3 | p | p | 3 | 79 | 83 | 3 | p | 13 | 3 | 167 |
| 19 | 7 | 3 | 37 | 23 | 3 | p | 151 | 3 | p | 17 | 3 | 13 | 47 | 3 | 7 | p | 3 | p | 19 | 3 |
| 21 | 31 | 53 | 3 | 61 | 83 | 3 | 7 | 43 | 3 | 151 | 17 | 3 | p | 7 | 3 | p | p | 3 | 13 | 11 |
| 23 | 3 | p | 19 | 3 | p | 7 | 3 | 193 | p | 3 | p | 17 | 3 | 31 | 23 | 3 | 107 | 11 | 3 | 7 |
| 27 | 13 | p | 3 | 7 | p | 3 | p | 139 | 3 | p | 7 | 3 | p | 11 | 3 | 131 | p | 3 | 151 | p |
| 29 | 3 | p | 7 | 3 | p | p | 3 | 13 | p | 3 | 89 | 11 | 3 | 37 | 17 | 3 | 7 | p | 3 | 23 |
| 31 | p | 3 | p | 31 | 3 | p | 41 | 3 | 7 | 11 | 3 | p | p | 3 | 13 | 7 | 3 | 29 | 59 | 3 |
| 33 | 7 | 67 | 3 | 53 | p | 3 | 179 | 7 | 3 | p | 37 | 3 | p | p | 3 | 41 | 17 | 3 | 11 | 19 |
| 37 | p | 3 | p | 11 | 3 | 7 | p | 3 | 97 | 13 | 3 | 31 | 7 | 3 | 11 | 73 | 3 | p | 17 | 3 |
| 39 | p | 11 | 3 | 13 | 7 | 3 | p | p | 3 | p | p | 3 | 11 | 67 | 3 | p | 13 | 3 | 7 | 17 |
| 41 | 3 | 137 | p | 3 | 37 | 71 | 3 | 131 | p | 3 | 7 | p | 3 | p | 29 | 3 | p | 7 | 3 | p |
| 43 | 23 | 3 | 7 | p | 3 | p | 97 | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 | 13 | p | 3 |
| 47 | 3 | 19 | 167 | 3 | 11 | 13 | 3 | 7 | p | 3 | p | 23 | 3 | 173 | 7 | 3 | p | 109 | 3 | p |
| 49 | 19 | 3 | 11 | 157 | 3 | 23 | 7 | 3 | p | p | 3 | p | 13 | 3 | 181 | p | 3 | 83 | p | 3 |
| 51 | 11 | p | 3 | p | 19 | 3 | 13 | p | 3 | 31 | p | 3 | 7 | p | 3 | 37 | p | 3 | p | 7 |
| 53 | 3 | p | p | 3 | 7 | 107 | 3 | 83 | p | 3 | 61 | 7 | 3 | 13 | p | 3 | 23 | 43 | 3 | p |
| 57 | 41 | 13 | 3 | p | 23 | 3 | 109 | 53 | 3 | 7 | p | 3 | p | p | 3 | 29 | 7 | 3 | 19 | p |
| 59 | 3 | 7 | 127 | 3 | p | p | 3 | 3 | 7 | 3 | 19 | 79 | 3 | 59 | 11 | 3 | p | p | 3 | p |
| 61 | 7 | 3 | 13 | p | 3 | 47 | 73 | 3 | 29 | p | 3 | p | 11 | 3 | 7 | 13 | 3 | p | 41 | 3 |
| 63 | p | p | 3 | 181 | 43 | 3 | 7 | p | 3 | 13 | 11 | 3 | p | 7 | 3 | 89 | 61 | 3 | p | 29 |
| 67 | 103 | 3 | 67 | 37 | 3 | 113 | 11 | 3 | p | 71 | 3 | 7 | 29 | 3 | p | 197 | 3 | 11 | 7 | 3 |
| 69 | 17 | p | 3 | 7 | 11 | 3 | 67 | 59 | 3 | 53 | 7 | 3 | p | 41 | 3 | 11 | p | 3 | 149 | p |
| 71 | 3 | 17 | 7 | 3 | p | 29 | 3 | p | 23 | 3 | 67 | 13 | 3 | 11 | 113 | 3 | 7 | p | 3 | 19 |
| 73 | 11 | 3 | 17 | 47 | 3 | 13 | 89 | 3 | 7 | p | 3 | 11 | 149 | 3 | 67 | 7 | 3 | 37 | 13 | 3 |
| 77 | 3 | p | p | 3 | 17 | p | 3 | 11 | 41 | 3 | p | p | 3 | 7 | 19 | 3 | 71 | p | 3 | 13 |
| 79 | 13 | 3 | 47 | 149 | 3 | 7 | 19 | 3 | p | 43 | 3 | p | 7 | 3 | p | p | 3 | 41 | p | 3 |
| 81 | 149 | 23 | 3 | 11 | 7 | 3 | 17 | 13 | 3 | 107 | p | 3 | p | p | 3 | 41 | p | 3 | 7 | p |
| 83 | 3 | 11 | p | 3 | p | p | 3 | 17 | p | 3 | 7 | p | 3 | 29 | 13 | 3 | 73 | 7 | 3 | p |
| 87 | p | 7 | 3 | p | p | 3 | 23 | p | 3 | 17 | 181 | 3 | 19 | p | 3 | 7 | p | 3 | p | 11 |
| 89 | 3 | p | p | 3 | 19 | 37 | 3 | 7 | 31 | 3 | 17 | p | 3 | p | 7 | 3 | 47 | 11 | 3 | 199 |
| 91 | 47 | 3 | 43 | 13 | 3 | p | 7 | 3 | 103 | 179 | 3 | 17 | 157 | 3 | p | 11 | 3 | 23 | 163 | 3 |
| 93 | p | p | 3 | 31 | p | 3 | p | 19 | 3 | p | 13 | 3 | 7 | 11 | 3 | p | 173 | 3 | p | 7 |
| 97 | 101 | 3 | 59 | 7 | 3 | p | p | 3 | p | 11 | 3 | 13 | 61 | 3 | 17 | p | 3 | 7 | p | 3 |
| 99 | p | 61 | 3 | 71 | p | p | p | 11 | 3 | 7 | 73 | 3 | p | p | 3 | 17 | 7 | 3 | 11 | p |

# INCOMPOSITS.

## TAB. XXII.

| | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 97 | p | 3 | 7 | 109 | 3 | 13 | p | 3 | p | 7 | 3 | p | 19 | 3 | 41 | 59 | 3 | p | 11 |
| 03 | 3 | 71 | 7 | 3 | p | 19 | 3 | p | 23 | 3 | p | p | 3 | 13 | p | 3 | 7 | 11 | 3 | 43 |
| 07 | 7 | 13 | 3 | p | p | 3 | 137 | 7 | 3 | 107 | 29 | 3 | p | 11 | 3 | 139 | p | 3 | 71 | 23 |
| 09 | 3 | 17 | p | 3 | p | p | 3 | p | 13 | 3 | 41 | 11 | 3 | 7 | 83 | 3 | p | 109 | 3 | 19 |
| 11 | 43 | 3 | 13 | 29 | 3 | 7 | p | 3 | 31 | 11 | 3 | 19 | 7 | 3 | p | 13 | 3 | p | 193 | 3 |
| 13 | p | 23 | 3 | 17 | 7 | 3 | 43 | 11 | 3 | 13 | p | 3 | 79 | p | 3 | 53 | p | 3 | 7 | p |
| 17 | p | 3 | 7 | 11 | 3 | 17 | 19 | 3 | 47 | 7 | 3 | p | 23 | 3 | 11 | p | 3 | p | 43 | 3 |
| 19 | p | 7 | 3 | 101 | 13 | 3 | 17 | p | 3 | 167 | p | 3 | 11 | p | 3 | 7 | 53 | 3 | 29 | 37 |
| 21 | 3 | 73 | p | 3 | 59 | 101 | 3 | 7 | p | 3 | 11 | 13 | 3 | p | 7 | 3 | 181 | p | 3 | 167 |
| 23 | p | 3 | p | p | 3 | 13 | 7 | 3 | 11 | p | 3 | 29 | p | 3 | 173 | 71 | 3 | 23 | 13 | 3 |
| 27 | 3 | 103 | p | 3 | 7 | 23 | 3 | p | 113 | 3 | 17 | 7 | 3 | 37 | p | 3 | p | 73 | 3 | 13 |
| 29 | 13 | 3 | 11 | 7 | 3 | 71 | 47 | 3 | p | p | 3 | 17 | 139 | 3 | 137 | 19 | 3 | 7 | 41 | 3 |
| 31 | 11 | p | 3 | p | 151 | 3 | 89 | 13 | 3 | 7 | 37 | 3 | 17 | p | 3 | 101 | 7 | 3 | 53 | 197 |
| 33 | 3 | 7 | 157 | 3 | p | p | 3 | 151 | 7 | 3 | 23 | p | 3 | 17 | 13 | 3 | p | 101 | 3 | p |
| 37 | 127 | 29 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 13 | 11 | 3 | 59 | 53 |
| 39 | 3 | p | p | 3 | 31 | 7 | 3 | 79 | p | 3 | 193 | 179 | 3 | 19 | 11 | 3 | 17 | 191 | 3 | 7 |
| 41 | 17 | 3 | 53 | 13 | 3 | 19 | p | 3 | p | 23 | 3 | 7 | 11 | 3 | p | p | 3 | 17 | 7 | 3 |
| 43 | p | 17 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 83 | 89 | 3 | p | 19 | 3 | 17 | p |
| 47 | 19 | 3 | 83 | 17 | 3 | 157 | 11 | 3 | 7 | 67 | 3 | 13 | 59 | 3 | 23 | 7 | 3 | 11 | 163 | 3 |
| 49 | 7 | 113 | 3 | p | 11 | 3 | p | 7 | 3 | 29 | p | 3 | 61 | 67 | 3 | 11 | p | 3 | 13 | 71 |
| 51 | 3 | 61 | 11 | 3 | p | 17 | 3 | p | 73 | 3 | p | p | 3 | 7 | p | 3 | p | 67 | 3 | p |
| 53 | 11 | 3 | 29 | 41 | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 19 | 97 | 3 | p | p | 3 |
| 57 | 3 | p | p | 3 | p | p | 3 | 11 | 17 | 3 | 7 | 103 | 3 | 191 | p | 3 | 149 | 7 | 3 | 113 |
| 59 | 137 | 3 | 7 | p | 3 | 11 | 29 | 3 | p | 7 | 3 | p | 181 | 3 | 13 | 43 | 3 | p | 61 | 3 |
| 61 | p | 7 | 3 | 11 | p | 3 | 37 | 61 | 3 | p | 17 | 3 | p | 131 | 3 | 7 | p | 3 | 23 | p |
| 63 | 3 | 11 | 13 | 3 | p | 31 | 3 | 7 | p | 3 | p | 17 | 3 | 103 | 7 | 3 | 47 | 107 | 3 | p |
| 67 | 23 | 149 | 3 | 13 | p | 3 | p | p | 3 | p | p | 3 | 7 | 17 | 3 | 19 | 13 | 3 | p | 7 |
| 69 | 3 | p | 43 | 3 | 7 | p | 3 | 19 | 163 | 3 | 13 | 7 | 3 | 31 | 17 | 3 | p | 11 | 3 | p |
| 71 | p | 3 | 41 | 7 | 3 | p | 71 | 3 | 43 | 97 | 3 | 23 | p | 3 | 29 | 11 | 3 | 7 | 19 | 3 |
| 73 | p | 181 | 3 | p | p | 3 | 139 | p | 3 | 7 | 19 | 3 | 109 | 11 | 3 | p | 7 | 3 | 73 | p |
| 77 | 7 | 3 | 67 | 31 | 3 | p | p | 3 | 53 | 11 | 3 | p | 13 | 3 | 7 | p | 3 | p | 17 | 3 |
| 79 | 29 | p | 3 | p | 107 | 3 | 7 | 11 | 3 | p | 23 | 3 | 113 | 7 | 3 | p | 31 | 3 | 11 | 13 |
| 81 | 3 | p | p | 3 | 23 | 7 | 3 | 179 | 137 | 3 | 67 | 29 | 3 | 13 | p | 3 | 11 | p | 3 | 7 |
| 83 | p | 3 | p | 11 | 3 | 97 | p | 3 | 19 | 53 | 3 | 7 | p | 3 | 11 | 41 | 3 | p | 7 | 3 |
| 87 | 3 | p | 7 | 3 | p | 37 | 3 | p | 13 | 3 | 11 | 19 | 3 | 43 | p | 3 | 7 | p | 3 | p |
| 89 | p | 3 | 13 | 19 | 3 | p | p | 3 | 7 | p | 3 | p | 73 | 3 | 157 | 7 | 3 | p | p | 3 |
| 91 | 7 | 31 | 3 | p | p | 3 | 11 | 7 | 3 | 13 | 41 | 3 | p | p | 3 | p | p | 3 | p | p |
| 93 | 3 | p | p | 3 | 11 | 191 | 3 | p | 59 | 3 | p | 47 | 3 | 7 | 23 | 3 | 13 | p | 3 | 29 |
| 97 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | 19 | 71 | 3 | 29 | p | 3 | p | 37 | 3 | 7 | p |
| 99 | 3 | 19 | p | 3 | p | 41 | 3 | 127 | p | 3 | 7 | 13 | 3 | p | p | 3 | 89 | 7 | 3 | 23 |

# INCOMPOSITS.

## TAB. XXIII.

| | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | p | 3 | 7 | p | 3 | p | 71 | 3 | 11 | 7 | 3 | 89 | 83 | 3 | 31 | 23 | 3 | 197 |
| 03 | 79 | 3 | p | 7 | 3 | 191 | 13 | 3 | 11 | 83 | 3 | 23 | 17 | 3 | p | p | 3 | 7 | 163 | 3 |
| 07 | 3 | 7 | p | 3 | 11 | p | 3 | 13 | 7 | 3 | p | 43 | 3 | p | 17 | 3 | 59 | p | 3 | 29 |
| 09 | 7 | 3 | 11 | 59 | 3 | 47 | 31 | 3 | p | p | 3 | 79 | 53 | 3 | 7 | 47 | 3 | 43 | 19 | 3 |
| 11 | 11 | p | 3 | 73 | 89 | 3 | 7 | p | 3 | 97 | 19 | 3 | 29 | 7 | 3 | 71 | 17 | 3 | 61 | 31 |
| 13 | 3 | 31 | 13 | 3 | 23 | 7 | 3 | 61 | 41 | 3 | p | 197 | 3 | 113 | p | 3 | p | 17 | 3 | 7 |
| 17 | p | 157 | 3 | 7 | p | 3 | p | 97 | 3 | p | 7 | 3 | 103 | p | 3 | 23 | 11 | 3 | p | 17 |
| 19 | 3 | p | 7 | 3 | 43 | p | 3 | 197 | p | 3 | 13 | p | 3 | p | 11 | 3 | 7 | 131 | 3 | 47 |
| 21 | p | 3 | p | 23 | 3 | 211 | p | 3 | 7 | 29 | 3 | p | 11 | 3 | 53 | 7 | 3 | 13 | p | 3 |
| 23 | 7 | p | 3 | 127 | 31 | 3 | p | 7 | 3 | 167 | 11 | 3 | 41 | 61 | 3 | p | 43 | 3 | p | 19 |
| 27 | p | 3 | 47 | 19 | 3 | 7 | 11 | 3 | 23 | p | 3 | p | 7 | 3 | p | 53 | 3 | 11 | p | 3 |
| 29 | p | p | 3 | 97 | 7 | 3 | 13 | p | 3 | 179 | 37 | 3 | 31 | p | 3 | 11 | 103 | 3 | 7 | 13 |
| 31 | 3 | p | 11 | 3 | 157 | p | 3 | 41 | 127 | 3 | 7 | p | 3 | 11 | 181 | 3 | p | 7 | 3 | 23 |
| 33 | 11 | 3 | 7 | 43 | 3 | p | p | 3 | 107 | 7 | 3 | 11 | p | 3 | p | p | 3 | 19 | p | 3 |
| 37 | 3 | 19 | 31 | 3 | 37 | p | 3 | 7 | 13 | 3 | 29 | p | 3 | p | 7 | 3 | 47 | p | 3 | 71 |
| 39 | 47 | 3 | 13 | 101 | 3 | 11 | 7 | 3 | p | p | 3 | p | 19 | 3 | p | 13 | 3 | 53 | 23 | 3 |
| 41 | p | 37 | 3 | 11 | 19 | 3 | p | p | 3 | 13 | 73 | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 43 | 3 | 11 | 151 | 3 | 7 | p | 3 | 101 | p | 3 | 31 | 7 | 3 | p | 29 | 3 | 13 | 149 | 3 | p |
| 47 | 17 | 131 | 3 | 61 | 13 | 3 | p | 29 | 3 | 7 | 107 | 3 | p | 137 | 3 | 37 | 7 | 3 | 19 | 11 |
| 49 | 3 | 7 | p | 3 | p | p | 3 | 73 | 7 | 3 | 19 | 13 | 3 | 101 | 47 | 3 | 191 | 11 | 3 | p |
| 51 | 7 | 3 | 17 | p | 3 | 13 | p | 3 | p | 79 | 3 | 163 | 37 | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 53 | p | 67 | 3 | 17 | p | 3 | 7 | p | 3 | p | p | 3 | 13 | 7 | 3 | p | 71 | 3 | p | p |
| 57 | 13 | 3 | p | p | 3 | 17 | p | 3 | 31 | 11 | 3 | 7 | 167 | 3 | 131 | p | 3 | p | 7 | 3 |
| 59 | p | p | 3 | 7 | 23 | 3 | 17 | 11 | 3 | p | 7 | 3 | p | 67 | 3 | 29 | p | 3 | 11 | p |
| 61 | 3 | 13 | 7 | 3 | 173 | 11 | 3 | 17 | 113 | 3 | p | p | 3 | p | 13 | 3 | 7 | 67 | 3 | 19 |
| 63 | 139 | 3 | p | 11 | 3 | p | 59 | 3 | 7 | p | 3 | 19 | p | 3 | 11 | 7 | 3 | p | p | 3 |
| 67 | 3 | 29 | p | 3 | 53 | 41 | 3 | 89 | p | 3 | 11 | 31 | 3 | 7 | 19 | 3 | p | p | 3 | 43 |
| 69 | 127 | 3 | p | 13 | 3 | 7 | 19 | 3 | 11 | 193 | 3 | 17 | 7 | 3 | 41 | p | 3 | 37 | p | 3 |
| 71 | p | p | 3 | p | 7 | 3 | 11 | p | 3 | p | 13 | 3 | 17 | 59 | 3 | 199 | 109 | 3 | 7 | p |
| 73 | 3 | 163 | p | 3 | 11 | 29 | 3 | p | 23 | 3 | 7 | 199 | 3 | 17 | 37 | 3 | p | 7 | 3 | 31 |
| 77 | 11 | 7 | 3 | 199 | 79 | 3 | 43 | p | 3 | 41 | p | 3 | 19 | p | 3 | 7 | p | 3 | 13 | 23 |
| 79 | 3 | p | p | 3 | 19 | p | 3 | 7 | p | 3 | 61 | p | 3 | 23 | 7 | 3 | 17 | p | 3 | p |
| 81 | 17 | 3 | p | p | 3 | 109 | 7 | 3 | 37 | 31 | 3 | p | p | 3 | p | 19 | 3 | 17 | 11 | 3 |
| 83 | 13 | 17 | 3 | p | p | 3 | p | 19 | 3 | p | p | 3 | 7 | 13 | 3 | 79 | 11 | 3 | 17 | 7 |
| 87 | p | 3 | 67 | 7 | 3 | p | p | 3 | p | p | 3 | 73 | 11 | 3 | 13 | p | 3 | 7 | p | 3 |
| 89 | p | p | 3 | p | 17 | 3 | 23 | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | 109 | p |
| 91 | 3 | 7 | 13 | 3 | p | 17 | 3 | 47 | 7 | 3 | 67 | p | 3 | 19 | p | 3 | p | 29 | 3 | 11 |
| 93 | 7 | 3 | p | 103 | 3 | 19 | 11 | 3 | p | 13 | 3 | 43 | p | 3 | 7 | 127 | 3 | 11 | p | 3 |
| 97 | 3 | 193 | 11 | 3 | p | 7 | 3 | p | 17 | 3 | 13 | p | 3 | 11 | p | 3 | p | 41 | 3 | 7 |
| 99 | 11 | 3 | 31 | 29 | 3 | 103 | p | 3 | 59 | 17 | 3 | 7 | 97 | 3 | 173 | p | 3 | 13 | 7 | 3 |

# INCOMPOSITS.

## TAB. XXIV.

| | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 157 | 3 | 47 | p | 3 | 7 | p | 3 | 17 | p | 3 | 19 | 7 | 3 | 107 | p | 3 | p | 13 | 3 |
| 03 | 179 | p | 3 | 19 | 7 | 3 | 29 | p | 3 | 17 | 11 | 3 | 13 | p | 3 | 67 | 181 | 3 | 7 | p |
| 07 | 13 | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | 17 | p | 3 | p | p | 3 | 11 | p | 3 |
| 09 | 139 | 7 | 3 | p | 11 | 3 | 127 | 13 | 3 | 61 | 29 | 3 | 17 | p | 3 | 7 | p | 3 | p | 23 |
| 11 | 3 | 13 | 11 | 3 | p | p | 3 | 7 | p | 3 | 53 | p | 3 | 11 | 7 | 3 | 47 | p | 3 | p |
| 13 | 11 | 3 | 37 | 29 | 3 | 193 | 7 | 3 | 13 | 49 | 3 | 11 | 31 | 3 | 17 | p | 3 | p | 137 | 3 |
| 17 | 3 | 107 | 113 | 3 | 7 | 181 | 3 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | 17 | p | 3 | p |
| 19 | 17 | 3 | p | 7 | 3 | 11 | p | 3 | p | p | 3 | p | 23 | 3 | p | 19 | 3 | 7 | p | 3 |
| 21 | p | 17 | 3 | 11 | 61 | 3 | 23 | 19 | 3 | 7 | 13 | 3 | p | 79 | 3 | p | 7 | 3 | 17 | 173 |
| 23 | 3 | 7 | 17 | 3 | 13 | p | 3 | p | 7 | 3 | 59 | p | 3 | 37 | 47 | 3 | p | 13 | 3 | 17 |
| 27 | p | 193 | 3 | p | 17 | 3 | 7 | p | 3 | 167 | 31 | 3 | 83 | 7 | 3 | p | 97 | 3 | 13 | 11 |
| 29 | 3 | 163 | p | 3 | 29 | 7 | 3 | 83 | p | 3 | 131 | p | 3 | 19 | 43 | 3 | p | 11 | 3 | 7 |
| 31 | 191 | 3 | 83 | 107 | 3 | 19 | 13 | 3 | p | 71 | 3 | 7 | 73 | 3 | p | 11 | 3 | 59 | 7 | 3 |
| 33 | 13 | p | 3 | 7 | 59 | 3 | p | 17 | 3 | p | 7 | 3 | 149 | 11 | 3 | p | 19 | 3 | 31 | p |
| 37 | 19 | 3 | p | p | 3 | 173 | 149 | 3 | 7 | 11 | 3 | p | p | 3 | 13 | 7 | 3 | p | p | 3 |
| 39 | 7 | 29 | 3 | 149 | p | 3 | p | 7 | 3 | 73 | 17 | 3 | 97 | p | 3 | 137 | p | 3 | 11 | p |
| 41 | 3 | p | 13 | 3 | p | 11 | 3 | 43 | 31 | 3 | p | 17 | 3 | 7 | p | 3 | 11 | p | 3 | 191 |
| 43 | 41 | 3 | 131 | 11 | 3 | 7 | p | 3 | 139 | 13 | 3 | p | 7 | 3 | 11 | p | 13 | p | p | 3 |
| 47 | 3 | p | 103 | 3 | p | 89 | 3 | p | 79 | 3 | 7 | p | 3 | 113 | 17 | 3 | 29 | 7 | 3 | p |
| 49 | p | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | p | 37 | 3 | 23 | 17 | 3 | 13 | 59 | 3 |
| 51 | p | 7 | 3 | p | p | 3 | 11 | p | 3 | 29 | p | 3 | p | p | 3 | 7 | 17 | 3 | 109 | p |
| 53 | 3 | p | 23 | 3 | 11 | 13 | 3 | 7 | p | 3 | 211 | 61 | 3 | p | 7 | 3 | p | 17 | 3 | 79 |
| 57 | 11 | 101 | 3 | 151 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | 23 | 3 | 19 | p | 3 | p | 7 |
| 59 | 3 | 31 | 167 | 3 | 7 | p | 3 | 19 | 47 | 3 | p | 7 | 3 | 13 | p | 3 | p | 163 | 3 | 199 |
| 61 | p | 3 | p | 7 | 3 | 101 | 29 | 3 | p | 151 | 3 | p | 167 | 3 | 31 | 199 | 3 | 7 | 11 | 3 |
| 63 | 73 | 13 | 3 | 71 | 97 | 3 | p | 101 | 3 | 7 | 19 | 3 | 151 | p | 3 | p | 7 | 3 | 23 | p |
| 67 | 7 | 3 | 13 | 199 | 3 | p | 23 | 3 | p | 67 | 3 | 101 | 11 | 3 | 7 | 13 | 3 | 37 | 151 | 3 |
| 69 | 23 | 137 | 3 | 89 | 31 | 3 | 7 | p | 3 | 13 | 11 | 3 | p | 7 | 3 | p | 73 | 3 | p | p |
| 71 | 3 | p | p | 3 | p | 7 | 3 | p | 11 | 3 | 103 | 43 | 3 | 127 | 37 | 3 | 13 | 23 | 3 | 17 |
| 73 | p | 3 | p | 79 | 3 | p | 11 | 3 | 19 | 107 | 3 | 7 | 41 | 3 | 29 | 113 | 3 | 11 | 7 | 3 |
| 77 | 3 | 61 | 7 | 3 | p | 47 | 3 | 29 | p | 3 | 179 | 13 | 3 | 11 | 197 | 33 | 7 | p | 3 | p |
| 79 | 11 | 3 | p | 19 | 3 | 13 | p | 3 | 7 | 109 | 3 | 11 | p | 3 | 79 | 7 | 3 | p | 13 | 3 |
| 81 | 7 | p | 3 | p | 53 | 3 | p | 7 | 3 | 11 | 23 | 3 | 13 | p | 3 | p | p | 3 | p | p |
| 83 | 3 | p | 31 | 3 | 23 | 37 | 3 | 11 | 173 | 3 | 197 | 29 | 3 | 7 | 103 | 3 | 41 | 71 | 3 | 13 |
| 87 | 17 | p | 3 | 11 | 7 | 3 | p | 13 | 3 | 19 | p | 3 | p | p | 3 | 23 | 43 | 3 | 7 | 47 |
| 89 | 3 | 11 | 41 | 3 | p | p | 3 | 71 | p | 3 | 7 | p | 3 | p | 13 | 3 | 103 | 7 | 3 | 37 |
| 91 | p | 3 | 7 | 23 | 3 | p | p | 3 | 13 | 7 | 3 | 41 | 19 | 3 | p | p | 3 | p | 83 | 3 |
| 93 | p | 7 | 3 | 17 | 19 | 3 | 53 | 73 | 3 | p | p | 3 | p | 83 | 3 | 7 | 37 | 3 | 47 | 11 |
| 97 | 31 | 3 | 67 | 13 | 3 | 17 | 7 | 3 | 23 | p | 3 | 109 | p | 3 | 1 | 11 | 3 | p | 211 | 3 |
| 9 | p | 73 | 3 | p | p | 3 | 17 | 53 | 3 | 43 | 13 | 3 | 7 | 11 | 3 | p | p | 3 | 19 | 7 |

# INCOMPOSITS.

## TAB. XXV.

| | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 23 | 103 | 3 | 11 | 29 | 3 | 7 | 31 | 3 | 79 | 19 | 3 | p | 7 | 3 | 59 | 193 | 3 | p | 139 |
| 03 | 3 | 11 | 19 | 3 | 97 | 7 | 3 | 113 | 37 | 3 | p | p | 3 | 47 | 127 | 3 | p | 23 | 3 | 7 |
| 07 | 61 | 73 | 3 | 7 | p | 3 | 13 | 53 | 3 | p | 7 | 3 | p | p | 3 | 31 | 113 | 3 | p | 11 |
| 09 | 3 | p | 7 | 3 | p | 179 | 3 | 67 | p | 3 | p | p | 3 | 13 | p | 3 | 7 | 11 | 3 | 29 |
| 11 | 41 | 3 | 37 | p | 3 | 139 | p | 3 | 7 | 59 | 3 | 67 | p | 3 | p | 7 | 3 | p | p | 3 |
| 13 | 7 | 13 | 3 | p | p | 3 | 173 | 7 | 3 | 41 | 23 | 3 | 29 | 11 | 3 | 67 | p | 3 | 109 | 19 |
| 17 | p | 3 | 13 | 19 | 3 | 7 | 61 | 3 | p | 11 | 3 | p | 7 | 3 | p | 13 | 3 | 83 | 31 | 3 |
| 19 | 31 | p | 3 | 211 | 7 | 3 | p | 11 | 3 | 13 | p | 3 | 83 | 149 | 3 | 23 | 29 | 3 | 7 | p |
| 21 | 3 | p | p | 3 | 41 | 11 | 3 | 83 | p | 3 | 7 | p | 3 | 31 | 73 | 3 | 11 | 7 | 3 | p |
| 23 | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | p | 3 | 11 | p | 3 | 19 | p | 3 |
| 27 | 3 | 17 | 29 | 3 | 79 | p | 3 | 7 | 157 | 3 | 11 | 13 | 3 | 107 | 7 | 3 | p | p | 3 | p |
| 29 | p | 3 | 17 | 31 | 3 | 13 | 7 | 3 | 11 | 113 | 3 | 73 | 19 | 3 | p | p | 3 | 223 | 13 | 3 |
| 31 | 43 | p | 3 | 17 | 19 | 3 | 11 | p | 3 | 167 | p | 3 | 7 | p | 3 | p | 31 | 3 | p | 7 |
| 33 | 3 | 127 | 139 | 3 | 7 | p | 3 | p | 47 | 3 | p | 7 | 3 | p | p | 3 | p | 41 | 3 | 13 |
| 37 | 11 | 37 | 3 | p | p | 3 | 17 | 13 | 3 | 7 | p | 3 | 53 | 103 | 3 | p | 7 | 3 | 19 | p |
| 39 | 3 | 7 | p | 3 | 59 | p | 3 | 17 | 7 | 3 | 19 | p | 3 | p | 13 | 3 | p | p | 3 | p |
| 41 | 7 | 3 | 19 | p | 3 | p | 127 | 3 | 13 | 109 | 3 | 157 | 41 | 3 | 7 | 107 | 3 | p | 11 | 3 |
| 43 | 107 | 31 | 3 | 29 | 193 | 3 | 7 | 79 | 3 | 17 | p | 3 | 23 | 7 | 3 | 13 | 11 | 3 | p | p |
| 47 | 23 | 3 | p | 13 | 3 | 43 | p | 3 | p | p | 3 | 7 | 11 | 3 | 197 | p | 3 | p | 7 | 3 |
| 49 | p | 89 | 3 | 7 | p | 3 | p | 29 | 3 | 31 | 7 | 3 | 17 | 61 | 3 | p | 131 | 3 | 79 | 199 |
| 51 | 3 | 179 | 7 | 3 | 13 | 47 | 3 | p | 11 | 3 | 181 | 23 | 3 | 17 | p | 3 | 7 | 13 | 3 | 11 |
| 53 | 29 | 3 | 73 | p | 3 | 23 | 11 | 3 | 7 | p | 3 | 13 | p | 3 | 17 | 7 | 3 | 11 | p | 3 |
| 57 | 3 | p | 11 | 3 | 47 | 59 | 3 | p | p | 3 | p | p | 3 | 7 | 19 | 3 | 17 | p | 3 | p |
| 59 | 11 | 3 | p | 37 | 3 | 7 | 13 | 3 | p | 173 | 3 | 11 | 7 | 3 | p | p | 3 | 17 | 73 | 3 |
| 61 | 13 | 17 | 3 | 137 | 7 | 3 | p | p | 3 | 11 | 71 | 3 | p | 13 | 3 | 29 | 53 | 3 | 7 | 47 |
| 63 | 3 | p | 17 | 3 | p | p | 3 | 11 | 131 | 3 | 7 | 211 | 3 | p | p | 3 | p | 7 | 3 | 17 |
| 67 | 71 | 7 | 3 | 11 | 17 | 3 | 41 | p | 3 | 23 | 139 | 3 | 19 | p | 3 | 7 | p | 3 | 47 | 29 |
| 69 | 3 | 11 | 13 | 3 | 19 | 17 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | p | 157 | 3 | 107 |
| 71 | 53 | 3 | p | p | 3 | p | 7 | 3 | p | 13 | 3 | p | 29 | 3 | 61 | 19 | 3 | 71 | p | 3 |
| 73 | p | 67 | 3 | 13 | p | 3 | p | 17 | 3 | p | 31 | 3 | 7 | 97 | 3 | 89 | 13 | 3 | 53 | 7 |
| 77 | 131 | 3 | 23 | 7 | 3 | 31 | p | 3 | 37 | 17 | 3 | p | p | 3 | p | 11 | 3 | 7 | p | 3 |
| 79 | p | p | 3 | 101 | p | 3 | p | p | 3 | 7 | 17 | 3 | p | 11 | 3 | 43 | 7 | 3 | 31 | 23 |
| 81 | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | p | 11 | 3 | 19 | p | 3 | p | 67 | 3 | 151 |
| 83 | 7 | 3 | 53 | p | 3 | 19 | 89 | 3 | p | 11 | 3 | 137 | 13 | 3 | 7 | 179 | 3 | p | 83 | 3 |
| 87 | 3 | p | 109 | 3 | p | 7 | 3 | p | 19 | 3 | 191 | 101 | 3 | 13 | 17 | 3 | 11 | p | 3 | 7 |
| 89 | 19 | 3 | 43 | 11 | 3 | p | 181 | 3 | p | p | 3 | 7 | 23 | 3 | 11 | 17 | 3 | p | 7 | 3 |
| 91 | p | 11 | 3 | 7 | p | 3 | 23 | 97 | 3 | p | 7 | 3 | 11 | p | 3 | 101 | 17 | 3 | p | p |
| 93 | 3 | p | 7 | 3 | 71 | p | 3 | 59 | 13 | 3 | 11 | p | 3 | p | 43 | 3 | 7 | 17 | 3 | p |
| 97 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | 13 | 29 | 3 | p | 47 | 3 | p | p | 3 | 41 | 17 |
| 99 | 3 | 157 | p | 3 | 11 | 23 | 3 | p | 107 | 3 | 37 | p | 3 | 7 | p | 3 | 13 | 19 | 3 | p |

# INCOMPOSITS.

## TAB. XXVI.

| | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | 17 | 3 | 13 | 11 | 3 | 7 | 37 | 3 | p | 137 | 3 | 29 | 7 | 3 | 11 | 13 | 3 | 17 |
| 03 | 31 | 3 | 61 | 11 | 3 | p | 7 | 3 | 101 | 109 | 3 | 13 | p | 3 | 11 | p | 3 | 149 | p | 3 |
| 07 | 3 | 89 | p | 3 | 7 | 17 | 3 | p | 23 | 3 | 11 | 7 | 3 | p | p | 3 | p | 29 | 3 | p |
| 09 | 43 | 3 | 23 | 7 | 3 | 53 | 13 | 3 | 11 | p | 3 | p | 41 | 3 | 101 | 19 | 3 | 7 | 103 | 3 |
| 11 | 13 | p | 3 | p | p | 3 | 11 | 17 | 3 | 7 | 29 | 3 | 83 | 13 | 3 | p | 7 | 3 | 197 | 23 |
| 13 | 3 | 7 | 149 | 3 | 11 | p | 3 | 13 | 7 | 3 | 139 | 79 | 3 | 23 | p | 3 | p | p | 3 | p |
| 17 | 11 | 23 | 3 | 67 | p | 3 | 7 | 41 | 3 | 59 | 17 | 3 | p | 7 | 3 | p | 71 | 3 | p | 193 |
| 19 | 3 | p | 13 | 3 | 127 | 7 | 3 | 67 | 89 | 3 | 163 | 17 | 3 | 19 | p | 3 | 41 | p | 3 | 7 |
| 21 | p | 3 | p | p | 3 | 19 | 223 | 3 | p | 13 | 3 | 7 | 17 | 3 | p | p | 3 | p | 7 | 3 |
| 23 | p | p | 3 | 7 | p | 3 | 23 | p | 3 | p | 7 | 3 | 181 | 17 | 3 | 67 | 11 | 3 | 29 | 137 |
| 27 | 19 | 3 | p | 59 | 3 | p | p | 3 | 7 | 127 | 3 | 29 | 11 | 3 | p | 7 | 3 | 13 | p | 3 |
| 29 | 7 | p | 3 | p | 211 | 3 | 197 | 7 | 3 | p | 11 | 3 | p | p | 3 | 227 | 17 | 3 | p | p |
| 31 | 3 | p | p | 3 | 29 | 13 | 3 | 97 | 11 | 3 | p | p | 3 | 7 | p | 3 | p | 17 | 3 | 11 |
| 33 | p | 3 | 191 | p | 3 | 7 | 11 | 3 | p | 31 | 3 | p | 7 | 3 | 19 | 29 | 3 | 11 | 17 | 3 |
| 37 | 3 | 181 | 11 | 3 | 31 | 97 | 3 | 113 | 29 | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | 167 |
| 39 | 11 | 3 | 7 | 71 | 3 | p | 79 | 3 | p | 7 | 3 | 11 | p | 3 | p | p | 3 | 31 | p | 3 |
| 41 | 163 | 7 | 3 | p | p | 3 | 89 | p | 3 | 11 | 43 | 3 | p | p | 3 | 7 | 113 | 3 | 47 | p |
| 43 | 3 | 41 | 47 | 3 | 73 | p | 3 | 7 | 13 | 3 | p | 199 | 3 | p | 7 | 3 | 43 | 59 | 3 | 127 |
| 47 | p | p | 3 | 11 | 61 | 3 | p | 31 | 3 | 13 | p | 3 | 7 | p | 3 | 19 | p | 3 | 139 | 7 |
| 49 | 3 | 11 | 109 | 3 | 7 | p | 3 | 19 | p | 3 | 71 | 7 | 3 | p | p | 3 | 13 | p | 3 | p |
| 51 | p | 3 | 31 | 7 | 3 | p | p | 3 | 211 | p | 3 | p | 53 | 3 | 23 | p | 3 | 7 | 19 | 3 |
| 53 | p | p | 3 | 43 | 13 | 3 | 37 | p | 3 | 7 | 19 | 3 | 107 | 89 | 3 | 31 | 7 | 3 | p | 11 |
| 57 | 7 | 3 | 29 | 37 | 3 | 13 | 179 | 3 | p | p | 3 | p | p | 3 | 7 | 11 | 3 | 73 | 13 | 3 |
| 59 | 113 | p | 3 | p | p | 3 | 7 | 193 | 3 | 131 | p | 3 | 13 | 7 | 3 | 47 | p | 3 | p | 223 |
| 61 | 3 | 103 | p | 3 | p | 7 | 3 | 23 | 181 | 3 | p | 11 | 3 | p | p | 3 | 19 | 191 | 3 | 7 |
| 63 | 13 | 3 | p | p | 3 | 59 | 29 | 3 | 19 | 11 | 3 | 7 | p | 3 | 53 | p | 3 | 37 | 7 | 3 |
| 67 | 3 | 13 | 7 | 3 | 109 | 11 | 3 | p | p | 3 | 223 | 19 | 3 | 31 | 13 | 3 | 7 | p | 3 | 157 |
| 69 | p | 3 | 17 | 11 | 3 | 61 | 23 | 3 | 7 | p | 3 | p | 167 | 3 | 11 | 7 | 3 | p | p | 3 |
| 71 | 7 | 11 | 3 | 17 | 41 | 3 | p | 7 | 3 | p | p | 3 | 11 | 47 | 3 | 13 | 163 | 3 | p | p |
| 73 | 3 | 131 | p | 3 | 17 | 103 | 3 | p | p | 3 | 11 | 73 | 3 | 7 | p | 3 | p | 23 | 3 | p |
| 77 | p | p | 3 | p | 7 | 3 | 11 | p | 3 | 19 | 13 | 3 | 47 | 83 | 3 | p | 31 | 3 | 7 | p |
| 79 | 3 | 19 | 137 | 3 | 11 | 37 | 3 | 17 | 83 | 3 | 7 | 61 | 3 | 191 | p | 3 | p | 7 | 3 | 59 |
| 81 | 61 | 3 | 7 | 83 | 3 | p | 59 | 3 | 17 | 7 | 3 | 13 | 19 | 3 | p | p | 3 | 53 | 29 | 3 |
| 83 | 11 | 7 | 3 | p | 19 | 3 | p | 43 | 3 | 17 | 23 | 3 | p | p | 3 | 7 | p | 3 | 13 | 227 |
| 87 | p | 3 | p | p | 3 | p | 7 | 3 | 151 | 67 | 3 | 17 | p | 3 | p | 79 | 3 | p | 11 | 3 |
| 89 | 13 | 31 | 3 | 41 | 29 | 3 | 173 | p | 3 | p | 47 | 3 | 7 | 13 | 3 | 23 | 11 | 3 | 19 | 7 |
| 91 | 3 | 53 | p | 3 | 7 | p | 3 | 13 | p | 3 | 19 | 7 | 3 | 17 | 11 | 3 | p | 67 | 3 | p |
| 93 | p | 3 | 19 | 7 | 3 | p | 163 | 3 | p | p | 3 | p | 11 | 3 | 13 | p | 3 | 7 | p | 3 |
| 97 | 3 | 7 | 13 | 3 | p | 19 | 3 | 79 | 7 | 3 | 37 | p | 3 | 103 | 23 | 3 | 17 | p | 3 | 11 |
| 99 | 7 | 3 | 179 | 101 | 3 | p | 11 | 3 | 23 | 13 | 3 | p | 43 | 3 | 7 | p | 3 | 11 | p | 3 |

# INCOMPOSITS.

## TAB. XXVII.

| | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 149 | 3 | p | p | 3 | p | 23 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 83 | 11 | 3 |
| 03 | 7 | p | 3 | 193 | 13 | 3 | 41 | 7 | 3 | p | p | 3 | 83 | 151 | 3 | p | 11 | 3 | 173 | 19 |
| 07 | 131 | 3 | 17 | 19 | 3 | 7 | 31 | 3 | p | 191 | 3 | 23 | 7 | 3 | p | p | 3 | 43 | 13 | 3 |
| 09 | p | 107 | 3 | 17 | 7 | 3 | p | p | 3 | 157 | 11 | 3 | 13 | p | 3 | 73 | p | 3 | 7 | 31 |
| 11 | 3 | 31 | 109 | 3 | 17 | p | 3 | p | 11 | 3 | 7 | 173 | 3 | 89 | p | 3 | p | 7 | 3 | 11 |
| 13 | 13 | 3 | 7 | p | 3 | 17 | 11 | 3 | p | 7 | 3 | p | 127 | 3 | 31 | 59 | 3 | 11 | p | 3 |
| 17 | 3 | 13 | 11 | 3 | 23 | p | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | p |
| 19 | 11 | 3 | 79 | 113 | 3 | 29 | 7 | 3 | 13 | p | 3 | 11 | 19 | 3 | p | 109 | 3 | p | p | 3 |
| 21 | p | p | 3 | p | 19 | 3 | 101 | p | 3 | 11 | 37 | 3 | 7 | 71 | 3 | 13 | 29 | 3 | 107 | 7 |
| 23 | 3 | 47 | p | 3 | 7 | 53 | 3 | 11 | 101 | 3 | 17 | 7 | 3 | p | 41 | 3 | p | 31 | 3 | p |
| 27 | p | p | 3 | 11 | 103 | 3 | p | p | 3 | 7 | 13 | 3 | 17 | p | 3 | p | 7 | 3 | 19 | p |
| 29 | 3 | 7 | 29 | 3 | 13 | p | 3 | 67 | 7 | 3 | 19 | p | 3 | 17 | 23 | 3 | p | 13 | 3 | 199 |
| 31 | 7 | 3 | 19 | 43 | 3 | 131 | p | 3 | 23 | 41 | 3 | 13 | p | 3 | 7 | 199 | 3 | p | p | 3 |
| 33 | 61 | 37 | 3 | 59 | p | 3 | 7 | p | 3 | 43 | 181 | 3 | p | 7 | 3 | 17 | p | 3 | 13 | 11 |
| 37 | 17 | 3 | p | 199 | 3 | 107 | 13 | 3 | p | p | 3 | 7 | 139 | 3 | p | 11 | 3 | 17 | 7 | 3 |
| 39 | 13 | 17 | 3 | 7 | 41 | 3 | p | 23 | 3 | 167 | 7 | 3 | p | 11 | 3 | 37 | p | 3 | 17 | p |
| 41 | 3 | 23 | 7 | 3 | 229 | p | 3 | 13 | 53 | 3 | 29 | 11 | 3 | 41 | p | 3 | 7 | 61 | 3 | 13 |
| 43 | 71 | 3 | 89 | 17 | 3 | p | 61 | 3 | 7 | 11 | 3 | 19 | 37 | 3 | 13 | 7 | 3 | 223 | 23 | 3 |
| 47 | 3 | p | 13 | 3 | 179 | 11 | 3 | p | 43 | 3 | p | p | 3 | 7 | 19 | 3 | 11 | 71 | 3 | 73 |
| 49 | 23 | 3 | p | 11 | 3 | 7 | 17 | 3 | 41 | 13 | 3 | p | 7 | 3 | 11 | p | 3 | 59 | p | 3 |
| 51 | p | 11 | 3 | 13 | 7 | 3 | 37 | 17 | 3 | p | p | 3 | 11 | 31 | 3 | p | 13 | 3 | 7 | p |
| 53 | 3 | p | p | 3 | p | p | 3 | 71 | 17 | 3 | 7 | 23 | 3 | p | p | 3 | p | 7 | 3 | 163 |
| 57 | p | 7 | 3 | 41 | p | 3 | 11 | p | 3 | p | 17 | 3 | 19 | 229 | 3 | 7 | p | 3 | p | 79 |
| 59 | 3 | 43 | p | 3 | 11 | 13 | 3 | 7 | p | 3 | 97 | 17 | 3 | p | 7 | 3 | 23 | p | 3 | p |
| 61 | 79 | 3 | 11 | p | 3 | p | 7 | 3 | p | 211 | 3 | p | 13 | 3 | 193 | 19 | 3 | 37 | p | 3 |
| 63 | 11 | p | 3 | p | 23 | 3 | 13 | 19 | 3 | p | 47 | 3 | 7 | 17 | 3 | 29 | 103 | 3 | 61 | 7 |
| 67 | p | 3 | p | 7 | 3 | p | p | 3 | 29 | p | 3 | 79 | p | 3 | 127 | 17 | 3 | 7 | 11 | 3 |
| 69 | p | 13 | 3 | p | 71 | 3 | 31 | p | 3 | 7 | p | 3 | p | 83 | 3 | p | 7 | 3 | 103 | 29 |
| 71 | 3 | 7 | 167 | 3 | 137 | p | 3 | 113 | 7 | 3 | 73 | p | 3 | 19 | 11 | 3 | 191 | 17 | 3 | 31 |
| 73 | 7 | 3 | 13 | 83 | 3 | 19 | p | 3 | 37 | p | 3 | p | 11 | 3 | 7 | 13 | 3 | p | 17 | 3 |
| 77 | 3 | p | 61 | 3 | 97 | 7 | 3 | 89 | 11 | 3 | p | 41 | 3 | p | 53 | 3 | 13 | p | 3 | 7 |
| 79 | 19 | 3 | 23 | p | 3 | p | 11 | 3 | p | 31 | 3 | 7 | p | 3 | p | 131 | 3 | 11 | 7 | 3 |
| 81 | p | p | 3 | 7 | 11 | 3 | 139 | 47 | 3 | p | 7 | 3 | p | p | 3 | 11 | p | 3 | p | 23 |
| 83 | 3 | p | 7 | 3 | 31 | p | 3 | p | p | 3 | 109 | 13 | 3 | 11 | 79 | 3 | 7 | p | 3 | 37 |
| 87 | 7 | 23 | 3 | p | 73 | 3 | 19 | 7 | 3 | 11 | p | 3 | 13 | 197 | 3 | 41 | 37 | 3 | p | p |
| 89 | 3 | p | p | 3 | p | 43 | 3 | 11 | p | 3 | p | p | 3 | 7 | 89 | 3 | 53 | 19 | 3 | 13 |
| 91 | 13 | 3 | p | p | 3 | 7 | p | 3 | 227 | 19 | 3 | 43 | 7 | 3 | 149 | p | 3 | p | p | 3 |
| 93 | 113 | 19 | 3 | 11 | 7 | 3 | 23 | 13 | 3 | 197 | p | 3 | 137 | 107 | 3 | p | p | 3 | 7 | p |
| 97 | 59 | 3 | 7 | 151 | 3 | 149 | p | 3 | 13 | 7 | 3 | p | 223 | 3 | 61 | p | 3 | 23 | p | 3 |
| 99 | 53 | 7 | 3 | 61 | 47 | 3 | 151 | 37 | 3 | p | 29 | 3 | p | 67 | 3 | 7 | p | 3 | p | 11 |

# INCOMPOSITS.

## TAB. XXVIII.

| | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | p | 3 | 13 | p | 3 | p | 19 | 3 | 7 | p | 3 | p | 17 | 3 | p | 7 | 3 | 41 | p |
| 03 | 3 | 7 | 67 | 3 | p | p | 3 | 11 | 7 | 3 | 13 | p | 3 | 29 | 17 | 3 | p | 53 | 3 | p |
| 07 | 53 | 61 | 3 | 11 | 41 | 3 | 7 | 227 | 3 | p | 67 | 3 | p | 7 | 3 | 47 | 17 | 3 | p | 37 |
| 09 | 3 | 11 | 151 | 3 | p | 7 | 3 | p | 23 | 3 | p | p | 3 | 19 | 67 | 3 | 3 | 17 | 3 | 7 |
| 11 | p | 3 | 23 | p | 3 | 19 | 97 | 3 | 59 | 43 | 3 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 |
| 13 | p | 53 | 3 | 7 | p | 3 | 13 | p | 3 | 89 | 7 | 3 | p | p | 3 | 43 | 19 | 3 | p | 11 |
| 17 | 19 | 3 | p | 29 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 151 | 7 | 3 | p | p | 3 |
| 19 | 7 | 13 | 3 | p | p | 3 | 193 | 7 | 3 | p | 37 | 3 | p | 11 | 3 | 59 | p | 3 | p | 199 |
| 21 | 3 | p | 59 | 3 | p | p | 3 | p | 13 | 3 | p | 11 | 3 | 7 | 157 | 3 | p | p | 3 | p |
| 23 | 89 | 3 | 13 | p | 3 | 7 | p | 3 | 73 | 11 | 3 | 199 | 7 | 3 | 19 | 13 | 3 | 103 | p | 3 |
| 27 | 3 | 113 | 211 | 3 | 37 | 11 | 3 | p | 109 | 3 | 7 | p | 3 | 61 | 43 | 3 | 11 | 7 | 3 | p |
| 29 | 97 | 3 | 7 | 11 | 3 | 31 | p | 3 | p | 7 | 3 | 29 | p | 3 | 11 | p | 3 | 23 | p | 3 |
| 31 | 71 | 7 | 3 | p | 13 | 3 | p | 229 | 3 | 163 | 113 | 3 | 11 | p | 3 | 7 | p | 3 | 31 | p |
| 33 | 3 | p | 193 | 3 | 29 | 23 | 3 | 7 | p | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | p |
| 37 | p | 43 | 3 | 67 | p | 3 | 11 | 127 | 3 | 137 | 47 | 3 | 7 | p | 3 | 19 | 23 | 3 | p | 7 |
| 39 | 3 | p | 73 | 3 | 7 | p | 3 | 19 | 29 | 3 | 23 | 7 | 3 | p | p | 3 | p | 139 | 3 | 13 |
| 41 | 13 | 3 | 11 | 7 | 3 | p | 101 | 3 | 173 | p | 3 | 67 | 37 | 3 | p | p | 3 | 7 | 19 | 3 |
| 43 | 11 | 29 | 3 | 31 | p | 3 | 53 | 13 | 3 | 7 | 19 | 3 | p | p | 3 | 67 | 7 | 3 | p | 43 |
| 47 | 7 | 3 | 17 | p | 3 | p | p | 3 | 13 | 23 | 3 | p | 101 | 3 | 7 | p | 3 | 107 | 11 | 3 |
| 49 | p | 173 | 3 | 17 | 71 | 3 | 7 | 53 | 3 | p | p | 3 | p | 7 | 3 | 13 | 11 | 3 | p | p |
| 51 | 3 | p | p | 3 | 17 | 7 | 3 | p | p | 3 | p | 131 | 3 | p | 11 | 3 | 19 | 197 | 3 | 7 |
| 53 | 191 | 3 | 227 | 13 | 3 | 17 | 31 | 3 | 19 | 179 | 3 | 7 | 11 | 3 | 23 | 73 | 3 | 127 | 7 | 3 |
| 57 | 3 | 31 | 7 | 3 | 13 | 89 | 3 | 17 | 11 | 3 | p | 19 | 3 | 197 | p | 3 | 7 | 13 | 3 | 11 |
| 59 | p | 3 | 29 | 19 | 3 | p | 11 | 3 | 7 | p | 3 | 13 | p | 3 | 31 | 7 | 3 | 11 | 83 | 3 |
| 61 | 7 | 41 | 3 | p | 11 | 3 | 47 | 7 | 3 | 17 | p | 3 | 73 | 23 | 3 | 11 | p | 3 | 13 | 107 |
| 63 | 3 | p | 11 | 3 | 107 | p | 3 | 23 | 83 | 3 | 17 | p | 3 | 7 | 37 | 3 | p | p | 3 | 191 |
| 67 | 13 | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 53 | 3 | 17 | 13 | 3 | 181 | p | 3 | 7 | p |
| 69 | 3 | 19 | p | 3 | p | 197 | 3 | 11 | p | 3 | 7 | 43 | 3 | 17 | p | 3 | 179 | 7 | 3 | 97 |
| 71 | 139 | 3 | 7 | p | 3 | 11 | 23 | 3 | 37 | 7 | 3 | p | 19 | 3 | 13 | 61 | 3 | 43 | p | 3 |
| 73 | 23 | 7 | 3 | 11 | 19 | 3 | p | p | 3 | p | p | 3 | 31 | p | 3 | 7 | p | 3 | 59 | 223 |
| 77 | 17 | 3 | p | p | 3 | p | 7 | 3 | p | 13 | 3 | 23 | 167 | 3 | 29 | 149 | 3 | 17 | 71 | 3 |
| 79 | 41 | 17 | 3 | 13 | 157 | 3 | p | p | 3 | p | p | 3 | 7 | 79 | 3 | p | 13 | 3 | 17 | 7 |
| 81 | 3 | p | 17 | 3 | 7 | p | 3 | 29 | p | 3 | 13 | 7 | 3 | p | 109 | 3 | p | 11 | 3 | 17 |
| 83 | p | 3 | 19 | 7 | 3 | p | 149 | 3 | 71 | p | 3 | 139 | 59 | 3 | 113 | 11 | 3 | 7 | 29 | 3 |
| 87 | 3 | 7 | p | 3 | 23 | 13 | 3 | p | 7 | 3 | 31 | 11 | 3 | 97 | p | 3 | 233 | p | 3 | p |
| 89 | 7 | 3 | 233 | 137 | 3 | 79 | 17 | 3 | 131 | 11 | 3 | 229 | 13 | 3 | 7 | p | 3 | 47 | p | 3 |
| 91 | p | 47 | 3 | 109 | 29 | 3 | 7 | 11 | 3 | 127 | 89 | 3 | p | 7 | 3 | 23 | p | 3 | 11 | 13 |
| 93 | 3 | p | p | 3 | p | 7 | 3 | 157 | 17 | 3 | 37 | 97 | 3 | 13 | 211 | 3 | 11 | p | 3 | 7 |
| 97 | 47 | 11 | 3 | 7 | p | 3 | 83 | 37 | 3 | 43 | 7 | 3 | 11 | 31 | 3 | 53 | p | 3 | p | p |
| 99 | 3 | 83 | 7 | 3 | p | 71 | 3 | p | 13 | 3 | 11 | 17 | 3 | p | 19 | 3 | 7 | p | 3 | 29 |

# INCOMPOSITS.

## TAB. XXIX.

| | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | 43 | 3 | p | p | 3 | p | 79 | 3 | 7 | 11 | 3 | p | 61 | 3 | p | 7 | 3 | p |
| 03 | p | 3 | 7 | 13 | 3 | p | 23 | 3 | 43 | 7 | 3 | 17 | p | 3 | 137 | p | 3 | 19 | p | 3 |
| 07 | 3 | 19 | p | 3 | 13 | 11 | 3 | 7 | p | 3 | 109 | p | 3 | 17 | 7 | 3 | 11 | 13 | 3 | 79 |
| 09 | p | 3 | p | 11 | 3 | p | 7 | 3 | p | p | 3 | 13 | 19 | 3 | 11 | 131 | 3 | p | p | 3 |
| 11 | 79 | 11 | 3 | p | 19 | 3 | p | p | 3 | p | 47 | 3 | 7 | 223 | 3 | 17 | 53 | 3 | 13 | 7 |
| 13 | 3 | p | 67 | 3 | 7 | 31 | 3 | p | p | 3 | 11 | 7 | 3 | 37 | p | 3 | 17 | p | 3 | 29 |
| 17 | 13 | 17 | 3 | 199 | p | 3 | 11 | 43 | 3 | 7 | 23 | 3 | 29 | 13 | 3 | 113 | 7 | 3 | 17 | p |
| 19 | 3 | 7 | 17 | 3 | 11 | p | 3 | 13 | 7 | 3 | 19 | p | 3 | 31 | 67 | 3 | 157 | p | 3 | 17 |
| 21 | 7 | 3 | 11 | 17 | 3 | 29 | 41 | 3 | p | p | 3 | 239 | p | 3 | 7 | 97 | 3 | 197 | 67 | 3 |
| 23 | 11 | p | 3 | 151 | 17 | 3 | 7 | 131 | 3 | p | 127 | 3 | p | 7 | 3 | 23 | 29 | 3 | 53 | p |
| 27 | 179 | 3 | 59 | 23 | 3 | p | 17 | 3 | p | 13 | 3 | 7 | 89 | 3 | p | p | 3 | p | 7 | 3 |
| 29 | 43 | 37 | 3 | 7 | 73 | 3 | p | 17 | 3 | p | 7 | 3 | 151 | p | 3 | p | 11 | 3 | p | 53 |
| 31 | 3 | p | 7 | 3 | p | p | 3 | p | 17 | 3 | 13 | p | 3 | p | 11 | 3 | 7 | p | 3 | 19 |
| 33 | 137 | 3 | 53 | p | 3 | p | p | 3 | 7 | 17 | 3 | 19 | 11 | 3 | 79 | 7 | 3 | 13 | 151 | 3 |
| 37 | 3 | 73 | p | 3 | p | 13 | 3 | p | 11 | 3 | p | 17 | 3 | 7 | 19 | 3 | p | p | 3 | 11 |
| 39 | p | 3 | p | 53 | 3 | 7 | 11 | 3 | 113 | 97 | 3 | p | 7 | 3 | 71 | 163 | 3 | 11 | p | 3 |
| 41 | p | 31 | 3 | 103 | 7 | 3 | 13 | 23 | 3 | p | p | 3 | p | 17 | 3 | 11 | p | 3 | 7 | 13 |
| 43 | 3 | 23 | 11 | 3 | p | p | 3 | 179 | p | 3 | 7 | p | 3 | 11 | 17 | 3 | 59 | 7 | 3 | p |
| 47 | 41 | 7 | 3 | 29 | 47 | 3 | 37 | p | 3 | 11 | p | 3 | 19 | p | 3 | 7 | 17 | 3 | p | p |
| 49 | 3 | p | p | 3 | 19 | 193 | 3 | 7 | 13 | 3 | 89 | p | 3 | p | 7 | 3 | p | 17 | 3 | 167 |
| 51 | 23 | 3 | 13 | 37 | 3 | 11 | 7 | 3 | 139 | p | 3 | 67 | p | 3 | 73 | 13 | 3 | p | 17 | 3 |
| 53 | p | 233 | 3 | 11 | p | 3 | 181 | 19 | 3 | 13 | 59 | 3 | 7 | 83 | 3 | 67 | p | 3 | p | 7 |
| 57 | 29 | 3 | 101 | 7 | 3 | 23 | 53 | 3 | p | p | 3 | 61 | 31 | 3 | p | p | 3 | 7 | 47 | 3 |
| 59 | 61 | 89 | 3 | p | 13 | 3 | p | 211 | 3 | 7 | p | 3 | p | 41 | 3 | p | 7 | 3 | p | 11 |
| 61 | 3 | 7 | 127 | 3 | 131 | 163 | 3 | 31 | 7 | 3 | 43 | 13 | 3 | 19 | 37 | 3 | 23 | 11 | 3 | 149 |
| 63 | 7 | 3 | p | 157 | 3 | 13 | p | 3 | 101 | p | 3 | p | 173 | 3 | 7 | 11 | 3 | 47 | 13 | 3 |
| 67 | 3 | p | p | 3 | p | 7 | 3 | p | 19 | 3 | 149 | 11 | 3 | p | p | 3 | p | 61 | 3 | 7 |
| 69 | 13 | 3 | p | p | 3 | p | 61 | 3 | 29 | 11 | 3 | 7 | p | 3 | 101 | 23 | 3 | 41 | 7 | 3 |
| 71 | 47 | p | 3 | 7 | 149 | 3 | p | 11 | 3 | 23 | 7 | 3 | p | 103 | 3 | p | 101 | 3 | 11 | 29 |
| 73 | 3 | 13 | 7 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | p | 13 | 3 | 7 | p | 3 | p |
| 77 | 7 | 11 | 3 | p | p | 3 | 19 | 7 | 3 | 227 | p | 3 | 11 | 181 | 3 | 13 | 137 | 3 | 31 | p |
| 79 | 3 | p | 167 | 3 | p | 29 | 3 | p | 23 | 3 | 11 | p | 3 | 7 | 229 | 3 | p | 19 | 3 | 37 |
| 81 | p | 3 | 23 | 13 | 3 | 7 | p | 3 | 11 | 19 | 3 | 211 | 7 | 3 | 47 | 71 | 3 | p | p | 3 |
| 83 | 17 | 19 | 3 | p | 7 | 3 | 11 | p | 3 | p | 13 | 3 | p | p | 3 | 89 | 37 | 3 | 7 | 23 |
| 87 | p | 3 | 7 | 113 | 3 | 71 | p | 3 | 163 | 7 | 3 | 13 | p | 3 | p | p | 3 | p | 107 | 3 |
| 89 | 11 | 7 | 3 | 17 | p | 3 | 83 | 109 | 3 | p | p | 3 | 59 | p | 3 | 7 | p | 3 | 13 | 103 |
| 91 | 3 | 83 | 181 | 3 | 17 | p | 3 | 7 | p | 3 | 37 | p | 3 | 29 | 7 | 3 | 31 | p | 3 | p |
| 93 | p | 3 | 41 | p | 3 | 17 | 7 | 3 | p | p | 3 | p | 23 | 3 | p | p | 3 | p | 11 | 3 |
| 97 | 3 | p | 19 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | p | 11 | 3 | p | 29 | 3 | 59 |
| 99 | p | 3 | p | 7 | 3 | p | 31 | 3 | 17 | p | 3 | 47 | 11 | 3 | 13 | 239 | 3 | 7 | p | 3 |

# INCOMPOSITS.

## TAB. XXX.

| | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 31 | 3 | 11 | 173 | 3 | 19 | p | 3 | 127 | p | 3 | 7 | 53 | 3 | 191 | 13 | 3 | 227 | 7 | 3 |
| 03 | 11 | 97 | 3 | 7 | p | 3 | p | 47 | 3 | 13 | 7 | 3 | 73 | 31 | 3 | 157 | 19 | 3 | 79 | 37 |
| 07 | 19 | 3 | p | 199 | 3 | 41 | 103 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | p | 11 | 3 |
| 09 | 7 | p | 3 | p | 13 | 3 | 29 | 7 | 3 | p | p | 3 | p | 127 | 3 | p | 11 | 3 | p | 139 |
| 11 | 3 | p | p | 3 | p | p | 3 | p | 23 | 3 | p | 13 | 3 | 7 | 11 | 3 | p | 29 | 3 | 181 |
| 13 | p | 3 | 23 | p | 3 | 7 | p | 3 | 103 | p | 3 | p | 7 | 3 | 19 | p | 3 | 211 | 13 | 3 |
| 17 | 3 | 89 | p | 3 | p | 163 | 3 | 71 | 11 | 3 | 7 | 31 | 3 | 23 | p | 3 | p | 7 | 3 | 11 |
| 19 | 13 | 3 | 7 | 29 | 3 | 139 | 11 | 3 | 131 | 7 | 3 | p | p | 3 | p | 53 | 3 | 11 | 41 | 3 |
| 21 | 17 | 7 | 3 | p | 11 | 3 | 31 | 13 | 3 | p | p | 3 | p | 137 | 3 | 7 | p | 3 | 163 | p |
| 23 | 3 | 13 | 11 | 3 | 37 | 43 | 3 | 7 | 59 | 3 | p | p | 3 | 11 | 7 | 3 | 109 | p | 3 | 37 |
| 27 | p | 37 | 3 | 17 | p | 3 | 23 | p | 3 | 11 | 67 | 3 | 7 | 41 | 3 | 13 | p | 3 | 29 | 7 |
| 29 | 3 | p | p | 3 | 7 | 107 | 3 | 11 | 89 | 3 | p | 7 | 3 | 79 | 67 | 3 | p | p | 3 | p |
| 31 | p | 3 | p | 7 | 3 | 11 | p | 3 | p | 31 | 3 | 29 | 161 | 3 | 103 | 59 | 3 | 7 | 19 | 3 |
| 33 | 131 | 61 | 3 | 11 | 71 | 3 | 17 | p | 3 | 7 | 13 | 3 | p | p | 3 | 37 | 7 | 3 | p | 73 |
| 37 | 7 | 3 | p | p | 3 | p | 191 | 3 | 17 | 3 | 3 | 13 | 37 | 3 | 7 | 29 | 3 | 31 | 53 | 3 |
| 39 | 127 | 47 | 3 | 227 | p | 3 | 7 | 151 | 3 | 17 | 43 | 3 | p | 7 | 3 | p | 23 | 3 | 13 | 11 |
| 41 | 3 | 53 | 139 | 3 | p | 7 | 3 | p | 29 | 3 | 17 | p | 3 | p | p | 3 | 19 | 11 | 3 | 7 |
| 43 | p | 3 | p | 41 | 3 | p | 13 | 3 | 19 | p | 3 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 |
| 47 | 3 | p | 7 | 3 | 211 | 127 | 3 | 13 | 83 | 3 | 137 | 11 | 3 | 17 | p | 3 | 7 | p | 3 | 151 |
| 49 | p | 3 | 31 | 19 | 3 | p | 223 | 3 | 7 | 11 | 3 | p | 179 | 3 | 13 | 7 | 3 | 149 | 97 | 3 |
| 51 | 7 | p | 3 | 23 | p | 3 | 89 | 7 | 3 | 167 | p | 3 | 193 | p | 3 | 17 | p | 3 | 11 | p |
| 53 | 3 | p | 13 | 3 | p | 11 | 3 | 41 | 229 | 3 | p | 149 | 3 | 7 | p | 3 | 11 | p | 3 | 167 |
| 57 | p | 11 | 3 | 13 | 7 | 3 | p | p | 3 | 19 | 73 | 3 | 11 | p | 3 | p | 13 | 3 | 7 | p |
| 59 | 3 | 19 | 17 | 3 | 53 | 31 | 3 | 67 | 71 | 3 | 7 | p | 3 | p | 37 | 3 | p | 7 | 3 | 17 |
| 61 | p | 3 | 7 | 17 | 3 | 157 | p | 3 | 11 | 7 | 3 | 67 | 19 | 3 | 97 | p | 3 | 13 | 31 | 3 |
| 63 | 31 | 7 | 3 | p | 17 | 3 | 11 | p | 3 | p | p | 3 | p | 23 | 3 | 7 | p | 3 | p | 61 |
| 67 | p | 3 | 11 | p | 3 | p | 7 | 3 | 37 | p | 3 | p | 13 | 3 | p | p | 3 | 59 | 131 | 3 |
| 69 | 11 | p | 3 | p | 59 | 3 | 13 | 17 | 3 | 109 | p | 3 | 7 | p | 3 | 71 | p | 3 | 19 | 7 |
| 71 | 3 | p | p | 3 | 7 | 37 | 3 | p | 17 | 3 | 19 | 7 | 3 | 13 | p | 3 | p | p | 3 | p |
| 73 | p | 3 | 19 | 7 | 3 | p | 23 | 3 | 113 | 17 | 3 | 47 | p | 3 | p | 41 | 3 | 7 | 11 | 3 |
| 77 | 3 | 7 | 101 | 3 | p | 19 | 3 | 53 | 7 | 3 | p | 17 | 3 | p | 11 | 3 | 83 | 23 | 3 | 37 |
| 79 | 7 | 3 | 13 | p | 3 | p | p | 3 | 97 | p | 3 | 23 | 11 | 3 | 7 | 13 | 3 | p | p | 3 |
| 81 | 241 | 73 | 3 | 79 | p | 3 | 7 | 43 | 3 | 13 | 11 | 3 | p | 7 | 3 | p | 37 | 3 | 233 | p |
| 83 | 3 | 83 | 167 | 3 | 233 | 7 | 3 | 29 | 11 | 3 | p | p | 3 | 43 | 17 | 3 | 13 | 191 | 3 | 7 |
| 87 | 29 | 31 | 3 | 7 | 11 | 3 | p | p | 3 | 61 | 7 | 3 | 101 | p | 3 | 11 | 17 | 3 | p | 223 |
| 89 | 3 | p | 7 | 3 | 23 | 41 | 3 | p | p | 3 | 37 | 13 | 3 | 11 | 19 | 3 | 7 | 17 | 3 | 239 |
| 91 | 11 | 3 | 71 | p | 3 | 13 | 19 | 3 | 7 | p | 3 | 11 | 211 | 3 | 41 | 7 | 3 | p | 13 | 3 |
| 93 | 7 | p | 3 | p | 29 | 3 | p | 7 | 3 | 11 | p | 3 | 13 | p | 3 | 23 | p | 3 | 101 | 17 |
| 97 | 13 | 3 | 97 | 23 | 3 | 7 | 79 | 3 | p | p | 3 | p | 7 | 3 | 1 | 61 | 3 | p | 89 | 3 |
| 99 | p | p | 3 | 11 | 7 | 3 | p | 13 | 3 | 41 | 113 | 3 | 19 | p | 3 | 107 | p | 3 | 7 | p |

# INCOMPOSITS.

## TAB. XXXI.

| | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 29 | p | 3 | 47 | 11 | 3 | p | 101 | 3 | p | p | 3 | 7 | 59 | 3 | 11 | 229 | 3 | 23 | 7 |
| 03 | 3 | p | 11 | 3 | 7 | 17 | 3 | p | 41 | 3 | 53 | 7 | 3 | 11 | p | 3 | p | p | 3 | 103 |
| 07 | 23 | p | 3 | 13 | 29 | 3 | p | 17 | 3 | 7 | p | 3 | 97 | 101 | 3 | p | 7 | 3 | 19 | 31 |
| 09 | 3 | 7 | p | 3 | 193 | p | 3 | 11 | 7 | 3 | 13 | 53 | 3 | 37 | p | 3 | p | 23 | 3 | p |
| 11 | 7 | 3 | 19 | 41 | 3 | 11 | p | 3 | p | 17 | 3 | 23 | p | 3 | 7 | p | 3 | 13 | 113 | 3 |
| 13 | p | 47 | 3 | 11 | p | 3 | 7 | 109 | 3 | p | 17 | 3 | 41 | 7 | 3 | 137 | p | 3 | p | 101 |
| 17 | p | 3 | p | p | 3 | 73 | p | 3 | 61 | p | 3 | 7 | 13 | 3 | p | 227 | 3 | p | 7 | 3 |
| 19 | 47 | 79 | 3 | 7 | 31 | 3 | 13 | p | 3 | p | 7 | 3 | 29 | 17 | 3 | p | 43 | 3 | p | 11 |
| 21 | 3 | 59 | 7 | 3 | 23 | p | 3 | 41 | p | 3 | 139 | p | 3 | 13 | 17 | 3 | 7 | 11 | 3 | 19 |
| 23 | 193 | 3 | p | 179 | 3 | 29 | p | 3 | 7 | p | 3 | 19 | p | 3 | 239 | 7 | 3 | p | 211 | 3 |
| 27 | 3 | p | 229 | 3 | p | p | 3 | p | 13 | 3 | p | 11 | 3 | 7 | 19 | 3 | p | 17 | 3 | p |
| 29 | p | 3 | 13 | 23 | 3 | 7 | 19 | 3 | 59 | 11 | 3 | p | 7 | 3 | 47 | 13 | 3 | p | 17 | 3 |
| 31 | 173 | 157 | 3 | p | 7 | 3 | p | 11 | 3 | 13 | p | 3 | p | p | 3 | 37 | p | 3 | 7 | 17 |
| 33 | 3 | p | 29 | 3 | 223 | 11 | 3 | p | 127 | 3 | 7 | 113 | 3 | p | 23 | 3 | 11 | 7 | 3 | p |
| 37 | p | 7 | 3 | p | 13 | 3 | p | p | 3 | p | 67 | 3 | 11 | 83 | 3 | 7 | p | 3 | p | 241 |
| 39 | 3 | p | 59 | 3 | 19 | p | 3 | 7 | 83 | 3 | 11 | 13 | 3 | p | 7 | 3 | 53 | 107 | 3 | 23 |
| 41 | p | 3 | 107 | 83 | 3 | 13 | 7 | 3 | 11 | 149 | 3 | p | 47 | 3 | p | 19 | 3 | 29 | 13 | 3 |
| 43 | 97 | 137 | 3 | p | p | 3 | 11 | 19 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 47 | 13 | 3 | 11 | 7 | 3 | 191 | p | 3 | 71 | 59 | 3 | 47 | 73 | 3 | 43 | p | 3 | 7 | 23 | 3 |
| 49 | 11 | p | 3 | 29 | p | 3 | p | 13 | 3 | 7 | 41 | 3 | 23 | 31 | 3 | 61 | 7 | 3 | 127 | p |
| 51 | 3 | 7 | p | 3 | 61 | 151 | 3 | 79 | 7 | 3 | p | p | 3 | 19 | 13 | 3 | p | p | 3 | 41 |
| 53 | 7 | 3 | 89 | p | 3 | 19 | 131 | 3 | 13 | p | 3 | p | p | 3 | 7 | p | 3 | 37 | 11 | 3 |
| 57 | 3 | 43 | p | 3 | p | 7 | 3 | p | 19 | 3 | p | 23 | 3 | p | 11 | 3 | p | p | 3 | 7 |
| 59 | 19 | 3 | p | 13 | 3 | 23 | p | 3 | p | 47 | 3 | 7 | 11 | 3 | 41 | p | 3 | 151 | 7 | 3 |
| 61 | 17 | p | 3 | 7 | 103 | 3 | p | p | 3 | p | 7 | 3 | p | 43 | 3 | p | 197 | 3 | p | p |
| 63 | 3 | 17 | 7 | 3 | 13 | 71 | 3 | p | 11 | 3 | 227 | 31 | 3 | p | p | 3 | 7 | 13 | 3 | 11 |
| 67 | 7 | p | 3 | 17 | 11 | 3 | 19 | 7 | 3 | 41 | 79 | 3 | 197 | 109 | 3 | 11 | p | 3 | 13 | p |
| 69 | 3 | p | 11 | 3 | 17 | 37 | 3 | 67 | p | 3 | 173 | p | 3 | 7 | p | 3 | 83 | 19 | 3 | 31 |
| 71 | 11 | 3 | p | 73 | 3 | 7 | 13 | 3 | 29 | 19 | 3 | 11 | 7 | 3 | p | 23 | 3 | 223 | p | 3 |
| 73 | 13 | 19 | 3 | p | 7 | 3 | 17 | p | 3 | 11 | 157 | 3 | 71 | 13 | 3 | 67 | p | 3 | 7 | 29 |
| 77 | p | 3 | 7 | 173 | 3 | 11 | 47 | 3 | 17 | 7 | 3 | 131 | 29 | 3 | 13 | 139 | 3 | 163 | 43 | 3 |
| 79 | 73 | 7 | 3 | 11 | 197 | 3 | p | p | 3 | 17 | 103 | 3 | 233 | p | 3 | 7 | 37 | 3 | p | p |
| 81 | 3 | 11 | 13 | 3 | 31 | 29 | 3 | 7 | 23 | 13 | 17 | 193 | 3 | p | 7 | 3 | p | p | 3 | p |
| 83 | p | 3 | 23 | p | 3 | 47 | 7 | 3 | 107 | 3 | 3 | 17 | p | 3 | p | p | 3 | 31 | 19 | 3 |
| 87 | 3 | 139 | 19 | 3 | 7 | 43 | 3 | 89 | p | 3 | 13 | 7 | 3 | 17 | p | 3 | p | 11 | 3 | p |
| 89 | p | 3 | p | 7 | 3 | p | p | 3 | p | 71 | 3 | 43 | 167 | 3 | 17 | 11 | 3 | 7 | 199 | 3 |
| 91 | p | 23 | 3 | 131 | 241 | 3 | 137 | 31 | 3 | 7 | p | 3 | p | 11 | 3 | 17 | 7 | 3 | 59 | p |
| 93 | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | 199 | 11 | 3 | 29 | p | 3 | 17 | 61 | 3 | 47 |
| 97 | 19 | 17 | 3 | p | p | 3 | 7 | 11 | 3 | 181 | 107 | 3 | p | 7 | 3 | 31 | 103 | 3 | 11 | 13 |
| 99 | 3 | 37 | 17 | 3 | 101 | 7 | 3 | 163 | p | 3 | p | 19 | 3 | 13 | 89 | 3 | 11 | 29 | 3 | 7 |

# INCOMPOSITS.

## TAB. XXXII.

| | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 13 | p | 3 | p | p | 3 | p | p | 3 | 251 | 89 | 3 | 7 | 13 | 3 | p | 11 | 3 | p |
| 03 | p | 3 | 17 | p | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 19 | 11 | 3 | p | p | 3 |
| 07 | 3 | 173 | p | 3 | 17 | p | 3 | 73 | 181 | 3 | 7 | 11 | 3 | 29 | 163 | 3 | p | 7 | 3 | p |
| 09 | 59 | 3 | 7 | 13 | 3 | 17 | 137 | 3 | 107 | 7 | 3 | 223 | 31 | 3 | p | 41 | 3 | p | p | 3 |
| 11 | p | 7 | 3 | p | 139 | 3 | 17 | 11 | 3 | 53 | 13 | 3 | p | p | 3 | 7 | p | 3 | 11 | 79 |
| 13 | 3 | 179 | p | 3 | 13 | 11 | 3 | 7 | 23 | 3 | 61 | p | 3 | p | 7 | 3 | 11 | 13 | 3 | p |
| 17 | p | 11 | 3 | 101 | p | 3 | p | 59 | 3 | 17 | 29 | 3 | 7 | p | 3 | 19 | p | 3 | 13 | 7 |
| 19 | 3 | p | p | 3 | 7 | 101 | 3 | 19 | p | 3 | 11 | 7 | 3 | 23 | p | 3 | 113 | p | 3 | 41 |
| 21 | 109 | 3 | 43 | 7 | 3 | 103 | 13 | 3 | 11 | p | 3 | 17 | 191 | 3 | p | p | 3 | 7 | 19 | 3 |
| 23 | 13 | 23 | 3 | p | p | 3 | 11 | p | 3 | 7 | 19 | 3 | 17 | 13 | 3 | 139 | 7 | 3 | p | 97 |
| 27 | 7 | 3 | 11 | p | 3 | 31 | p | 3 | p | p | 3 | p | 23 | 3 | 7 | p | 3 | p | 83 | 3 |
| 29 | 11 | p | 3 | 157 | 163 | 3 | 7 | 149 | 3 | p | p | 3 | 53 | 7 | 3 | 17 | p | 3 | 29 | p |
| 31 | 3 | p | 13 | 3 | 149 | 7 | 3 | 3 | 83 | 3 | p | p | 3 | p | 137 | 3 | 17 | 101 | 3 | 7 |
| 33 | 17 | 3 | p | 83 | 3 | p | p | p | 19 | 13 | 3 | 7 | 37 | 3 | 229 | p | 3 | 17 | 7 | 3 |
| 37 | 3 | p | 7 | 3 | 29 | 23 | 3 | 43 | 31 | 3 | 13 | 19 | 3 | p | 11 | 3 | 7 | p | 3 | 17 |
| 39 | p | 3 | 109 | 17 | 3 | p | p | 3 | 7 | p | 3 | 103 | 11 | 3 | p | 7 | 3 | 13 | p | 3 |
| 41 | 7 | p | 3 | 31 | 17 | 3 | 37 | 7 | 3 | 113 | 11 | 3 | p | 97 | 3 | p | 23 | 3 | p | 43 |
| 43 | 3 | p | 67 | 3 | 41 | 13 | 3 | p | 11 | 3 | 23 | 233 | 3 | 7 | p | 3 | 31 | p | 3 | 11 |
| 47 | p | 29 | 3 | p | 7 | 3 | 13 | 17 | 3 | 19 | 67 | 3 | p | p | 3 | 11 | p | 3 | 7 | 13 |
| 49 | 3 | 19 | 11 | 3 | 197 | p | 3 | 131 | 17 | 3 | 7 | p | 3 | 11 | 67 | 3 | p | 7 | 3 | p |
| 51 | 11 | 3 | 7 | p | 3 | 71 | 31 | 3 | p | 7 | 3 | 11 | 19 | 3 | 107 | 103 | 3 | 37 | 67 | 3 |
| 53 | p | 7 | 3 | 23 | 19 | 3 | p | p | 3 | 11 | 17 | 3 | 43 | p | 3 | 7 | 53 | 3 | p | 31 |
| 57 | p | 3 | 13 | 127 | 3 | 11 | 7 | 3 | 239 | 157 | 3 | 137 | 17 | 3 | 23 | 13 | 3 | 103 | p | 3 |
| 59 | 229 | 61 | 3 | 11 | p | 3 | p | 97 | 3 | 13 | p | 3 | 7 | 17 | 3 | p | p | 3 | 19 | 7 |
| 61 | 3 | 11 | 23 | 3 | 7 | 73 | 3 | p | p | 3 | 19 | 7 | 3 | p | 17 | 3 | 13 | p | 3 | 167 |
| 63 | 53 | 3 | 19 | 7 | 3 | p | 223 | 3 | 37 | 79 | 3 | 83 | 41 | 3 | p | 17 | 3 | 7 | p | 3 |
| 67 | 3 | 7 | 71 | 3 | p | 19 | 3 | 23 | 7 | 3 | p | 13 | 3 | p | p | 3 | p | 11 | 3 | 47 |
| 69 | 7 | 3 | 73 | 47 | 3 | 13 | 29 | 3 | p | p | 3 | 181 | 151 | 3 | 7 | 11 | 3 | 43 | 13 | 3 |
| 71 | p | p | 3 | 97 | 179 | 3 | 7 | 41 | 3 | p | 59 | 3 | 13 | 7 | 3 | 151 | p | 3 | 23 | 17 |
| 73 | 3 | 79 | p | 3 | p | 7 | 3 | p | p | 3 | p | 11 | 3 | 127 | p | 3 | 41 | p | 3 | 7 |
| 77 | 23 | 97 | 3 | 7 | p | 3 | 233 | 11 | 3 | 71 | 7 | 3 | p | p | 3 | p | 37 | 3 | 11 | p |
| 79 | 3 | 13 | 7 | 3 | 43 | 11 | 3 | 67 | 227 | 3 | p | p | 3 | 61 | 13 | 3 | 7 | 23 | 3 | 137 |
| 81 | p | 3 | 61 | 11 | 3 | p | 19 | 3 | 7 | p | 3 | 23 | p | 3 | 11 | 7 | 3 | p | 127 | 3 |
| 83 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | 199 | 3 | 11 | 241 | 3 | 13 | 43 | 3 | 193 | 109 |
| 87 | 47 | 3 | 199 | 13 | 3 | 7 | p | 3 | 11 | p | 3 | 179 | 7 | 3 | p | p | 3 | 227 | 29 | 3 |
| 89 | 29 | p | 3 | 89 | 7 | 3 | 11 | 37 | 3 | p | 13 | 3 | 19 | p | 3 | p | p | 3 | 7 | 61 |
| 91 | 3 | p | 167 | 3 | 11 | p | 3 | p | 61 | 3 | 7 | 29 | 3 | p | 173 | 3 | p | 7 | 3 | 89 |
| 93 | 31 | 3 | 7 | 43 | 3 | 53 | 71 | 3 | 109 | 7 | 3 | 13 | 167 | 3 | p | 19 | 3 | p | 181 | 3 |
| 97 | 3 | 37 | p | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | p | 131 | 3 | p |
| 99 | p | 3 | p | 23 | 3 | 59 | 7 | 3 | 31 | 73 | 3 | p | p | 3 | p | p | 3 | p | 11 | 3 |

# INCOMPOSITS.

## TAB. XXXIII.

| | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7 | 3 | 19 | p | 3 | 53 | p | 3 | 11 | p | 3 | p | 113 | 3 | 7 | 17 | 3 | p | 29 | 3 |
| 03 | 29 | 13 | 3 | p | p | 3 | 7 | 89 | 3 | 41 | p | 3 | p | 7 | 3 | 31 | 17 | 3 | 23 | 59 |
| 07 | p | 3 | 11 | 107 | 3 | 251 | 23 | 3 | 229 | 47 | 3 | 7 | 197 | 3 | p | 13 | 3 | p | 7 | 3 |
| 09 | 11 | p | 3 | 7 | 29 | 3 | p | p | 3 | 13 | 7 | 3 | 61 | p | 3 | 109 | p | 3 | p | 17 |
| 11 | 3 | 61 | 7 | 3 | 41 | 31 | 3 | 163 | p | 3 | p | p | 3 | 241 | 149 | 3 | 7 | 23 | 3 | 19 |
| 13 | p | 3 | 157 | 73 | 3 | p | p | 3 | 7 | 139 | 3 | 19 | p | 3 | p | 7 | 3 | p | 11 | 3 |
| 17 | 3 | 97 | p | 3 | 37 | 149 | 3 | p | p | 3 | 79 | 13 | 3 | 7 | 11 | 3 | p | p | 3 | 29 |
| 19 | p | 3 | 149 | p | 3 | 7 | 19 | 3 | 53 | p | 3 | p | 7 | 3 | p | p | 3 | p | 13 | 3 |
| 21 | 73 | 37 | 3 | 131 | 7 | 3 | p | 61 | 3 | p | 11 | 3 | 13 | 83 | 3 | p | 211 | 3 | 7 | p |
| 23 | 3 | p | p | 3 | 23 | 113 | 3 | 59 | 11 | 3 | 7 | p | 3 | p | p | 3 | 137 | 7 | 3 | 11 |
| 27 | 43 | 7 | 3 | p | 11 | 3 | p | 13 | 3 | p | p | 3 | 19 | p | 3 | 7 | 29 | 3 | p | p |
| 29 | 3 | 13 | 11 | 3 | 19 | 173 | 3 | 7 | 241 | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | p |
| 31 | 11 | 3 | p | 23 | 3 | 47 | 7 | 3 | 13 | 29 | 3 | 11 | 37 | 3 | 59 | 19 | 3 | p | p | 3 |
| 33 | p | 59 | 3 | p | p | 3 | p | 19 | 3 | 11 | p | 3 | 7 | 79 | 3 | 13 | p | 3 | 43 | 7 |
| 37 | p | 3 | p | 7 | 3 | 11 | 109 | 3 | 23 | p | 3 | 53 | 89 | 3 | p | p | 3 | 7 | p | 3 |
| 39 | 17 | 31 | 3 | 11 | p | 3 | 37 | 41 | 3 | 7 | 13 | 3 | p | 223 | 3 | p | 7 | 3 | p | 233 |
| 41 | 3 | 7 | 227 | 3 | 13 | 233 | 3 | 101 | 7 | 3 | 193 | p | 3 | 19 | 31 | 3 | 41 | 13 | 3 | 23 |
| 43 | 7 | 3 | 17 | 37 | 3 | 19 | 127 | 3 | 61 | 101 | 3 | 13 | 53 | 3 | 7 | p | 3 | 29 | p | 3 |
| 47 | 3 | 23 | 41 | 3 | 17 | 7 | 3 | p | 19 | 3 | 29 | p | 3 | 101 | p | 3 | p | 11 | 3 | 7 |
| 49 | 19 | 3 | 47 | 229 | 3 | 17 | 13 | 3 | p | 107 | 3 | 7 | 71 | 3 | p | 11 | 3 | 37 | 7 | 3 |
| 51 | 13 | p | 3 | 7 | p | 3 | 17 | 73 | 3 | p | 7 | 3 | 23 | 11 | 3 | p | p | 3 | p | p |
| 53 | 3 | p | 7 | 3 | p | p | 3 | 13 | p | 3 | p | 11 | 3 | p | 29 | 3 | 7 | 47 | 3 | 101 |
| 57 | 7 | p | 3 | 139 | 43 | 3 | 19 | 7 | 3 | 17 | 67 | 3 | p | p | 3 | p | p | 3 | 11 | p |
| 59 | 3 | 83 | 13 | 3 | 73 | 11 | 3 | 31 | 79 | 3 | 17 | 23 | 3 | 7 | 67 | 3 | 11 | 19 | 3 | 71 |
| 61 | 29 | 3 | 179 | 11 | 3 | 7 | p | 3 | 37 | 13 | 3 | 17 | 7 | 3 | 11 | 53 | 3 | p | 67 | 3 |
| 63 | p | 11 | 3 | 13 | 7 | 3 | p | p | 3 | 167 | p | 3 | 11 | 163 | 3 | p | 13 | 3 | 7 | p |
| 67 | p | 3 | 7 | 191 | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | 17 | 173 | 3 | 13 | p | 3 |
| 69 | 79 | 7 | 3 | 59 | 23 | 3 | 11 | 239 | 3 | p | 31 | 3 | p | 131 | 3 | 7 | 97 | 3 | 199 | 41 |
| 71 | 3 | p | p | 3 | 11 | 13 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 17 | 89 | 3 | 37 |
| 73 | 17 | 3 | 11 | p | 3 | 31 | 7 | 3 | 29 | 43 | 3 | p | 13 | 3 | 233 | 23 | 3 | 17 | 19 | 3 |
| 77 | 3 | 29 | 17 | 3 | 7 | p | 3 | 211 | p | 3 | 59 | 7 | 3 | 13 | 41 | 3 | p | p | 3 | 17 |
| 79 | 139 | 3 | p | 7 | 3 | p | p | 3 | p | 181 | 3 | p | 29 | 3 | 3 | p | 3 | 7 | 11 | 3 |
| 81 | p | 13 | 3 | p | 17 | 3 | 71 | p | 3 | 7 | 151 | 3 | 97 | p | 3 | p | 7 | 3 | p | p |
| 83 | 3 | 7 | p | 3 | p | 17 | 3 | p | 7 | 3 | 37 | p | 3 | 151 | 11 | 3 | 19 | 157 | 3 | p |
| 87 | 19 | p | 3 | 31 | 59 | 3 | 7 | 17 | 3 | 13 | 11 | 3 | p | 7 | 3 | p | p | 3 | 41 | 19 |
| 89 | 3 | p | 53 | 3 | p | 7 | 3 | 67 | 11 | 3 | p | 19 | 3 | 23 | 43 | 3 | 13 | p | 3 | 7 |
| 91 | p | 3 | 239 | 19 | 3 | p | 11 | 3 | p | 17 | 3 | 7 | 109 | 3 | 79 | 107 | 3 | 11 | 7 | 3 |
| 93 | 107 | 23 | 3 | 7 | 11 | 3 | p | p | 3 | 103 | 7 | 3 | p | p | 3 | 11 | 179 | 3 | 131 | p |
| 97 | 11 | 3 | 113 | 71 | 3 | 13 | 31 | 3 | 7 | p | 3 | 11 | 17 | 3 | p | 7 | 3 | 19 | 13 | 3 |
| 99 | 7 | 43 | 3 | p | 13 | 3 | 23 | 7 | 3 | 11 | p | 3 | 13 | 17 | 3 | p | p | 3 | p | 31 |

# INCOMPOSITS.

## TAB. XXXIV.

| | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 13 | 7 | 3 | p | 23 | 3 | p | p | 3 | 149 | 11 | 3 | 17 | 13 | 3 | 7 | p | 3 | p | p |
| 03 | 3 | p | 239 | 3 | p | 73 | 3 | 7 | 11 | 3 | p | p | 3 | 17 | 7 | 3 | 67 | 79 | 3 | 11 |
| 07 | 149 | p | 3 | 61 | 11 | 3 | 43 | 41 | 3 | 23 | 37 | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 |
| 09 | 3 | p | 11 | 3 | 7 | p | 3 | 19 | p | 3 | 113 | 7 | 3 | 11 | p | 3 | 17 | p | 3 | 59 |
| 11 | 11 | 3 | 73 | 7 | 3 | 227 | 59 | 3 | 71 | 13 | 3 | 11 | p | 3 | p | p | 3 | 7 | 19 | 3 |
| 13 | 251 | 17 | 3 | 13 | p | 3 | 29 | p | 3 | 7 | 19 | 3 | p | 83 | 3 | 181 | 7 | 3 | 17 | 113 |
| 17 | 7 | 3 | 23 | 17 | 3 | 11 | p | 3 | 109 | 61 | 3 | 41 | p | 3 | 7 | 107 | 3 | 13 | 73 | 3 |
| 19 | 107 | 37 | 3 | 11 | 17 | 3 | 7 | 137 | 3 | p | 29 | 3 | p | 7 | 3 | 251 | p | 3 | p | 23 |
| 21 | 3 | 11 | p | 3 | 127 | 7 | 3 | p | p | 3 | p | p | 3 | 23 | p | 3 | 19 | 241 | 3 | 7 |
| 23 | 103 | 3 | 47 | 29 | 3 | p | 17 | 3 | 19 | p | 3 | 7 | 13 | 3 | 191 | p | 3 | p | 7 | 3 |
| 27 | 3 | 89 | 7 | 3 | 181 | 71 | 3 | 53 | 17 | 3 | 97 | 19 | 3 | 13 | p | 3 | 7 | 11 | 3 | p |
| 29 | p | 3 | 103 | 19 | 3 | p | p | 3 | 7 | 17 | 3 | p | 23 | 3 | p | 7 | 3 | 89 | p | 3 |
| 31 | 7 | 13 | 3 | 113 | p | 3 | 23 | 7 | 3 | p | 17 | 3 | p | 11 | 3 | p | p | 3 | 29 | p |
| 33 | 3 | 41 | 107 | 3 | 31 | p | 3 | p | 13 | 3 | p | 11 | 3 | 7 | p | 3 | 47 | p | 3 | p |
| 37 | p | p | 3 | p | 7 | 3 | 37 | 11 | 3 | 13 | 43 | 3 | 71 | 17 | 3 | p | 239 | 3 | 7 | 41 |
| 39 | 3 | 19 | p | 3 | 29 | 11 | 3 | p | 89 | 3 | 7 | p | 3 | p | 17 | 3 | 11 | 7 | 3 | p |
| 41 | p | 3 | 7 | 11 | 3 | p | 103 | 3 | p | 7 | 3 | p | 19 | 3 | 11 | 17 | 3 | p | 179 | 3 |
| 43 | 211 | 7 | 3 | p | 13 | 3 | p | 31 | 3 | p | p | 3 | 11 | p | 3 | 7 | 17 | 3 | p | p |
| 47 | p | 3 | 31 | p | 3 | 13 | 7 | 3 | 11 | p | 3 | 83 | p | 3 | p | p | 3 | 37 | 13 | 3 |
| 49 | 257 | 29 | 3 | 43 | p | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 31 | 61 | 3 | 19 | 7 |
| 51 | 3 | 83 | 97 | 3 | 7 | 61 | 3 | p | p | 3 | 19 | 7 | 3 | 47 | 37 | 3 | p | p | 3 | 13 |
| 53 | 13 | 3 | 11 | 7 | 3 | p | p | 3 | p | 23 | 3 | p | 109 | 3 | p | 43 | 3 | 7 | p | 3 |
| 57 | 3 | 7 | 59 | 3 | p | 19 | 3 | 241 | 7 | 3 | p | p | 3 | 193 | 13 | 3 | 29 | p | 3 | p |
| 59 | 7 | 3 | 173 | p | 3 | 101 | 191 | 3 | 13 | p | 3 | 239 | 103 | 3 | 7 | p | 3 | p | 11 | 3 |
| 61 | 31 | p | 3 | p | 41 | 3 | 7 | 101 | 3 | 29 | p | 3 | p | 7 | 3 | 13 | 11 | 3 | 79 | p |
| 63 | 3 | 109 | 23 | 3 | p | 7 | 3 | p | p | 3 | 199 | 47 | 3 | 31 | 11 | 3 | 71 | p | 3 | 7 |
| 67 | p | 127 | 3 | 7 | p | 3 | 163 | 179 | 3 | 167 | 7 | 3 | 137 | 23 | 3 | p | 157 | 3 | p | p |
| 69 | 3 | p | 7 | 3 | 13 | p | 3 | 23 | 11 | 3 | 47 | p | 3 | p | 19 | 3 | 7 | 13 | 3 | 11 |
| 71 | p | 3 | p | 31 | 3 | p | 11 | 3 | 7 | 193 | 3 | 13 | p | 3 | 109 | 7 | 3 | 11 | 67 | 3 |
| 73 | 7 | p | 3 | p | 11 | 3 | 61 | 7 | 3 | p | p | 3 | p | 89 | 3 | 11 | 31 | 3 | 13 | 101 |
| 77 | 11 | 3 | 191 | p | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 | p | 103 | 3 |
| 79 | 13 | p | 3 | 41 | 7 | 3 | 131 | 43 | 3 | 11 | p | 3 | 19 | 13 | 3 | p | p | 3 | 7 | p |
| 81 | 3 | 17 | 79 | 3 | 19 | 139 | 3 | 11 | 47 | 3 | 7 | p | 3 | 43 | p | 3 | 53 | 7 | 3 | 157 |
| 83 | p | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | 23 | 61 | 3 | 13 | 19 | 3 | p | p | 3 |
| 87 | 3 | 11 | 13 | 3 | 17 | p | 3 | 7 | 211 | 3 | 73 | p | 3 | 79 | 7 | 3 | 113 | 53 | 3 | p |
| 89 | p | 3 | 151 | 197 | 3 | 17 | 7 | 3 | p | 13 | 3 | p | p | 3 | p | p | 3 | p | 29 | 3 |
| 91 | 29 | p | 3 | 13 | p | 3 | 17 | p | 3 | 31 | 23 | 3 | 7 | p | 3 | 257 | 13 | 3 | p | 7 |
| 93 | 3 | 37 | p | 3 | 7 | p | 3 | 17 | 151 | 3 | 13 | 3 | 3 | 19 | p | 3 | 139 | 11 | 3 | 1 |
| 97 | 157 | 53 | 3 | 67 | 29 | 3 | p | p | 3 | 7 | 229 | 3 | 173 | 11 | 3 | 23 | 7 | 3 | 43 | 97 |
| 99 | 3 | 7 | 167 | 3 | p | 13 | 3 | 67 | 7 | 3 | 17 | 11 | 3 | p | p | 3 | p | 151 | 3 | 53 |

# INCOMPOSITS.

## TAB. XXXV.

| | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 11 | 7 | 3 | 73 | p | 3 | 23 | 107 | 3 | p | 43 | 3 | 37 | p | 3 | 7 | 47 | 3 | 13 |
| 03 | 13 | 3 | 241 | 167 | 3 | 61 | 31 | 3 | 7 | p | 3 | 19 | p | 3 | p | 7 | 3 | 43 | 29 | 3 |
| 07 | 3 | 13 | p | 3 | 67 | p | 3 | 127 | 83 | 3 | 151 | 29 | 3 | 7 | 13 | 3 | 47 | 11 | 3 | 53 |
| 09 | 47 | 3 | p | 83 | 3 | 7 | 19 | 3 | 13 | p | 3 | p | 7 | 3 | 31 | 11 | 3 | p | p | 3 |
| 11 | 23 | p | 3 | p | 7 | 3 | p | p | 3 | 137 | p | 3 | 67 | 11 | 3 | 13 | 151 | 3 | 7 | p |
| 13 | 3 | p | p | 3 | 37 | 131 | 3 | p | p | 3 | 7 | 11 | 3 | p | 41 | 3 | 67 | 7 | 3 | 151 |
| 17 | 17 | 7 | 3 | 53 | 31 | 3 | 59 | 11 | 3 | p | 13 | 3 | 19 | p | 3 | 7 | 43 | 3 | 11 | 139 |
| 19 | 3 | 17 | p | 3 | 13 | 11 | 3 | 7 | p | 3 | p | p | 3 | 103 | 7 | 3 | 11 | 13 | 3 | 29 |
| 21 | 251 | 3 | 17 | 11 | 3 | p | 7 | 3 | p | 41 | 3 | 13 | p | 3 | 11 | 19 | 3 | 113 | p | 3 |
| 23 | p | 11 | 3 | 17 | 53 | 3 | 163 | 19 | 3 | 157 | 23 | 3 | 7 | 181 | 3 | 37 | p | 3 | 13 | 7 |
| 27 | 59 | 3 | p | 7 | 3 | 17 | 13 | 3 | 11 | p | 3 | p | 37 | 3 | p | 251 | 3 | 7 | p | 3 |
| 29 | 13 | 193 | 3 | p | 41 | 3 | 11 | p | 3 | 7 | p | 3 | 107 | 13 | 3 | 23 | 7 | 3 | p | p |
| 31 | 3 | 7 | 31 | 3 | 11 | p | 3 | 13 | 7 | 3 | p | 73 | 3 | 19 | p | 3 | 179 | 103 | 3 | p |
| 33 | 7 | 3 | 11 | 23 | 3 | 19 | p | 3 | 17 | 29 | 3 | 257 | p | 3 | 7 | 31 | 3 | 137 | p | 3 |
| 37 | 3 | 61 | 13 | 3 | p | 7 | 3 | p | 19 | 3 | 17 | 47 | 3 | p | 23 | 3 | 83 | p | 3 | 7 |
| 39 | 19 | 3 | p | 37 | 3 | p | p | 3 | 23 | 13 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 41 | p | p | 3 | 7 | 89 | 3 | 83 | 53 | 3 | 71 | 7 | 3 | 17 | p | 3 | 197 | 11 | 3 | 211 | p |
| 43 | 3 | 83 | 7 | 3 | p | p | 3 | p | 43 | 3 | 13 | p | 3 | 17 | 11 | 3 | 7 | 97 | 3 | 23 |
| 47 | 7 | p | 3 | 41 | p | 3 | 19 | 7 | 3 | p | 11 | 3 | p | 31 | 3 | 17 | 257 | 3 | p | 113 |
| 49 | 3 | 23 | 139 | 3 | p | 13 | 3 | p | 11 | 3 | 29 | p | 3 | 7 | 37 | 3 | 17 | 19 | 3 | 11 |
| 51 | 17 | 3 | 131 | p | 3 | 7 | 11 | 3 | 31 | 19 | 3 | p | 7 | 3 | 199 | 157 | 3 | 11 | 23 | 3 |
| 53 | p | 17 | 3 | 29 | 7 | 3 | 13 | 197 | 3 | 53 | 199 | 3 | 23 | 223 | 3 | 11 | p | 3 | 7 | 13 |
| 57 | 11 | 3 | 7 | 17 | 3 | 179 | 71 | 3 | 37 | 7 | 3 | 11 | p | 3 | p | p | 3 | 79 | p | 3 |
| 59 | p | 7 | 3 | 197 | 17 | 3 | p | 29 | 3 | 11 | 53 | 3 | p | 43 | 3 | 7 | 41 | 3 | p | p |
| 61 | 3 | p | p | 3 | 223 | 17 | 3 | 7 | 13 | 3 | p | 23 | 3 | 139 | 7 | 3 | p | p | 3 | 43 |
| 63 | 29 | 3 | 13 | 137 | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 | p | 13 | 3 | p | 19 | 3 |
| 67 | 3 | 11 | 19 | 3 | 7 | p | 3 | p | 17 | 3 | p | 7 | 3 | 71 | p | 3 | 13 | p | 3 | 31 |
| 69 | 43 | 3 | 233 | 7 | 3 | 191 | p | 3 | 61 | 17 | 3 | 263 | 113 | 3 | 127 | 73 | 3 | 7 | 109 | 3 |
| 71 | p | p | 3 | p | 13 | 3 | 43 | p | 3 | 7 | 17 | 3 | 53 | p | 3 | 29 | 7 | 3 | 107 | 11 |
| 73 | 3 | 7 | 67 | 3 | p | 47 | 3 | 97 | 7 | 3 | p | 13 | 3 | 173 | p | 3 | 19 | 11 | 3 | 167 |
| 77 | 19 | 79 | 3 | 101 | p | 3 | 7 | p | 3 | 23 | 67 | 3 | 13 | 7 | 3 | 41 | p | 3 | p | 19 |
| 79 | 3 | 29 | p | 3 | 31 | 7 | 3 | 109 | p | 3 | 37 | 11 | 3 | p | 17 | 3 | 59 | p | 3 | 7 |
| 81 | 13 | 3 | p | 19 | 3 | p | 173 | 3 | p | 11 | 3 | 7 | 29 | 3 | p | 17 | 3 | 31 | 7 | 3 |
| 83 | 103 | 41 | 3 | 7 | p | 3 | p | 11 | 3 | 101 | 7 | 3 | 79 | p | 3 | 149 | 17 | 3 | 11 | 47 |
| 87 | p | 3 | 23 | 11 | 3 | 107 | p | 3 | 7 | 149 | 3 | 43 | 193 | 3 | 11 | 7 | 3 | 19 | 17 | 3 |
| 89 | 7 | 11 | 3 | p | p | 3 | 149 | 7 | 3 | 19 | 59 | 3 | 11 | p | 3 | 13 | 227 | 3 | 47 | 17 |
| 91 | 3 | 19 | 47 | 3 | p | 113 | 3 | p | p | 3 | 11 | p | 3 | 7 | p | 3 | p | 101 | 3 | p |
| 93 | 149 | 3 | 31 | 13 | 3 | 7 | 73 | 3 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | 71 | 37 | 3 |
| 97 | 3 | 47 | 163 | 3 | 11 | p | 3 | 89 | p | 3 | 7 | p | 3 | 29 | p | 3 | p | 7 | 3 | p |
| 99 | p | 3 | 7 | p | 3 | 181 | p | 3 | p | 7 | 3 | 13 | 23 | 3 | p | 79 | 3 | 223 | p | 3 |

# INCOMPOSITS.

## TAB. XXXVI.

| | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 3 | p | 7 | 3 | p | 17 | 3 | 101 | p | 3 | 97 | 13 | 3 | 11 | 127 | 3 | 7 | 19 | 3 |
| 03 | p | 11 | 3 | 229 | 23 | 3 | 13 | 17 | 3 | 7 | 19 | 3 | 11 | 113 | 3 | p | 7 | 3 | 59 | 13 |
| 07 | 7 | 3 | p | 167 | 3 | p | p | 3 | 11 | 17 | 3 | 211 | 31 | 3 | 7 | 23 | 3 | p | p | 3 |
| 09 | p | 13 | 3 | p | 181 | 3 | 7 | p | 3 | 23 | 17 | 3 | p | 7 | 3 | 43 | 101 | 3 | p | p |
| 11 | 3 | p | 61 | 3 | 11 | 7 | 3 | 31 | 13 | 3 | p | 17 | 3 | 29 | p | 3 | 19 | p | 3 | 7 |
| 13 | 53 | 3 | 11 | p | 3 | 107 | 241 | 3 | 19 | p | 3 | 7 | 17 | 3 | p | 13 | 3 | p | 7 | 3 |
| 17 | 3 | p | 7 | 3 | 67 | 151 | 3 | p | 23 | 3 | 47 | 19 | 3 | p | 17 | 3 | 7 | 29 | 3 | p |
| 19 | p | 3 | 23 | 19 | 3 | 97 | p | 3 | 7 | p | 3 | p | 229 | 3 | p | 7 | 3 | p | 11 | 3 |
| 21 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | p | 29 | 3 | 67 | 73 | 3 | 37 | 11 | 3 | p | 23 |
| 23 | 3 | p | p | 3 | p | 109 | 3 | 197 | p | 3 | p | 13 | 3 | 7 | 11 | 3 | 67 | 17 | 3 | 71 |
| 27 | 239 | 23 | 3 | p | 7 | 3 | p | 107 | 3 | 19 | 11 | 3 | 13 | p | 3 | p | 41 | 3 | 7 | 17 |
| 29 | 3 | 19 | p | 3 | p | p | 3 | p | 11 | 3 | 7 | p | 3 | p | p | 3 | 83 | 7 | 3 | 11 |
| 31 | 13 | 3 | 7 | 53 | 3 | 251 | 11 | 3 | 193 | 7 | 3 | 83 | 19 | 3 | 61 | 233 | 3 | 11 | 109 | 3 |
| 33 | 59 | 7 | 3 | 61 | 11 | 3 | 23 | 13 | 3 | 89 | 251 | 3 | p | p | 3 | 7 | p | 3 | 29 | p |
| 37 | 11 | 3 | p | 37 | 3 | p | 7 | 3 | 13 | p | 3 | 11 | p | 3 | p | p | 3 | 23 | p | 3 |
| 39 | p | p | 3 | 31 | p | 3 | p | 127 | 3 | 11 | p | 3 | 7 | p | 3 | 13 | 71 | 3 | 19 | 7 |
| 41 | 3 | p | 3 | 3 | 7 | 23 | 3 | 11 | p | 3 | 19 | 7 | 3 | p | 199 | 3 | 31 | p | 3 | p |
| 43 | 89 | 3 | 19 | 7 | 3 | 11 | 41 | 3 | p | 61 | 3 | p | 191 | 3 | p | 29 | 3 | 7 | p | 3 |
| 47 | 3 | 7 | 199 | 3 | 13 | 19 | 3 | 263 | 7 | 3 | 23 | p | 3 | p | 37 | 3 | p | 13 | 3 | p |
| 49 | 7 | 3 | p | 103 | 3 | p | 31 | 3 | p | p | 3 | 13 | p | 3 | 7 | p | 3 | 157 | p | 3 |
| 51 | p | 29 | 3 | p | p | 3 | 7 | 139 | 3 | p | 227 | 3 | 43 | 7 | 3 | p | 137 | 3 | 13 | 11 |
| 53 | 3 | 31 | 163 | 3 | 47 | 7 | 3 | p | p | 3 | 41 | p | 3 | p | p | 3 | 79 | 11 | 3 | 7 |
| 57 | 13 | p | 3 | 7 | p | 3 | p | 173 | 3 | p | 7 | 3 | p | 11 | 3 | 163 | 131 | 3 | 181 | 47 |
| 59 | 3 | 17 | 7 | 3 | p | 37 | 3 | 13 | 59 | 3 | p | 11 | 3 | p | 19 | 3 | 7 | 73 | 3 | 227 |
| 61 | p | 3 | 17 | 71 | 3 | 41 | 19 | 3 | 7 | 11 | 3 | p | p | 3 | 13 | 7 | 3 | p | p | 3 |
| 63 | 7 | p | 3 | 17 | 31 | 3 | p | 7 | 3 | 29 | 179 | 3 | p | p | 3 | p | p | 3 | 11 | p |
| 67 | p | 3 | 29 | 11 | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | 11 | 59 | 3 | 43 | p | 3 |
| 69 | 41 | 11 | 3 | 13 | 7 | 3 | 17 | p | 3 | p | p | 3 | 11 | 23 | 3 | p | 13 | 3 | 7 | 79 |
| 71 | 3 | 47 | p | 3 | 19 | p | 3 | 17 | 131 | 3 | 7 | p | 3 | 149 | p | 3 | p | 7 | 3 | p |
| 73 | 79 | 3 | 7 | p | 3 | p | 29 | 3 | 11 | 7 | 3 | 103 | 263 | 3 | p | 19 | 3 | 13 | 41 | 3 |
| 77 | 3 | p | 31 | 3 | 11 | 13 | 3 | 7 | p | 3 | 17 | 109 | 3 | 137 | 7 | 3 | 229 | p | 3 | 167 |
| 79 | p | 3 | 11 | p | 3 | 163 | 7 | 3 | p | p | 3 | 17 | 13 | 3 | p | 31 | 3 | 179 | p | 3 |
| 81 | 11 | p | 3 | p | p | 3 | 13 | 37 | 3 | p | p | 3 | 7 | 41 | 3 | 47 | 43 | 3 | p | 7 |
| 83 | 3 | p | 67 | 3 | 7 | p | 3 | p | 73 | 3 | 31 | 7 | 3 | 13 | p | 3 | 97 | 23 | 3 | p |
| 87 | 109 | 13 | 3 | 59 | p | 3 | p | 71 | 3 | 7 | 67 | 3 | p | p | 3 | 17 | 7 | 3 | p | p |
| 89 | 3 | 7 | p | 3 | p | p | 3 | 29 | 7 | 3 | p | 257 | 3 | p | 11 | 3 | 17 | p | 3 | 193 |
| 91 | 7 | 3 | 13 | 43 | 3 | 73 | 223 | 3 | p | p | 3 | p | 11 | 3 | 7 | 13 | 3 | 17 | 29 | 3 |
| 93 | 29 | 17 | 3 | p | 157 | 3 | 7 | p | 3 | 13 | 11 | 3 | p | 7 | 3 | p | p | 3 | 17 | p |
| 97 | 191 | 3 | p | 17 | 3 | 227 | 11 | 3 | 31 | p | 3 | 7 | 83 | 3 | 19 | p | 3 | 11 | 7 | 3 |
| 99 | p | p | 3 | 7 | 11 | 3 | 19 | 83 | 3 | p | 7 | 3 | 37 | p | 2 | 11 | p | 3 | p | p |

# INCOMPOSITS.

## TAB. XXXVII.

| | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 89 | p | 3 | 17 | 7 | 3 | 79 | p | 3 | p | 37 | 3 | 71 | 23 | 3 | 31 | 11 | 3 | 7 | 67 |
| 03 | 3 | p | 103 | 3 | 17 | p | 3 | 23 | 47 | 3 | 7 | 41 | 3 | p | 11 | 3 | 89 | 7 | 3 | 263 |
| 07 | 13 | 7 | 3 | p | 61 | 3 | 17 | p | 3 | p | 11 | 3 | 19 | 13 | 3 | 7 | p | 3 | 23 | p |
| 09 | 3 | p | 163 | 3 | 19 | 31 | 3 | 7 | 11 | 3 | p | 29 | 3 | p | 7 | 3 | p | p | 3 | 11 |
| 11 | 107 | 3 | p | 167 | 3 | 59 | 7 | 3 | 17 | p | 3 | 113 | 179 | 3 | 13 | 19 | 3 | 11 | 31 | 3 |
| 13 | 23 | 37 | 3 | p | 11 | 3 | p | 19 | 3 | 17 | p | 3 | 7 | 167 | 3 | 11 | p | 3 | 223 | 7 |
| 17 | 11 | 3 | 257 | 7 | 3 | 127 | p | 3 | p | 13 | 3 | 11 | 211 | 3 | p | p | 3 | 7 | 97 | 3 |
| 19 | p | 41 | 3 | 13 | 139 | 3 | 101 | p | 3 | 7 | p | 3 | 17 | 157 | 3 | 37 | 7 | 3 | p | 193 |
| 21 | 3 | 7 | p | 3 | p | 47 | 3 | 11 | 7 | 3 | 13 | p | 3 | 17 | p | 3 | 83 | p | 3 | 29 |
| 23 | 7 | 3 | p | 31 | 3 | 11 | p | 3 | p | p | 3 | 83 | 37 | 3 | 7 | p | 3 | 13 | p | 3 |
| 27 | 3 | 11 | p | 3 | 23 | 7 | 3 | p | 19 | 3 | 103 | p | 3 | p | 101 | 3 | 17 | p | 3 | 7 |
| 29 | 17 | 3 | p | 151 | 3 | 29 | 59 | 3 | 67 | 233 | 3 | 7 | 13 | 3 | 97 | p | 3 | 17 | 7 | 3 |
| 31 | p | 17 | 3 | 7 | p | 3 | 13 | 257 | 3 | p | 7 | 3 | 67 | p | 3 | 23 | 29 | 3 | 17 | 11 |
| 33 | 3 | 53 | 7 | 3 | 113 | p | 3 | p | 173 | 3 | 199 | p | 3 | 13 | p | 3 | 7 | 11 | 3 | 17 |
| 37 | 7 | 13 | 3 | p | 17 | 3 | 19 | 7 | 3 | p | p | 3 | p | 11 | 3 | 151 | p | 3 | 47 | 107 |
| 39 | 3 | p | 29 | 3 | 107 | 17 | 3 | p | 13 | 3 | p | 11 | 3 | 7 | 23 | 3 | 211 | 19 | 3 | p |
| 41 | 61 | 3 | 13 | p | 3 | 7 | 17 | 3 | 23 | 11 | 3 | p | 7 | 3 | 271 | 13 | 3 | 37 | 41 | 3 |
| 43 | p | 19 | 3 | 73 | 7 | 3 | p | 11 | 3 | 13 | p | 3 | p | 71 | 3 | 251 | p | 3 | 7 | p |
| 47 | p | 3 | 7 | 11 | 3 | p | p | 3 | 97 | 7 | 3 | 193 | 89 | 3 | 11 | p | 3 | 29 | p | 3 |
| 49 | 109 | 7 | 3 | 71 | 13 | 3 | p | 23 | 3 | p | 17 | 3 | 11 | 41 | 3 | 7 | 47 | 3 | p | 73 |
| 51 | 3 | 23 | p | 3 | 53 | p | 3 | 7 | 263 | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | p |
| 53 | p | 3 | p | p | 3 | 13 | 7 | 3 | 11 | p | 3 | 191 | 17 | 3 | p | p | 3 | 131 | 13 | 3 |
| 57 | 3 | 59 | 19 | 3 | 7 | 37 | 3 | 31 | 41 | 3 | 43 | 7 | 3 | 109 | 17 | 3 | 73 | p | 3 | 13 |
| 59 | 13 | 3 | 11 | 7 | 3 | p | 113 | 3 | p | p | 3 | 149 | p | 3 | p | 17 | 3 | 7 | p | 3 |
| 61 | 11 | p | 3 | 269 | p | 3 | p | 13 | 3 | 7 | p | 3 | 61 | p | 3 | p | 7 | 3 | 233 | p |
| 63 | 3 | 7 | 127 | 3 | 233 | 149 | 3 | p | 7 | 3 | p | 23 | 3 | p | 13 | 3 | 19 | 17 | 3 | 37 |
| 67 | 19 | p | 3 | p | p | 3 | 7 | p | 3 | 131 | 31 | 3 | 41 | 7 | 3 | 13 | 11 | 3 | p | 17 |
| 69 | 3 | p | p | 3 | p | 7 | 3 | 53 | p | 3 | 89 | 19 | 3 | p | 11 | 3 | 23 | 71 | 3 | 7 |
| 71 | 97 | 3 | p | 13 | 3 | 31 | p | 3 | p | 43 | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 |
| 73 | p | p | 3 | 7 | 23 | 3 | p | 61 | 3 | p | 7 | 3 | 47 | 239 | 3 | 29 | p | 3 | 31 | p |
| 77 | p | 3 | p | 157 | 3 | p | 11 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 11 | p | 3 |
| 79 | 7 | 89 | 3 | p | 11 | 3 | p | 7 | 3 | 19 | p | 3 | 127 | p | 3 | 11 | p | 3 | 13 | 29 |
| 81 | 3 | 19 | 11 | 3 | p | 181 | 3 | 73 | 31 | 3 | 107 | p | 3 | 7 | 197 | 3 | p | 89 | 3 | 167 |
| 83 | 11 | 3 | 41 | p | 3 | 7 | 13 | 3 | p | 59 | 3 | 11 | 7 | 3 | p | p | 3 | p | p | 3 |
| 87 | 3 | 37 | p | 3 | 173 | 29 | 3 | 11 | 23 | 3 | 7 | 163 | 3 | p | 43 | 3 | 31 | 7 | 3 | 241 |
| 89 | p | 3 | 7 | 191 | 3 | 11 | p | 3 | p | 7 | 3 | p | 83 | 3 | 13 | p | 3 | 113 | 37 | 3 |
| 91 | p | 7 | 3 | 11 | 71 | 3 | 157 | 83 | 3 | 47 | p | 3 | p | 79 | 3 | 7 | 59 | 3 | 19 | 23 |
| 93 | 3 | 11 | 13 | 3 | p | 229 | 3 | 7 | p | 3 | 19 | 53 | 3 | 23 | 7 | 3 | p | 109 | 3 | 61 |
| 97 | 17 | 23 | 3 | 13 | p | 3 | 139 | p | 3 | p | 67 | 3 | 7 | 19 | 3 | p | 13 | 3 | p | 7 |
| 99 | 3 | 17 | 197 | 2 | 7 | 19 | 3 | 43 | 269 | 3 | 13 | 7 | 3 | 29 | 67 | 3 | p | 11 | 3 | p |

# INCOMPOSITS.

## TAB. XXXVIII.

| | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | p | 3 | 47 | 7 | 3 | 11 | 131 | 3 | 179 | 13 | 3 | 257 | p | 3 | 19 | 17 | 3 | 7 |
| 03 | 43 | 3 | p | 67 | 3 | 11 | 61 | 3 | 19 | p | 3 | 7 | 157 | 3 | p | p | 3 | p | 7 | 3 |
| 07 | 3 | 11 | 7 | 3 | 37 | p | 3 | p | 239 | 3 | 107 | 19 | 3 | p | p | 3 | 7 | p | 3 | 13 |
| 09 | 13 | 3 | p | 19 | 3 | p | p | 3 | 7 | 173 | 3 | p | p | 3 | 73 | 7 | 3 | p | 41 | 3 |
| 11 | 7 | 37 | 3 | p | p | 3 | p | 7 | 3 | 23 | p | 3 | p | 127 | 3 | p | p | 3 | 47 | 11 |
| 13 | 3 | 13 | 47 | 3 | p | 269 | 3 | p | 79 | 3 | p | 31 | 3 | 7 | 13 | 3 | 83 | 11 | 3 | p |
| 17 | p | 137 | 3 | p | 7 | 3 | 29 | p | 3 | 19 | p | 3 | p | 11 | 3 | 13 | p | 3 | 7 | 89 |
| 19 | 3 | 19 | p | 3 | p | 43 | 3 | p | 23 | 3 | 7 | 11 | 3 | 109 | 53 | 3 | p | 7 | 3 | 31 |
| 21 | p | 3 | 7 | 13 | 3 | p | 71 | 3 | p | 7 | 3 | 43 | 19 | 3 | 199 | p | 3 | p | p | 3 |
| 23 | 79 | 7 | 3 | p | 19 | 3 | p | 11 | 3 | p | 13 | 3 | p | p | 3 | 7 | 47 | 3 | 11 | 23 |
| 27 | p | 3 | 199 | 11 | 3 | p | 7 | 3 | p | 31 | 3 | 13 | p | 3 | 11 | p | 3 | 41 | 191 | 3 |
| 29 | 181 | 11 | 3 | 239 | 263 | 3 | 37 | p | 3 | p | p | 3 | 7 | p | 3 | 47 | p | 3 | 13 | 7 |
| 31 | 3 | p | p | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | 71 | p | 3 | 53 | p | 3 | p |
| 33 | 101 | 3 | 19 | 7 | 3 | 73 | 13 | 3 | 11 | p | 3 | p | 23 | 3 | 241 | p | 3 | 7 | p | 3 |
| 37 | 3 | 7 | 61 | 3 | 11 | 19 | 3 | 13 | 7 | 3 | p | 227 | 3 | p | p | 3 | 43 | 53 | 3 | p |
| 39 | 7 | 3 | 11 | 79 | 3 | 131 | 101 | 3 | 67 | 137 | 3 | 29 | p | 3 | 7 | p | 3 | 23 | 181 | 3 |
| 41 | 11 | 151 | 3 | 17 | p | 3 | 7 | 31 | 3 | p | p | 3 | 67 | 7 | 3 | p | p | 3 | 149 | p |
| 43 | 3 | p | 13 | 3 | 17 | 7 | 3 | 41 | p | 3 | 101 | 163 | 3 | 59 | 37 | 3 | 67 | p | 3 | 7 |
| 47 | p | 53 | 3 | 7 | 109 | 3 | 17 | p | 3 | 149 | 7 | 3 | 47 | p | 3 | 31 | 11 | 3 | 73 | 173 |
| 49 | 3 | p | 7 | 3 | p | 127 | 3 | 17 | 29 | 3 | 13 | p | 3 | 151 | 11 | 3 | 7 | 211 | 3 | 53 |
| 51 | p | 3 | 41 | 149 | 3 | p | 19 | 3 | 7 | 241 | 3 | 223 | 11 | 3 | 197 | 7 | 3 | 13 | 101 | 3 |
| 53 | 7 | 29 | 3 | p | p | 3 | p | 7 | 3 | 17 | 11 | 3 | p | p | 3 | p | 151 | 3 | p | 151 |
| 57 | 103 | 3 | p | p | 3 | 7 | 11 | 3 | p | 23 | 3 | 17 | 7 | 3 | 61 | p | 3 | 11 | 31 | 3 |
| 59 | 31 | p | 3 | 23 | 7 | 3 | 13 | p | 3 | p | 47 | 3 | 17 | 179 | 3 | 11 | p | 3 | 7 | 13 |
| 61 | 3 | p | 11 | 3 | 19 | p | 3 | p | p | 3 | 7 | p | 3 | 11 | 59 | 3 | 29 | 7 | 3 | 37 |
| 63 | 11 | 3 | 7 | p | 3 | 173 | 197 | 3 | 43 | 7 | 3 | 11 | 73 | 3 | 17 | 19 | 3 | 239 | 107 | 3 |
| 67 | 3 | p | 23 | 3 | 113 | p | 3 | 7 | 13 | 3 | 271 | p | 3 | p | 7 | 3 | 17 | p | 3 | p |
| 69 | 17 | 3 | 13 | 31 | 3 | 11 | 7 | 3 | p | 61 | 3 | p | p | 3 | 163 | 13 | 3 | 17 | p | 3 |
| 71 | p | 17 | 3 | 11 | p | 3 | 89 | p | 3 | 13 | 41 | 3 | 7 | 23 | 3 | p | 31 | 3 | 17 | 7 |
| 73 | 3 | 11 | 17 | 3 | 7 | p | 3 | 23 | p | 3 | 37 | 7 | 3 | 19 | 71 | 3 | 13 | p | 3 | 17 |
| 77 | p | p | 3 | p | 13 | 3 | 53 | 37 | 3 | 7 | 193 | 3 | p | p | 3 | p | 7 | 3 | 23 | 11 |
| 79 | 3 | 7 | p | 3 | 71 | 17 | 3 | p | 7 | 3 | p | 13 | 3 | 43 | p | 3 | p | 11 | 3 | p |
| 81 | 7 | 3 | 59 | p | 3 | 13 | 17 | 3 | 103 | 97 | 3 | p | 83 | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 83 | 23 | 31 | 3 | p | 211 | 3 | 7 | 17 | 3 | 167 | p | 3 | 13 | 7 | 3 | p | p | 3 | p | p |
| 87 | 13 | 3 | p | 73 | 3 | p | p | 3 | p | 11 | 3 | 7 | 79 | 3 | 19 | 131 | 3 | p | 7 | 3 |
| 89 | 47 | p | 3 | 7 | p | 3 | 19 | 11 | 3 | 31 | 7 | 3 | p | p | 3 | 269 | p | 3 | 11 | p |
| 91 | 3 | 13 | 7 | 3 | 163 | 11 | 3 | 29 | p | 3 | 61 | 17 | 3 | p | 13 | 3 | 7 | 19 | 3 | p |
| 93 | p | 3 | p | 11 | 3 | 97 | 113 | 3 | 7 | 19 | 3 | p | 17 | 3 | 11 | 7 | 3 | p | 29 | 3 |
| 97 | 3 | p | p | 3 | 23 | p | 3 | p | p | 3 | 11 | 29 | 3 | 7 | 17 | 3 | 59 | p | 3 | p |
| 99 | p | 3 | 191 | 13 | 3 | 7 | p | 3 | 11 | 37 | 3 | 139 | 7 | 3 | 103 | 17 | 3 | 229 | 71 | 3 |

# INCOMPOSITS.

## TAB. XXXIX.

| | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 3 | 181 | 41 | 3 | 113 | 7 | 3 | p | 11 | 3 | p | p | 3 | 17 | 19 | 3 | 13 | p | 3 |
| 03 | p | p | 3 | p | p | 3 | p | 11 | 3 | 53 | p | 3 | 7 | 23 | 3 | 17 | 71 | 3 | 11 | 7 |
| 07 | 17 | 3 | p | 7 | 3 | p | p | 3 | 89 | p | 3 | 83 | 13 | 3 | 11 | 179 | 3 | 7 | 29 | 3 |
| 09 | 29 | 11 | 3 | 137 | 109 | 3 | 13 | 79 | 3 | 7 | 53 | 3 | 11 | 97 | 3 | p | 7 | 3 | 17 | 13 |
| 11 | 3 | 7 | 17 | 3 | 43 | p | 3 | 41 | 7 | 3 | 11 | 29 | 3 | 13 | 199 | 3 | p | p | 3 | 17 |
| 13 | 7 | 3 | p | 17 | 3 | 19 | 23 | 3 | 11 | p | 3 | 59 | p | 3 | 7 | p | 3 | p | p | 3 |
| 17 | 3 | 103 | 199 | 3 | 11 | 7 | 3 | p | 13 | 3 | p | 67 | 3 | p | p | 3 | p | 23 | 3 | 7 |
| 19 | 19 | 3 | 11 | 167 | 3 | p | 17 | 3 | p | p | 3 | 7 | 37 | 3 | p | 13 | 3 | p | 7 | 3 |
| 21 | 11 | 163 | 3 | 7 | p | 3 | 193 | 17 | 3 | 13 | 7 | 3 | 31 | 167 | 3 | p | p | 3 | 59 | 67 |
| 23 | 3 | p | 7 | 3 | p | 59 | 3 | 73 | 17 | 3 | p | 233 | 3 | p | 139 | 3 | 7 | p | 3 | 29 |
| 27 | 7 | 269 | 3 | 127 | 13 | 3 | 19 | 7 | 3 | 43 | 17 | 3 | 29 | 53 | 3 | p | 11 | 3 | 223 | 149 |
| 29 | 3 | p | 31 | 3 | 23 | 103 | 3 | 277 | p | 3 | p | 13 | 3 | 7 | 11 | 3 | 149 | 19 | 3 | p |
| 31 | p | 3 | p | 37 | 3 | 7 | p | 3 | p | 19 | 3 | 137 | 7 | 3 | p | 31 | 3 | p | 13 | 3 |
| 33 | 139 | 19 | 3 | p | 7 | 3 | 197 | p | 3 | 107 | 11 | 3 | 13 | 17 | 3 | 23 | 29 | 3 | 7 | p |
| 37 | 13 | 3 | 7 | 23 | 3 | p | 11 | 3 | p | 7 | 3 | p | p | 3 | 211 | 17 | 3 | 11 | 277 | 3 |
| 39 | p | 7 | 3 | 97 | 11 | 3 | 173 | 13 | 3 | 47 | 41 | 3 | p | p | 3 | 7 | 17 | 3 | p | 59 |
| 41 | 3 | 13 | 11 | 3 | p | p | 3 | 7 | 43 | 3 | p | p | 3 | 11 | 7 | 3 | p | 17 | 3 | 41 |
| 43 | 11 | 3 | p | p | 3 | p | 7 | 3 | 13 | p | 3 | 11 | p | 3 | 43 | p | 3 | p | 17 | 3 |
| 47 | 3 | p | 19 | 3 | 7 | 41 | 3 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 23 |
| 49 | 113 | 3 | p | 7 | 3 | 11 | p | 3 | 31 | p | 3 | 179 | p | 3 | 41 | p | 3 | 7 | p | 3 |
| 51 | 59 | 271 | 3 | 11 | 89 | 3 | p | 23 | 3 | 7 | 13 | 3 | 67 | p | 3 | p | 7 | 3 | 127 | p |
| 53 | 3 | 7 | p | 3 | 13 | 37 | 3 | p | 7 | 3 | 29 | p | 3 | 103 | 73 | 3 | 19 | 13 | 3 | 137 |
| 57 | 19 | p | 3 | 29 | 101 | 3 | 7 | p | 3 | 41 | 251 | 3 | 23 | 7 | 3 | p | 79 | 3 | 13 | 11 |
| 59 | 3 | p | p | 3 | 157 | 7 | 3 | 59 | 151 | 3 | 263 | 19 | 3 | p | 29 | 3 | p | 11 | 3 | 7 |
| 61 | 23 | 3 | p | 19 | 3 | p | 13 | 3 | 101 | p | 3 | 7 | p | 3 | 71 | 11 | 3 | p | 7 | 3 |
| 63 | 13 | p | 3 | 7 | p | 3 | 31 | 29 | 3 | p | 7 | 3 | p | 11 | 3 | p | 37 | 3 | p | 53 |
| 67 | 29 | 3 | 53 | p | 3 | 23 | p | 3 | 7 | 11 | 3 | p | p | 3 | 13 | 7 | 3 | 19 | p | 3 |
| 69 | 7 | 59 | 3 | p | 47 | 3 | 43 | 7 | 3 | 19 | p | 3 | p | p | 3 | p | 101 | 3 | 11 | p |
| 71 | 3 | 19 | 13 | 3 | p | 11 | 3 | p | p | 3 | 37 | p | 3 | 7 | p | 3 | 11 | 83 | 3 | 103 |
| 73 | 127 | 3 | 89 | 11 | 3 | 7 | p | 3 | p | 13 | 3 | 229 | 7 | 3 | 11 | p | 3 | p | 43 | 3 |
| 77 | 3 | 17 | 83 | 3 | 31 | 73 | 3 | p | 59 | 3 | 7 | 71 | 3 | p | p | 3 | 173 | 7 | 3 | p |
| 79 | p | 3 | 7 | p | 3 | p | p | 3 | 11 | 7 | 3 | 113 | p | 3 | p | 23 | 3 | 13 | 47 | 3 |
| 81 | p | 7 | 3 | 17 | p | 3 | 11 | p | 3 | 23 | p | 3 | 109 | 223 | 3 | 7 | p | 3 | 19 | 29 |
| 83 | 3 | 29 | p | 3 | 11 | 13 | 3 | 7 | p | 3 | 19 | 79 | 3 | p | 7 | 3 | 131 | p | 3 | p |
| 87 | 11 | 47 | 3 | p | p | 3 | 13 | 31 | 3 | 167 | 157 | 3 | 7 | 19 | 3 | p | p | 3 | 71 | 7 |
| 89 | 3 | 61 | p | 3 | 7 | 19 | 3 | 17 | 23 | 3 | 127 | 7 | 3 | 13 | p | 3 | p | 107 | 3 | 167 |
| 91 | p | 3 | 23 | 7 | 3 | 191 | 53 | 3 | 17 | p | 3 | p | p | 3 | p | p | 3 | 7 | 11 | 3 |
| 93 | 47 | 13 | 3 | 79 | p | 3 | 271 | 41 | 3 | 7 | p | 3 | 37 | 193 | 3 | 31 | 7 | 3 | p | 23 |
| 97 | 7 | 3 | 13 | 241 | 3 | p | p | 3 | 131 | 37 | 3 | 17 | 11 | 3 | 7 | 13 | 3 | p | 61 | 3 |
| 99 | p | 23 | 3 | 19 | 227 | 3 | 7 | 61 | 3 | 13 | 11 | 3 | 17 | 7 | 3 | 73 | p | 3 | p | p |

# INCOMPOSITS.

## TAB. XL.

| | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 7 | p | 3 | p | p | 3 | 83 | 7 | 3 | p | 13 | 3 | p | p | 3 | 107 | p | 3 | p | p |
| 03 | 3 | 83 | p | 3 | 13 | 29 | 3 | 211 | p | 3 | 199 | p | 3 | 7 | 271 | 3 | 23 | 13 | 3 | p |
| 07 | p | 37 | 3 | p | 7 | 3 | p | p | 3 | 19 | 41 | 3 | 103 | 71 | 3 | 43 | 11 | 3 | 7 | p |
| 09 | 3 | 19 | 197 | 3 | 89 | p | 3 | 31 | p | 3 | 7 | 239 | 3 | p | 11 | 3 | p | 7 | 3 | 41 |
| 11 | 181 | 3 | 7 | p | 3 | p | 13 | 3 | 53 | 7 | 3 | p | 11 | 3 | p | 23 | 3 | 79 | p | 3 |
| 13 | 13 | 7 | 3 | 71 | 19 | 3 | 127 | p | 3 | 23 | 11 | 3 | 113 | 13 | 3 | 7 | p | 3 | p | 157 |
| 17 | p | 3 | 17 | p | 3 | p | 7 | 3 | 269 | 53 | 3 | 61 | 37 | 3 | 13 | 131 | 3 | 11 | p | 3 |
| 19 | 61 | 191 | 3 | 17 | 11 | 3 | 29 | 223 | 3 | p | 31 | 3 | 7 | p | 3 | 11 | 103 | 3 | 19 | 7 |
| 21 | 3 | 3 | 11 | 3 | 7 | 233 | 3 | p | 23 | 3 | 19 | 7 | 3 | 11 | 43 | 3 | p | 29 | 3 | 229 |
| 23 | 11 | p | 19 | 7 | 3 | 17 | p | 3 | p | 13 | 3 | 11 | 227 | 3 | p | 281 | 3 | 7 | p | 3 |
| 27 | 3 | 7 | 137 | 3 | p | 19 | 3 | 11 | 7 | 3 | 13 | 67 | 3 | 23 | p | 3 | p | 61 | 3 | 257 |
| 29 | 7 | 3 | p | 29 | 3 | 11 | 61 | 3 | 17 | p | 3 | 53 | p | 3 | 7 | 67 | 3 | 13 | p | 3 |
| 31 | p | 23 | 3 | 11 | 107 | 3 | 7 | 131 | 3 | 17 | p | 3 | p | 7 | 3 | p | p | 3 | 97 | 67 |
| 33 | 3 | 11 | p | 3 | 41 | 7 | 3 | 43 | 31 | 3 | 17 | p | 3 | p | p | 3 | p | 71 | 3 | 7 |
| 37 | 73 | p | 3 | 7 | p | 3 | 13 | p | 3 | 193 | 7 | 3 | 17 | p | 3 | p | 97 | 3 | 29 | 11 |
| 39 | 3 | p | 7 | 3 | p | p | 3 | 71 | p | 3 | p | p | 3 | 13 | 19 | 3 | 7 | 11 | 3 | p |
| 41 | p | 3 | p | p | 3 | p | 19 | 3 | 7 | p | 3 | 29 | p | 3 | 17 | 7 | 3 | 23 | p | 3 |
| 43 | 7 | 13 | 3 | 157 | 47 | 3 | p | 7 | 3 | 89 | p | 3 | 109 | 11 | 3 | 17 | 73 | 3 | p | p |
| 47 | 17 | 3 | 13 | p | 3 | 7 | 31 | 3 | 37 | 11 | 3 | p | 7 | 3 | 53 | 13 | 3 | 17 | p | 3 |
| 49 | p | 17 | 3 | 47 | 7 | 3 | p | 11 | 3 | 13 | 137 | 3 | 19 | p | 3 | p | 23 | 3 | 7 | 31 |
| 51 | 3 | 31 | 17 | 3 | 19 | 11 | 3 | 61 | 29 | 3 | 7 | p | 3 | 73 | p | 3 | 11 | 7 | 3 | 17 |
| 53 | 89 | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | 41 | 3 | 11 | 19 | 3 | 173 | 47 | 3 |
| 57 | 3 | p | 139 | 3 | 67 | 17 | 3 | 7 | p | 3 | 11 | 13 | 3 | p | 7 | 3 | p | p | 3 | 37 |
| 59 | p | 3 | p | 127 | 3 | 13 | 7 | 3 | 11 | 23 | 3 | p | p | 3 | 181 | p | 3 | 47 | 13 | 3 |
| 61 | 251 | 47 | 3 | 23 | 31 | 3 | 11 | 17 | 3 | 281 | 173 | 3 | 7 | 61 | 3 | p | 37 | 3 | p | 7 |
| 63 | 3 | p | 61 | 3 | 7 | 251 | 3 | 79 | 17 | 3 | p | 7 | 3 | 19 | 229 | 3 | 29 | 31 | 3 | 13 |
| 67 | 11 | p | 3 | p | p | 3 | 97 | 13 | 3 | 7 | 17 | 3 | 31 | p | 3 | 251 | 7 | 3 | p | p |
| 69 | 3 | 7 | 23 | 3 | 131 | p | 3 | 227 | 7 | 3 | 37 | 17 | 3 | 139 | 13 | 3 | p | p | 3 | 211 |
| 71 | 7 | 3 | 29 | 109 | 3 | p | 151 | 3 | 13 | 157 | 3 | 41 | 17 | 3 | 7 | 47 | 3 | 241 | 11 | 3 |
| 73 | 101 | p | 3 | 181 | 97 | 3 | 7 | 37 | 3 | 151 | 107 | 3 | p | 7 | 3 | 13 | 11 | 3 | p | p |
| 77 | 163 | 3 | p | 13 | 3 | p | 29 | 3 | p | p | 3 | 7 | 11 | 3 | 19 | 17 | 3 | p | 7 | 3 |
| 79 | p | p | 3 | 7 | p | 3 | 19 | p | 3 | p | 7 | 3 | p | p | 3 | p | 17 | 3 | 23 | p |
| 81 | 3 | 37 | 7 | 3 | 13 | 179 | 3 | p | 11 | 3 | 31 | p | 3 | 163 | p | 3 | 7 | 13 | 3 | 11 |
| 83 | 113 | 3 | p | 103 | 3 | p | 11 | 3 | 7 | 19 | 3 | 13 | p | 3 | 61 | 7 | 3 | 11 | 17 | 3 |
| 87 | 3 | 41 | 11 | 3 | p | 89 | 3 | p | p | 3 | p | p | 3 | 7 | 101 | 3 | p | 23 | 3 | p |
| 89 | 11 | 3 | 79 | 43 | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 29 | p | 3 | 73 | p | 3 |
| 91 | 13 | p | 3 | 277 | 7 | 3 | p | p | 3 | 11 | 139 | 3 | 37 | 13 | 3 | 19 | p | 3 | 7 | 41 |
| 93 | 3 | p | 59 | 3 | 53 | p | 3 | 11 | p | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 167 |
| 97 | 29 | 7 | 3 | 11 | p | 3 | p | p | 3 | 197 | 19 | 3 | 179 | p | 3 | 7 | p | 3 | 109 | p |
| 99 | 3 | 11 | 13 | 3 | 23 | 53 | 3 | 7 | 257 | 3 | 83 | 29 | 3 | p | 7 | 3 | p | 199 | 3 | p |

# INCOMPOSITS.

## TAB. XLI.

| | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 7 | 11 | 3 | 37 | 79 | 3 | p | 7 | 3 | p | p | 3 | 11 | p | 3 | 13 | p | 3 | p |
| 03 | 7 | 3 | 139 | 131 | 3 | 19 | p | 3 | p | 17 | 3 | 11 | p | 3 | 7 | 149 | 3 | p | 179 | 3 |
| 07 | 3 | p | p | 3 | p | 7 | 3 | 11 | 19 | 3 | 59 | 13 | 3 | p | 127 | 3 | 79 | p | 3 | 7 |
| 09 | 19 | 3 | p | p | 3 | 11 | 149 | 3 | p | p | 3 | 7 | 17 | 3 | p | p | 3 | 101 | 7 | 3 |
| 11 | 29 | p | 3 | 7 | 191 | 3 | p | 43 | 3 | p | 7 | 3 | 13 | 17 | 3 | 37 | p | 3 | 23 | 101 |
| 13 | 3 | 11 | 7 | 3 | 97 | p | 3 | p | 211 | 3 | p | 29 | 3 | 31 | 17 | 3 | 7 | 41 | 3 | 13 |
| 17 | 7 | 113 | 3 | p | 29 | 3 | 19 | 7 | 3 | p | p | 3 | 241 | 233 | 3 | p | 17 | 3 | p | 11 |
| 19 | 3 | 13 | 97 | 3 | 137 | 73 | 3 | 53 | p | 3 | p | p | 3 | 7 | 13 | 3 | p | 11 | 3 | p |
| 21 | p | 3 | p | 31 | 3 | 7 | p | 3 | 13 | 19 | 3 | 23 | 7 | 3 | p | 11 | 3 | 71 | 17 | 3 |
| 23 | 43 | 19 | 3 | 47 | 7 | 3 | 37 | 89 | 3 | p | p | 3 | p | 11 | 3 | 13 | 31 | 3 | 7 | 17 |
| 27 | 79 | 3 | 7 | 13 | 3 | p | p | 3 | 131 | 7 | 3 | 31 | 43 | 3 | 107 | p | 3 | p | 47 | 3 |
| 29 | 191 | 7 | 3 | p | p | 3 | p | 11 | 3 | p | 13 | 3 | 29 | 167 | 3 | 7 | p | 3 | 11 | p |
| 31 | 3 | 227 | p | 3 | 13 | 11 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 11 | 13 | 3 | p |
| 33 | 163 | 3 | p | 11 | 3 | 29 | 7 | 3 | p | p | 3 | 13 | p | 3 | 11 | p | 3 | 37 | 19 | 3 |
| 37 | 3 | 127 | 19 | 3 | 7 | p | 3 | p | 229 | 3 | 11 | 7 | 3 | 163 | 31 | 3 | p | p | 3 | p |
| 39 | p | 3 | p | 7 | 3 | 43 | 13 | 3 | 11 | 29 | 3 | 41 | p | 3 | p | 67 | 3 | 7 | p | 3 |
| 41 | 13 | p | 3 | p | 257 | 3 | 11 | 263 | 3 | 7 | p | 3 | 137 | 13 | 3 | 73 | 7 | 3 | 223 | 67 |
| 43 | 3 | 7 | 29 | 3 | 11 | 239 | 3 | 13 | 7 | 3 | p | 53 | 3 | p | 23 | 3 | 19 | 43 | 3 | p |
| 47 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 61 | p | 3 | 113 | 7 | 3 | p | p | 3 | p | 19 |
| 49 | 3 | p | 13 | 3 | p | 7 | 3 | p | p | 3 | p | 19 | 3 | p | 79 | 3 | p | p | 3 | 7 |
| 51 | p | 3 | p | 19 | 3 | 109 | p | 3 | 233 | 13 | 3 | 7 | 31 | 3 | 47 | p | 3 | 29 | 7 | 3 |
| 53 | 17 | p | 3 | 7 | 43 | 3 | 59 | 23 | 3 | p | 7 | 3 | 193 | p | 3 | p | 11 | 3 | p | p |
| 57 | 223 | 3 | 17 | 107 | 3 | p | p | 3 | 7 | 73 | 3 | p | 11 | 3 | p | 7 | 3 | 13 | 23 | 3 |
| 59 | 7 | 71 | 3 | 17 | 61 | 3 | 79 | 7 | 3 | 19 | 11 | 3 | 23 | p | 3 | p | 37 | 3 | 109 | 41 |
| 61 | 3 | 19 | 83 | 3 | 17 | 17 | 3 | p | 11 | 3 | 103 | 227 | 3 | 7 | 29 | 3 | 127 | p | 3 | 11 |
| 63 | 23 | 3 | p | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 71 | 3 |
| 67 | 3 | p | 11 | 3 | 67 | p | 3 | 17 | 193 | 3 | 7 | 23 | 3 | 11 | 41 | 3 | p | 7 | 3 | p |
| 69 | 11 | 3 | 7 | p | 3 | 23 | p | 3 | 17 | 7 | 3 | 11 | 181 | 3 | 257 | p | 3 | p | p | 3 |
| 71 | p | 7 | 3 | 179 | p | 3 | p | 37 | 3 | 11 | p | 3 | 67 | p | 3 | 7 | p | 3 | 19 | p |
| 73 | 3 | p | p | 3 | p | 197 | 3 | 7 | 13 | 3 | 17 | p | 3 | p | 7 | 3 | 23 | p | 3 | p |
| 77 | p | p | 3 | 11 | 23 | 3 | p | p | 3 | 13 | p | 3 | 7 | 19 | 3 | 29 | p | 3 | 41 | 7 |
| 79 | 3 | 11 | p | 3 | 7 | 19 | 3 | p | 31 | 3 | 89 | 7 | 3 | 17 | 59 | 3 | 13 | 53 | 3 | 73 |
| 81 | 73 | 3 | 43 | 7 | 3 | 61 | p | 3 | 29 | 47 | 3 | p | p | 3 | 17 | 23 | 3 | 7 | 37 | 3 |
| 83 | 53 | 181 | 3 | 31 | 13 | 3 | p | p | 3 | 7 | p | 3 | p | 97 | 3 | 17 | 7 | 3 | p | 11 |
| 87 | 7 | 3 | p | p | 3 | 13 | p | 3 | 47 | 109 | 3 | 19 | 29 | 3 | 7 | 11 | 3 | 17 | 13 | 3 |
| 89 | 283 | 17 | 3 | 19 | p | 3 | 7 | p | 3 | p | 131 | 3 | 13 | 7 | 3 | 83 | p | 3 | 17 | 163 |
| 91 | 3 | p | 17 | 3 | p | 7 | 3 | 173 | 23 | 3 | 83 | 11 | 3 | 199 | 19 | 3 | 151 | 89 | 3 | 7 |
| 93 | 13 | 3 | 23 | 17 | 3 | 83 | 19 | 3 | 41 | 11 | 3 | 7 | p | 3 | 227 | 139 | 3 | 263 | 7 | 3 |
| 97 | 3 | 13 | 7 | 3 | 101 | 11 | 3 | 43 | p | 3 | p | p | 3 | 23 | 13 | 3 | 7 | 157 | 3 | 167 |
| 99 | 173 | 3 | 59 | 11 | 3 | p | 17 | 3 | 7 | 107 | 3 | p | p | 3 | 11 | 7 | 3 | p | p | 3 |

# INCOMPOSITS.

## TAB. XLII.

| | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 43 | 3 | 7 | p | 3 | 17 | p | 3 | 31 | 7 | 3 | p | 19 | 3 | p | 11 | 3 | p | 47 | 3 |
| 03 | p | 7 | 3 | 13 | 19 | 3 | 17 | 191 | 3 | p | p | 3 | p | 11 | 3 | 7 | 13 | 3 | 181 | p |
| 07 | p | 3 | p | p | 3 | p | 7 | 3 | 17 | 11 | 3 | 41 | p | 3 | p | 113 | 3 | 13 | 43 | 3 |
| 09 | p | 47 | 3 | 53 | 23 | 3 | p | 11 | 3 | 17 | p | 3 | 7 | 227 | 3 | 37 | p | 3 | 11 | 7 |
| 11 | 3 | 157 | 229 | 3 | 7 | 11 | 3 | 107 | p | 3 | 17 | 7 | 3 | p | 239 | 3 | 11 | 97 | 3 | p |
| 13 | p | 3 | 19 | 7 | 3 | 109 | p | 3 | p | p | 3 | 17 | 13 | 3 | 11 | 23 | 3 | 7 | p | 3 |
| 17 | 3 | 7 | p | 3 | 73 | 19 | 3 | 181 | 7 | 3 | 11 | p | 3 | 13 | p | 3 | p | p | 3 | 31 |
| 19 | 7 | 3 | p | 263 | 3 | 179 | p | 3 | 11 | 283 | 3 | 43 | p | 3 | 7 | 47 | 3 | p | 79 | 3 |
| 21 | p | 13 | 3 | 191 | p | 3 | 7 | p | 3 | 101 | 61 | 3 | p | 7 | 3 | 17 | p | 3 | 109 | p |
| 23 | 3 | 41 | p | 3 | 11 | 7 | 3 | p | 13 | 3 | p | 101 | 3 | 97 | p | 3 | 17 | 29 | 3 | 7 |
| 27 | 11 | 17 | 3 | 7 | 139 | 3 | 53 | p | 3 | 13 | 7 | 3 | p | 103 | 3 | 101 | 241 | 3 | 17 | 23 |
| 29 | 3 | p | 7 | 3 | 31 | p | 3 | p | 113 | 3 | 79 | 97 | 3 | 23 | 19 | 3 | 7 | 101 | 3 | 17 |
| 31 | p | 3 | p | 17 | 3 | p | 19 | 3 | 7 | 127 | 3 | 59 | p | 3 | p | 7 | 3 | 31 | 11 | 3 |
| 33 | 7 | 23 | 3 | 281 | 13 | 3 | p | 7 | 3 | 239 | 43 | 3 | p | 167 | 3 | 103 | 11 | 3 | p | p |
| 37 | p | 3 | p | 137 | 3 | 7 | 17 | 3 | p | 197 | 3 | p | 7 | 3 | p | p | 3 | p | 13 | 3 |
| 39 | p | p | 3 | p | 7 | 3 | 23 | 17 | 3 | p | 11 | 3 | 13 | p | 3 | 139 | p | 3 | 7 | p |
| 41 | 3 | p | p | 3 | 19 | 59 | 3 | 97 | 11 | 3 | 7 | 71 | 3 | p | 181 | 3 | p | 7 | 3 | 11 |
| 43 | 13 | 3 | 7 | 67 | 3 | 197 | 11 | 3 | 37 | 7 | 3 | 29 | p | 3 | p | 19 | 3 | 11 | p | 3 |
| 47 | 3 | 13 | 11 | 3 | 29 | 23 | 3 | 7 | p | 3 | p | 17 | 3 | 11 | 7 | 3 | 233 | 83 | 3 | 127 |
| 49 | 11 | 3 | 233 | p | 3 | p | 7 | 3 | 13 | 109 | 3 | 11 | 17 | 3 | p | 29 | 3 | 89 | 191 | 3 |
| 51 | p | 113 | 3 | p | 41 | 3 | p | 83 | 3 | 11 | 53 | 3 | 7 | 17 | 3 | 13 | 23 | 3 | 71 | 7 |
| 53 | 3 | p | 83 | 3 | 7 | 31 | 3 | 11 | 29 | 3 | 23 | 7 | 3 | 19 | 17 | 3 | p | 61 | 3 | 37 |
| 57 | 31 | 29 | 3 | 11 | p | 3 | p | p | 3 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 | p | 59 |
| 59 | 3 | 7 | 43 | 3 | 13 | p | 3 | p | 7 | 3 | p | 137 | 3 | 31 | p | 3 | 269 | 13 | 3 | 113 |
| 61 | 7 | 3 | p | p | 3 | p | 131 | 3 | 41 | 23 | 3 | 13 | 139 | 3 | 7 | p | 3 | p | 17 | 3 |
| 63 | 137 | p | 3 | 23 | p | 3 | 7 | p | 3 | p | p | 3 | 53 | 7 | 3 | p | p | 3 | 13 | 11 |
| 67 | p | 3 | p | 31 | 3 | p | 13 | 3 | 173 | 163 | 3 | 7 | p | 3 | 19 | 11 | 3 | 211 | 7 | 3 |
| 69 | 13 | 127 | 3 | 7 | p | 3 | 19 | 37 | 3 | 29 | 7 | 3 | p | 11 | 3 | 193 | 31 | 3 | p | p |
| 71 | 3 | p | 7 | 3 | p | p | 3 | 13 | 79 | 3 | p | 11 | 3 | 263 | p | 3 | 7 | 19 | 3 | 131 |
| 73 | p | 3 | 29 | p | 3 | 71 | 47 | 3 | 7 | 11 | 3 | 31 | p | 3 | 13 | 7 | 3 | p | p | 3 |
| 77 | 3 | 37 | 13 | 3 | 67 | 11 | 3 | 23 | 179 | 3 | p | p | 3 | 7 | p | 3 | 11 | p | 3 | 79 |
| 79 | 211 | 3 | p | 11 | 3 | 7 | 29 | 3 | 67 | 13 | 3 | 223 | 7 | 3 | 11 | p | 3 | 199 | 37 | 3 |
| 81 | 79 | 11 | 3 | 13 | 7 | 3 | 89 | p | 3 | p | 251 | 3 | 11 | 199 | 3 | 19 | 13 | 3 | 7 | 137 |
| 83 | 3 | p | 107 | 3 | p | 269 | 3 | 19 | p | 3 | 7 | 193 | 3 | p | 31 | 3 | 67 | 7 | 3 | p |
| 87 | 23 | 7 | 3 | p | p | 3 | 11 | p | 3 | 31 | 19 | 3 | 37 | 61 | 3 | 7 | 53 | 3 | 149 | p |
| 89 | 3 | p | 19 | 3 | 11 | 13 | 3 | 7 | p | 3 | p | 41 | 3 | p | 7 | 3 | p | 23 | 3 | 47 |
| 91 | 103 | 3 | 11 | 47 | 3 | p | 7 | 3 | p | 37 | 3 | 23 | 13 | 3 | 29 | p | 3 | p | p | 3 |
| 93 | 11 | p | 3 | p | p | 3 | 13 | p | 3 | 149 | p | 3 | 7 | 89 | 3 | 179 | 127 | 3 | 43 | 7 |
| 97 | 53 | 3 | 17 | 7 | 3 | 151 | 41 | 3 | 19 | p | 3 | 271 | 31 | 3 | p | p | 3 | 7 | 11 | 3 |
| 99 | 19 | 13 | 3 | 17 | p | 3 | p | p | 3 | 7 | 23 | 3 | p | p | 3 | 41 | 7 | 3 | 53 | 19 |

# INCOMPOSITS.

## TAB. XLIII.

| | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 167 | 37 | 3 | 7 | p | 3 | 11 | p | 3 | 59 | 7 | 3 | p | 197 | 3 | 13 | p | 3 | 239 | 17 |
| 03 | 3 | 31 | 7 | 3 | 11 | p | 3 | 71 | 137 | 3 | 167 | p | 3 | p | 41 | 3 | 7 | p | 3 | p |
| 07 | 7 | 151 | 3 | p | p | 3 | 19 | 7 | 3 | 197 | 13 | 3 | 139 | 23 | 3 | 37 | p | 3 | 53 | 271 |
| 09 | 3 | 241 | 107 | 3 | 13 | p | 3 | 23 | p | 3 | p | p | 3 | 7 | 223 | 3 | 59 | 13 | 3 | 137 |
| 11 | p | 3 | p | 59 | 3 | 7 | 211 | 3 | p | 19 | 3 | 13 | 7 | 3 | p | 233 | 3 | p | 11 | 3 |
| 13 | 29 | 19 | 3 | p | 7 | 3 | 191 | p | 3 | p | 151 | 3 | p | p | 3 | p | 11 | 3 | 7 | 53 |
| 17 | p | 3 | 7 | p | 3 | 223 | 13 | 3 | 89 | 7 | 3 | 47 | 11 | 3 | 229 | p | 3 | p | p | 3 |
| 19 | 13 | 7 | 3 | p | 29 | 3 | 37 | p | 3 | p | 11 | 3 | 31 | 13 | 3 | 7 | p | 3 | p | 151 |
| 21 | 3 | p | p | 3 | p | p | 3 | 7 | 11 | 3 | p | p | 3 | 41 | 7 | 3 | p | 23 | 3 | 11 |
| 23 | 73 | 3 | p | 37 | 3 | p | 7 | 3 | 271 | 163 | 3 | 23 | p | 3 | 13 | p | 3 | 11 | 19 | 3 |
| 27 | 3 | p | 11 | 3 | 7 | 181 | 3 | 193 | p | 3 | p | 7 | 3 | 11 | p | 3 | p | 59 | 3 | 29 |
| 29 | 11 | 3 | p | 7 | 3 | 137 | p | 3 | 41 | 13 | 3 | 11 | p | 3 | p | 31 | 3 | 7 | p | 3 |
| 31 | 17 | p | 3 | 13 | p | 3 | p | p | 3 | 7 | 23 | 3 | 29 | p | 3 | p | 7 | 3 | p | p |
| 33 | 3 | 7 | 131 | 3 | 23 | p | 3 | 11 | 7 | 3 | 13 | p | 3 | p | 37 | 3 | 19 | p | 3 | p |
| 37 | 19 | p | 3 | 11 | p | 3 | 7 | p | 3 | 157 | p | 3 | p | 7 | 3 | 23 | 29 | 3 | p | 19 |
| 39 | 3 | 11 | p | 3 | 17 | 7 | 3 | 101 | 43 | 3 | 277 | 19 | 3 | 61 | p | 3 | p | 83 | 3 | 7 |
| 41 | 31 | 3 | 61 | 19 | 3 | 17 | 53 | 3 | 37 | 29 | 3 | 7 | 13 | 3 | 43 | 113 | 3 | 179 | 7 | 3 |
| 43 | 229 | p | 3 | 7 | p | 3 | 13 | 83 | 3 | 173 | 7 | 3 | p | 31 | 3 | 131 | p | 3 | p | 11 |
| 47 | p | 3 | p | p | 3 | 59 | 47 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 19 | p | 3 |
| 49 | 7 | 13 | 3 | p | p | 3 | p | 7 | 3 | 17 | p | 3 | 163 | 11 | 3 | p | 41 | 3 | 293 | 61 |
| 51 | 3 | 19 | 173 | 3 | 79 | p | 3 | p | 13 | 3 | 17 | 11 | 3 | 7 | p | 3 | 97 | p | 3 | 23 |
| 53 | p | 3 | 13 | 67 | 3 | 7 | p | 3 | 53 | 11 | 3 | 17 | 7 | 3 | p | 13 | 3 | 29 | p | 3 |
| 57 | 3 | 23 | 109 | 3 | p | 11 | 3 | 131 | p | 3 | 7 | 31 | 3 | 17 | 97 | 3 | 11 | 7 | 3 | 43 |
| 59 | p | 3 | 7 | 11 | 3 | p | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 67 | 3 | 191 | 23 | 3 |
| 61 | p | 7 | 3 | 29 | 13 | 3 | 31 | p | 3 | p | p | 3 | 11 | p | 3 | 7 | p | 3 | 19 | 67 |
| 63 | 3 | p | p | 3 | p | 103 | 3 | 7 | 113 | 3 | 11 | 13 | 3 | p | 7 | 3 | 17 | 139 | 3 | 31 |
| 67 | p | 17 | 3 | 239 | p | 3 | 11 | 29 | 3 | p | 257 | 3 | 7 | 19 | 3 | 41 | p | 3 | 17 | 7 |
| 69 | 3 | 73 | 17 | 3 | 7 | 19 | 3 | 103 | p | 3 | 97 | 7 | 3 | p | p | 3 | p | 199 | 3 | 13 |
| 71 | 13 | 3 | 11 | 7 | 3 | 23 | 227 | 3 | p | 31 | 3 | 53 | 71 | 3 | 127 | p | 3 | 7 | 43 | 3 |
| 73 | 11 | 41 | 3 | 139 | 17 | 3 | p | 13 | 3 | 7 | 241 | 3 | 269 | 59 | 3 | 83 | 7 | 3 | 79 | 149 |
| 77 | 7 | 3 | 71 | p | 3 | 83 | 17 | 3 | 13 | p | 3 | 19 | 53 | 3 | 7 | p | 3 | 31 | 11 | 3 |
| 79 | 83 | p | 3 | 19 | 23 | 3 | 7 | 17 | 3 | p | 149 | 3 | 107 | 7 | 3 | 13 | 11 | 3 | 157 | 127 |
| 81 | 3 | p | 271 | 3 | p | 7 | 3 | 149 | 17 | 3 | p | 103 | 3 | p | 11 | 3 | 47 | p | 3 | 7 |
| 83 | 47 | 3 | 89 | 13 | 3 | 41 | 19 | 3 | 29 | 17 | 3 | 7 | 11 | 3 | 73 | 23 | 3 | 109 | 7 | 3 |
| 87 | 3 | 29 | 7 | 3 | 13 | 251 | 3 | p | 11 | 3 | p | 17 | 3 | 103 | p | 3 | 7 | 13 | 3 | 11 |
| 89 | p | 3 | 31 | p | 3 | p | 11 | 3 | 7 | 37 | 3 | 13 | 17 | 3 | 53 | 7 | 3 | 11 | p | 3 |
| 91 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | p | p | 3 | 19 | 17 | 3 | 11 | p | 3 | 13 | p |
| 93 | 3 | 59 | 11 | 3 | 19 | 29 | 3 | p | 23 | 3 | p | p | 3 | 7 | 17 | 3 | 67 | p | 3 | 113 |
| 97 | 13 | 269 | 3 | 37 | 7 | 3 | p | 19 | 3 | 11 | 43 | 3 | p | 13 | 3 | p | 17 | 3 | 7 | 23 |
| 99 | 3 | p | p | 3 | p | 31 | 3 | 11 | 73 | 3 | 7 | p | 3 | 23 | 193 | 3 | 43 | 7 | 3 | p |

# INCOMPOSITS.

## TAB. XLIV.

| | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 29 | p | 3 | 7 | p | 3 | 277 | 11 | 3 | 19 | 7 | 3 | 67 | 71 | 3 | 17 | p | 3 | 11 |
| 03 | 17 | 3 | 13 | 7 | 3 | 23 | 11 | 3 | 61 | 43 | 3 | p | 29 | 3 | p | 13 | 3 | 7 | p | 3 |
| 07 | 3 | 7 | 11 | 3 | 71 | 19 | 3 | 31 | 7 | 3 | 167 | p | 3 | 11 | p | 3 | 13 | 229 | 3 | 17 |
| 09 | 7 | 3 | p | 17 | 3 | p | 257 | 3 | 47 | 233 | 3 | 11 | 37 | 3 | 7 | p | 3 | 139 | 277 | 3 |
| 11 | p | p | 3 | p | 13 | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | p | 79 | 3 | p | p |
| 13 | 3 | p | 73 | 3 | p | 7 | 3 | 11 | p | 3 | p | 13 | 3 | p | 61 | 3 | p | 239 | 3 | 7 |
| 17 | p | p | 3 | 7 | 103 | 3 | 37 | 17 | 3 | 23 | 7 | 3 | 13 | p | 3 | p | 41 | 3 | 137 | p |
| 19 | 3 | 11 | 7 | 3 | 89 | 241 | 3 | p | 17 | 3 | 173 | p | 3 | 29 | 19 | 3 | 7 | p | 3 | 13 |
| 21 | 13 | 3 | 151 | 37 | 3 | 31 | 19 | 3 | 7 | 17 | 3 | p | p | 3 | p | 7 | 3 | p | 53 | 3 |
| 23 | 7 | 71 | 3 | p | p | 3 | 29 | 7 | 3 | p | 17 | 3 | p | p | 3 | p | p | 3 | 31 | 11 |
| 27 | p | 3 | 23 | 173 | 3 | 7 | p | 3 | 13 | p | 3 | 151 | 7 | 3 | p | 11 | 3 | 37 | 71 | 3 |
| 29 | p | 43 | 3 | 131 | 7 | 3 | p | p | 3 | p | 29 | 3 | 19 | 11 | 3 | 13 | p | 3 | 7 | 23 |
| 31 | 3 | p | 53 | 3 | 19 | p | 3 | 43 | 31 | 3 | 7 | 11 | 3 | 23 | 17 | 3 | p | 7 | 3 | p |
| 33 | 227 | 3 | 7 | 13 | 3 | p | 41 | 3 | 71 | 7 | 3 | p | 83 | 3 | p | 17 | 3 | 59 | p | 3 |
| 37 | 3 | p | 83 | 3 | 13 | 11 | 3 | 7 | p | 3 | p | 79 | 3 | p | 7 | 3 | 11 | 13 | 3 | 47 |
| 39 | 97 | 3 | p | 11 | 3 | p | 7 | 3 | 37 | p | 3 | 13 | 23 | 3 | 11 | p | 3 | p | 17 | 3 |
| 41 | 139 | 11 | 3 | p | p | 3 | 23 | 127 | 3 | 227 | p | 3 | 7 | 167 | 3 | p | p | 3 | 13 | 7 |
| 43 | 3 | p | p | 3 | 7 | 37 | 3 | p | p | 3 | 11 | 7 | 3 | 19 | p | 3 | p | p | 3 | p |
| 47 | 13 | 277 | 3 | 79 | 137 | 3 | 11 | 223 | 3 | 7 | 61 | 3 | 43 | 13 | 3 | p | 7 | 3 | 107 | 31 |
| 49 | 3 | 7 | p | 3 | 11 | 23 | 3 | 13 | 7 | 3 | p | p | 3 | 113 | 157 | 3 | p | 47 | 3 | 37 |
| 51 | 7 | 3 | 11 | p | 3 | 41 | 73 | 3 | p | p | 3 | p | p | 3 | 7 | 29 | 3 | p | 59 | 3 |
| 53 | 11 | 101 | 3 | p | p | 3 | 7 | p | 3 | 89 | 263 | 3 | p | 7 | 3 | p | 23 | 3 | p | 281 |
| 57 | 47 | 3 | p | p | 3 | 101 | 193 | 3 | p | 13 | 3 | 7 | p | 3 | 19 | p | 3 | 127 | 7 | 3 |
| 59 | 41 | 29 | 3 | 7 | 31 | 3 | 19 | 101 | 3 | p | 7 | 3 | 71 | p | 3 | p | 11 | 3 | 103 | p |
| 61 | 3 | p | 7 | 3 | p | p | 3 | 53 | p | 3 | 13 | 43 | 3 | 199 | 11 | 3 | 7 | 19 | 3 | p |
| 63 | 89 | 3 | p | 67 | 3 | 107 | 79 | 3 | 7 | 19 | 3 | 101 | 11 | 3 | 149 | 7 | 3 | 13 | 41 | 3 |
| 67 | 3 | 199 | 281 | 3 | p | 13 | 3 | p | 11 | 3 | 83 | 67 | 3 | 7 | 47 | 3 | 29 | p | 3 | 11 |
| 69 | p | 3 | p | p | 3 | 7 | 11 | 3 | p | p | 3 | 61 | 7 | 3 | 23 | 67 | 3 | 11 | p | 3 |
| 71 | 17 | p | 3 | p | 7 | 3 | 13 | p | 3 | 29 | p | 3 | 197 | 41 | 3 | 11 | p | 3 | 7 | 13 |
| 73 | 3 | 17 | 11 | 3 | 43 | p | 3 | 19 | 109 | 3 | 7 | 179 | 3 | 11 | p | 3 | 73 | 7 | 3 | p |
| 77 | p | 7 | 3 | 17 | p | 3 | p | 107 | 3 | 11 | 19 | 3 | p | 23 | 3 | 7 | 43 | 3 | p | p |
| 79 | 3 | p | 19 | 3 | 17 | p | 3 | 7 | 13 | 3 | 31 | p | 3 | 59 | 7 | 3 | p | 61 | 3 | 97 |
| 81 | 59 | 3 | 13 | p | 3 | 11 | 7 | 3 | 283 | p | 3 | p | p | 3 | p | 13 | 3 | 41 | p | 3 |
| 83 | p | p | 3 | 11 | 197 | 3 | 17 | p | 3 | 13 | p | 3 | 3 | p | 3 | p | p | 3 | 23 | 7 |
| 87 | 31 | 3 | p | 7 | 3 | p | 23 | 3 | 17 | 37 | 3 | p | 191 | 3 | 89 | p | 3 | 7 | p | 3 |
| 89 | 19 | 79 | 3 | p | 13 | 3 | p | 59 | 3 | 7 | 73 | 3 | 41 | 31 | 3 | p | 7 | 3 | 179 | 11 |
| 91 | 3 | 7 | p | 3 | p | 131 | 3 | 229 | 7 | 3 | 17 | 13 | 3 | 281 | p | 3 | p | 11 | 3 | p |
| 93 | 7 | 3 | p | 19 | 3 | 13 | p | 3 | 31 | 79 | 3 | 17 | p | 3 | 7 | 11 | 3 | p | 13 | 3 |
| 97 | 3 | p | p | 3 | 67 | 7 | 3 | 29 | 113 | 3 | 251 | 11 | 3 | 17 | 59 | 3 | p | p | 3 | 7 |
| 99 | 13 | 3 | 211 | p | 3 | p | 181 | 3 | 67 | 11 | 3 | 7 | p | 3 | 17 | 251 | 3 | 19 | 7 | 3 |

# INCOMPOSITS.

## TAB. XLV.

| | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 3 | 193 | p | 3 | 7 | 41 | 3 | p | 19 | 3 | p | 7 | 3 | 13 | p | 3 | 271 | 89 | 3 |
| 03 | p | 19 | 3 | 227 | 7 | 3 | 251 | 107 | 3 | p | p | 3 | p | p | 3 | 37 | p | 3 | 7 | 11 |
| 07 | p | 3 | 7 | 233 | 3 | 67 | p | 3 | p | 7 | 3 | p | 37 | 3 | 29 | 11 | 3 | 109 | 31 | 3 |
| 09 | 17 | 7 | 3 | 13 | 211 | 3 | p | 43 | 3 | 67 | p | 3 | p | 11 | 3 | 7 | 13 | 3 | p | p |
| 11 | 3 | 17 | p | 3 | p | 61 | 3 | 7 | p | 3 | 13 | 11 | 3 | 31 | 7 | 3 | p | 283 | 3 | 47 |
| 13 | 283 | 3 | 17 | 47 | 3 | p | 7 | 3 | p | 11 | 3 | p | p | 3 | p | p | 3 | 13 | 19 | 3 |
| 17 | 3 | p | 19 | 3 | 7 | 11 | 3 | 79 | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 73 | 3 | p |
| 19 | p | 3 | 47 | 7 | 3 | 17 | 23 | 3 | p | p | 3 | p | 13 | 3 | 11 | p | 3 | 7 | p | 3 |
| 21 | 23 | 11 | 3 | p | 29 | 3 | 13 | p | 3 | 7 | p | 3 | 11 | 179 | 3 | p | 7 | 3 | p | 13 |
| 23 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 11 | p | 3 | 13 | 223 | 3 | 19 | 23 | 3 | p |
| 27 | 19 | 13 | 3 | p | p | 3 | 7 | 83 | 3 | 17 | 127 | 3 | p | 7 | 3 | p | p | 3 | 43 | 19 |
| 29 | 3 | p | 83 | 3 | 11 | 7 | 3 | p | 13 | 3 | 17 | 19 | 3 | p | 37 | 3 | 47 | 53 | 3 | 7 |
| 31 | 47 | 3 | 11 | 19 | 3 | 223 | 263 | 3 | 211 | 113 | 3 | 7 | p | 3 | p | 13 | 3 | 61 | 7 | 3 |
| 33 | 11 | 31 | 3 | 7 | 191 | 3 | 61 | 89 | 3 | 13 | 7 | 3 | 17 | 157 | 3 | p | p | 3 | p | 139 |
| 37 | p | 3 | p | p | 3 | 29 | 151 | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 19 | 11 | 3 |
| 39 | 7 | 53 | 3 | p | 13 | 3 | 137 | 7 | 3 | 19 | 269 | 3 | 233 | 41 | 3 | 17 | 11 | 3 | p | p |
| 41 | 3 | 19 | p | 3 | 59 | 37 | 3 | p | 73 | 3 | p | 13 | 3 | 7 | 11 | 3 | 17 | 43 | 3 | 53 |
| 43 | 17 | 3 | 79 | 23 | 3 | 7 | p | 3 | p | 29 | 3 | 97 | 7 | 3 | p | 151 | 3 | 17 | 13 | 3 |
| 47 | 3 | 181 | 17 | 3 | 241 | p | 3 | p | 11 | 3 | 7 | 239 | 3 | 47 | 23 | 3 | 157 | 7 | 3 | 11 |
| 49 | 13 | 3 | 7 | 17 | 3 | 73 | 11 | 3 | 23 | 7 | 3 | 59 | 31 | 3 | p | 149 | 3 | 11 | p | 3 |
| 51 | 191 | 7 | 3 | 53 | 11 | 3 | p | 13 | 3 | p | p | 3 | 149 | 199 | 3 | 7 | 37 | 3 | 19 | 293 |
| 53 | 3 | 13 | 11 | 3 | 197 | 17 | 3 | 7 | p | 3 | 19 | p | 3 | 11 | 7 | 3 | p | p | 3 | 23 |
| 57 | 173 | 199 | 3 | 149 | 53 | 3 | p | 17 | 3 | 11 | p | 3 | 7 | 19 | 3 | 13 | p | 3 | 59 | 7 |
| 59 | 3 | 23 | p | 3 | 7 | 19 | 3 | 11 | 17 | 3 | 29 | 7 | 3 | 193 | p | 3 | p | p | 3 | p |
| 61 | 107 | 3 | p | 7 | 3 | 11 | p | 3 | p | 17 | 3 | 163 | p | 3 | 137 | p | 3 | 7 | 23 | 3 |
| 63 | 83 | 131 | 3 | 11 | p | 3 | p | 37 | 3 | 7 | 13 | 3 | 23 | p | 3 | p | 7 | 3 | 73 | p |
| 67 | 7 | 3 | 61 | 97 | 3 | 31 | p | 3 | p | 43 | 3 | 13 | 17 | 3 | 7 | p | 3 | p | p | 3 |
| 69 | p | p | 3 | 19 | p | 3 | 7 | 29 | 3 | p | p | 3 | p | 7 | 3 | 43 | p | 3 | 13 | 11 |
| 71 | 3 | 37 | 103 | 3 | p | 7 | 3 | p | 181 | 3 | p | 23 | 3 | p | 17 | 3 | p | 11 | 3 | 7 |
| 73 | 29 | 3 | 41 | 67 | 3 | 23 | 13 | 3 | p | 193 | 3 | 7 | p | 3 | 131 | 11 | 3 | 107 | 7 | 3 |
| 77 | 3 | p | 7 | 3 | 103 | 101 | 3 | 13 | 31 | 3 | 281 | 11 | 3 | 139 | p | 3 | 7 | 17 | 3 | p |
| 79 | p | 3 | 43 | p | 3 | 283 | 71 | 3 | 7 | 11 | 3 | 257 | 73 | 3 | 13 | 7 | 3 | p | 17 | 3 |
| 81 | 7 | 109 | 3 | 31 | 23 | 3 | p | 7 | 3 | 101 | 229 | 3 | 19 | p | 3 | 29 | p | 3 | 11 | 17 |
| 83 | 3 | 163 | 13 | 3 | 19 | 11 | 3 | 47 | p | 3 | p | 101 | 3 | 7 | 43 | 3 | 11 | p | 3 | p |
| 87 | 59 | 11 | 3 | 13 | 7 | 3 | 131 | 19 | 3 | 23 | p | 3 | 11 | p | 3 | 101 | 13 | 3 | 7 | 29 |
| 89 | 3 | 29 | p | 3 | 107 | p | 3 | p | 103 | 3 | 7 | p | 3 | 71 | 109 | 3 | p | 7 | 3 | p |
| 91 | 137 | 3 | 7 | 157 | 3 | p | 31 | 3 | 11 | 7 | 3 | 79 | 29 | 3 | p | p | 3 | 13 | p | 3 |
| 93 | p | 7 | 3 | 37 | p | 3 | 11 | p | 3 | p | 41 | 3 | p | p | 3 | 7 | 257 | 3 | 241 | 31 |
| 97 | 37 | 3 | 11 | p | 3 | 19 | 7 | 3 | p | p | 3 | 191 | 13 | 3 | 31 | p | 3 | p | p | 3 |
| 99 | 11 | 89 | 3 | 109 | p | 3 | 13 | p | 3 | 61 | 139 | 3 | 7 | p | 3 | p | 19 | 3 | p | 7 |

# INCOMPOSITS.

## TAB. XLVI.

| | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 11 | 3 | 73 | p | 3 | 7 | 13 | 3 | p | 17 | 3 | 11 | 7 | 3 | 37 | 139 | 3 | p | 29 |
| 03 | 3 | 13 | p | 3 | p | 7 | 3 | p | p | 3 | 11 | 17 | 3 | p | 13 | 3 | 47 | p | 3 | 7 |
| 07 | p | p | 3 | 7 | p | 3 | 11 | 61 | 3 | p | 7 | 3 | 223 | 17 | 3 | 13 | 101 | 3 | p | 73 |
| 09 | 3 | 251 | 7 | 3 | 11 | 29 | 3 | p | 71 | 3 | p | 31 | 3 | p | 17 | 3 | 7 | 293 | 3 | p |
| 11 | p | 3 | 11 | 13 | 3 | p | 19 | 3 | 7 | p | 3 | 179 | 197 | 3 | p | 7 | 3 | p | p | 3 |
| 13 | 7 | 97 | 3 | p | 23 | 3 | 31 | 7 | 3 | 229 | 13 | 3 | 53 | 127 | 3 | p | 17 | 3 | p | 107 |
| 17 | p | 3 | p | 37 | 3 | 7 | p | 3 | 197 | p | 3 | 13 | 7 | 3 | 113 | 23 | 3 | 41 | 11 | 3 |
| 19 | p | 227 | 3 | 181 | 7 | 3 | p | 83 | 3 | 23 | p | 3 | 19 | 53 | 3 | 71 | 11 | 3 | 7 | 17 |
| 21 | 3 | p | 83 | 3 | 19 | 131 | 3 | 257 | p | 3 | 7 | p | 3 | 29 | 11 | 3 | p | 7 | 3 | p |
| 23 | p | 3 | 7 | 41 | 3 | p | 13 | 3 | p | 7 | 3 | 293 | 11 | 3 | p | 19 | 3 | 37 | p | 3 |
| 27 | 3 | p | p | 3 | 31 | p | 3 | 7 | 11 | 3 | 227 | p | 3 | 271 | 7 | 3 | 59 | 29 | 3 | 11 |
| 29 | 197 | 3 | 23 | 59 | 3 | p | 7 | 3 | 61 | 79 | 3 | p | p | 3 | 13 | p | 3 | 11 | 229 | 3 |
| 31 | p | 193 | 3 | 103 | 11 | 3 | p | p | 3 | p | 29 | 3 | 7 | p | 3 | 11 | p | 3 | 131 | 7 |
| 33 | 3 | 173 | 11 | 3 | 7 | p | 3 | 41 | p | 3 | p | 7 | 3 | 11 | p | 3 | 43 | p | 3 | 149 |
| 37 | 179 | 23 | 3 | 13 | p | 3 | 233 | 31 | 3 | 7 | 59 | 3 | p | 149 | 3 | 239 | 7 | 3 | p | 89 |
| 39 | 3 | 7 | p | 3 | p | 37 | 3 | 11 | 7 | 3 | 13 | p | 3 | 241 | 61 | 3 | p | 199 | 3 | p |
| 41 | 7 | 3 | 31 | 61 | 3 | 11 | p | 3 | p | 211 | 3 | p | 23 | 3 | 7 | p | 3 | 13 | p | 3 |
| 43 | 127 | 109 | 3 | 11 | 149 | 3 | 7 | 103 | 3 | 199 | 181 | 3 | p | 7 | 3 | 31 | 113 | 3 | 29 | p |
| 47 | 53 | 3 | p | 167 | 3 | p | p | 3 | p | p | 3 | 7 | 13 | 3 | 19 | 43 | 3 | 23 | 7 | 3 |
| 49 | 17 | p | 3 | 7 | 151 | 3 | 13 | p | 3 | 103 | 7 | 3 | p | 167 | 3 | 83 | 37 | 3 | 53 | 11 |
| 51 | 3 | 17 | 7 | 3 | 29 | 23 | 3 | 151 | 47 | 3 | 83 | p | 3 | 13 | 109 | 3 | 7 | 11 | 3 | p |
| 53 | p | 3 | 17 | p | 3 | 83 | 269 | 3 | 7 | 19 | 3 | p | p | 3 | p | 7 | 3 | p | 31 | 3 |
| 57 | 3 | 89 | 43 | 3 | 17 | 137 | 3 | 47 | 13 | 3 | 23 | 11 | 3 | 7 | p | 3 | 151 | p | 3 | p |
| 59 | p | 3 | 13 | p | 3 | 7 | p | 3 | 43 | 11 | 3 | p | 7 | 3 | p | 13 | 3 | 89 | 97 | 3 |
| 61 | 113 | 29 | 3 | 109 | 7 | 3 | 17 | 11 | 3 | 13 | 41 | 3 | 263 | 103 | 3 | 19 | 71 | 3 | 7 | p |
| 63 | 3 | p | p | 3 | 61 | 11 | 3 | 17 | p | 3 | 7 | p | 3 | 211 | p | 3 | 11 | 7 | 3 | 41 |
| 67 | p | 7 | 3 | 23 | 13 | 3 | 71 | 139 | 3 | 17 | 19 | 3 | 11 | p | 3 | 7 | 31 | 3 | p | p |
| 69 | 3 | 37 | 19 | 3 | p | 41 | 3 | 7 | 89 | 3 | 11 | 13 | 3 | p | 7 | 3 | 29 | 163 | 3 | p |
| 71 | p | 3 | p | p | 3 | 13 | 7 | 3 | 11 | p | 3 | 17 | 107 | 3 | 23 | p | 3 | p | 13 | 3 |
| 73 | p | p | 3 | p | p | 3 | 11 | 43 | 3 | 29 | 61 | 3 | 7 | p | 3 | p | p | 3 | p | 7 |
| 77 | 13 | 3 | 11 | 7 | 3 | 53 | p | 3 | 19 | p | 3 | 73 | 97 | 3 | 17 | p | 3 | 7 | 79 | 3 |
| 79 | 11 | 31 | 3 | p | 173 | 3 | p | 13 | 3 | 7 | p | 3 | 37 | 23 | 3 | 17 | 7 | 3 | 139 | 19 |
| 81 | 3 | 7 | p | 3 | p | 239 | 3 | 23 | 7 | 3 | p | 19 | 3 | p | 13 | 3 | 17 | p | 3 | 59 |
| 83 | 7 | 3 | 137 | 19 | 3 | p | 29 | 3 | 13 | 37 | 3 | p | p | 3 | 7 | p | 3 | 17 | 11 | 3 |
| 87 | 3 | p | 17 | 3 | 41 | 7 | 3 | p | p | 3 | 79 | 67 | 3 | p | 11 | 3 | 277 | 263 | 3 | 7 |
| 89 | p | 3 | p | 13 | 3 | 157 | 23 | 3 | 97 | p | 3 | 7 | 11 | 3 | 191 | 67 | 3 | 19 | 7 | 3 |
| 91 | 23 | p | 3 | 7 | 17 | 3 | 89 | 163 | 3 | 19 | 7 | 3 | p | 59 | 3 | p | p | 3 | 43 | 67 |
| 93 | 3 | 19 | 7 | 3 | 13 | 17 | 3 | p | 11 | 3 | 71 | p | 3 | p | p | 3 | 7 | 17 | 3 | 11 |
| 97 | 7 | p | 3 | p | 11 | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 11 | 47 | 3 | 13 | p |
| 99 | 3 | p | 11 | 3 | p | p | 3 | 29 | 17 | 3 | p | p | 3 | 7 | p | 3 | 107 | 41 | 3 | 197 |

# INCOMPOSITS.

## TAB. XLVII.

| | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | 31 | 137 | 3 | p | 233 | 3 | 7 | p | 3 | p | 157 | 3 | 13 | 7 | 3 | p | p | 3 | p |
| 03 | p | 3 | p | 241 | 3 | p | 7 | 3 | 17 | 61 | 3 | p | 11 | 3 | 23 | p | 3 | p | 19 | 3 |
| 07 | 3 | p | 19 | 3 | 7 | p | 3 | p | 11 | 3 | 17 | 7 | 3 | p | p | 3 | p | 83 | 3 | 11 |
| 09 | p | 3 | 13 | 7 | 3 | 79 | 11 | 3 | p | 53 | 3 | 17 | 83 | 3 | 29 | 13 | 3 | 7 | p | 3 |
| 11 | 101 | p | 3 | p | 11 | 3 | 37 | 83 | 3 | 7 | 281 | 3 | 17 | 23 | 3 | 11 | 7 | 3 | p | p |
| 13 | 3 | 7 | 11 | 3 | p | 71 | 3 | 23 | 7 | 3 | 47 | p | 3 | 11 | 109 | 3 | 13 | 31 | 3 | p |
| 17 | 19 | 251 | 3 | p | 13 | 3 | 7 | p | 3 | 11 | 191 | 3 | 31 | 7 | 3 | 17 | 179 | 3 | 23 | 19 |
| 19 | 3 | p | p | 3 | p | 7 | 3 | 11 | 101 | 3 | 167 | 13 | 3 | p | p | 3 | 17 | 7 | 3 | 7 |
| 21 | 17 | 3 | p | 19 | 3 | 11 | 23 | 3 | p | p | 3 | 7 | 73 | 3 | 103 | 41 | 3 | 17 | 7 | 3 |
| 23 | 23 | 17 | 3 | 7 | 29 | 3 | p | p | 3 | 43 | 7 | 3 | 13 | p | 3 | p | 251 | 3 | 17 | p |
| 27 | 13 | 3 | p | 17 | 3 | 67 | p | 3 | 7 | p | 3 | 23 | 53 | 3 | p | 7 | 3 | 19 | p | 3 |
| 29 | 7 | 181 | 3 | 127 | 17 | 3 | 211 | 7 | 3 | 19 | 41 | 3 | p | p | 3 | p | p | 3 | 101 | 11 |
| 31 | 3 | 13 | 149 | 3 | p | 17 | 3 | 47 | p | 3 | 31 | p | 3 | 7 | 13 | 3 | 109 | 11 | 3 | 29 |
| 33 | p | 3 | p | p | 3 | 7 | 17 | 3 | 13 | 199 | 3 | p | 7 | 3 | 233 | 11 | 3 | 67 | 103 | 3 |
| 37 | 3 | 199 | p | 3 | 23 | 37 | 3 | p | 17 | 3 | 7 | 11 | 3 | p | 223 | 3 | p | 7 | 3 | p |
| 39 | 31 | 3 | 7 | 13 | 3 | 29 | p | 3 | 263 | 7 | 3 | p | p | 3 | 41 | 89 | 3 | p | 107 | 3 |
| 41 | p | 7 | 3 | 107 | 97 | 3 | p | 11 | 3 | p | 13 | 3 | p | 31 | 3 | 7 | 29 | 3 | 11 | p |
| 43 | 3 | p | p | 3 | 13 | 11 | 3 | 7 | 227 | 3 | 19 | 17 | 3 | 269 | 7 | 3 | 11 | 13 | 3 | 37 |
| 47 | 83 | 11 | 3 | p | 193 | 3 | p | 163 | 3 | 41 | p | 3 | 7 | 17 | 3 | 139 | 37 | 3 | 13 | 7 |
| 49 | 3 | 43 | 29 | 3 | 7 | 19 | 3 | 137 | p | 3 | 11 | 7 | 3 | 277 | 17 | 3 | 71 | 241 | 3 | p |
| 51 | p | 3 | p | 7 | 3 | p | 13 | 3 | 11 | p | 3 | p | p | 3 | 113 | 17 | 3 | 7 | p | 3 |
| 53 | 13 | p | 3 | p | 59 | 3 | 11 | p | 3 | 7 | p | 3 | p | 13 | 3 | p | 7 | 3 | 127 | 47 |
| 57 | 7 | 3 | 11 | p | 3 | p | p | 3 | p | p | 3 | 19 | p | 3 | 7 | p | 3 | 29 | 17 | 3 |
| 59 | 11 | 157 | 3 | 19 | p | 3 | 7 | 23 | 3 | p | p | 3 | 179 | 7 | 3 | p | 73 | 3 | 47 | 17 |
| 61 | 3 | 23 | 13 | 3 | p | 7 | 3 | p | p | 3 | 29 | 59 | 3 | 89 | 19 | 3 | 229 | p | 3 | 7 |
| 63 | 43 | 3 | 257 | p | 3 | 151 | 19 | 3 | p | 13 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 |
| 67 | 3 | 37 | 7 | 3 | p | p | 3 | p | p | 3 | 13 | 151 | 3 | 73 | 11 | 3 | 7 | 41 | 3 | p |
| 69 | 23 | 3 | p | p | 3 | p | p | 3 | 7 | 31 | 3 | p | 11 | 3 | 151 | 7 | 3 | 13 | 37 | 3 |
| 71 | 7 | 61 | 3 | 71 | 89 | 3 | p | 7 | 3 | 239 | 11 | 3 | 19 | p | 3 | 137 | 47 | 3 | p | p |
| 73 | 3 | p | 53 | 3 | 19 | 13 | 3 | 113 | 11 | 3 | 163 | 23 | 3 | 7 | 211 | 3 | 283 | 79 | 3 | 11 |
| 77 | p | p | 3 | p | 7 | 3 | 13 | 19 | 3 | 109 | p | 3 | 37 | p | 3 | 11 | 113 | 3 | 7 | 13 |
| 79 | 3 | p | 11 | 3 | p | 43 | 3 | p | 131 | 3 | 7 | p | 3 | 11 | p | 3 | 23 | 7 | 3 | p |
| 81 | 11 | 3 | 7 | p | 3 | p | p | 3 | 293 | 7 | 3 | 11 | p | 3 | p | p | 3 | 191 | 269 | 3 |
| 83 | p | 7 | 3 | p | 23 | 3 | p | 31 | 3 | 11 | p | 3 | p | p | 3 | 7 | p | 3 | 223 | p |
| 87 | 71 | 3 | 13 | p | 3 | 11 | 7 | 3 | 29 | p | 3 | p | p | 3 | p | 13 | 3 | p | p | 3 |
| 89 | 17 | p | 3 | 11 | p | 3 | 59 | p | 3 | 13 | p | 3 | 7 | 47 | 3 | 31 | 19 | 3 | p | 7 |
| 91 | 3 | 11 | 41 | 3 | 7 | 53 | 3 | p | 19 | 3 | 127 | 7 | 3 | 61 | .p | 3 | 13 | 71 | 3 | 193 |
| 93 | 19 | 3 | 17 | 7 | 3 | p | p | 3 | p | p | 3 | 41 | 29 | 3 | p | 173 | 3 | 7 | p | 3 |
| 97 | 3 | 7 | p | 3 | 17 | 29 | 3 | 71 | 7 | 3 | p | 13 | 3 | 59 | p | 3 | 43 | 11 | 3 | p |
| 99 | 7 | 3 | 23 | p | 3 | 13 | p | 3 | p | 113 | 3 | p | 79 | 3 | 7 | 11 | 3 | 97 | 13 | 3 |

# INCOMPOSITS.

## TAB. XLVIII.

| | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 23 | 3 | p | 181 | 3 | 11 | 13 | 3 | 7 | 43 | 3 | p | 31 | 3 | p | 7 | 3 | p | p | 3 |
| 03 | 7 | 139 | 3 | 11 | 67 | 3 | p | 7 | 3 | p | p | 3 | p | 13 | 3 | 43 | p | 3 | p | 29 |
| 07 | p | 3 | p | p | 3 | 7 | 89 | 3 | 113 | p | 3 | p | 7 | 3 | 13 | p | 3 | p | 149 | 3 |
| 09 | p | p | 3 | p | 7 | 3 | 37 | p | 3 | 107 | p | 3 | 19 | 191 | 3 | 149 | 67 | 3 | 7 | 11 |
| 11 | 3 | p | 13 | 3 | 19 | 29 | 3 | 53 | p | 3 | 7 | p | 3 | p | 73 | 3 | 23 | 7 | 3 | p |
| 13 | 41 | 3 | 7 | 37 | 3 | p | p | 3 | 59 | 7 | 3 | 227 | p | 3 | p | 11 | 3 | p | p | 3 |
| 17 | 3 | p | 71 | 3 | 263 | 47 | 3 | 7 | 53 | 3 | 13 | 11 | 3 | p | 7 | 3 | p | p | 3 | p |
| 19 | 149 | 3 | p | 257 | 3 | 31 | 7 | 3 | p | 11 | 3 | 73 | p | 3 | p | 23 | 3 | 13 | p | 3 |
| 21 | 167 | p | 3 | p | p | 3 | p | 11 | 3 | 23 | p | 3 | 7 | 199 | 3 | 59 | p | 3 | 11 | 7 |
| 23 | 3 | 61 | 59 | 3 | 7 | 11 | 3 | p | p | 3 | 167 | 7 | 3 | 19 | 37 | 3 | 11 | p | 3 | p |
| 27 | 17 | 11 | 3 | p | p | 3 | 13 | p | 3 | 7 | p | 3 | 11 | p | 3 | p | 7 | 3 | 79 | 13 |
| 29 | 3 | 7 | p | 3 | 89 | p | 3 | 43 | 7 | 3 | 11 | 251 | 3 | 13 | p | 3 | p | 29 | 3 | p |
| 31 | 7 | 3 | 17 | p | 3 | p | 173 | 3 | 11 | 59 | 3 | p | p | 3 | 7 | p | 3 | p | 61 | 3 |
| 33 | p | 13 | 3 | 17 | p | 3 | 7 | 61 | 3 | p | 29 | 3 | p | 7 | 3 | 83 | p | 3 | 47 | 23 |
| 37 | 271 | 3 | 11 | 29 | 3 | 17 | 101 | 3 | p | 139 | 3 | 7 | 131 | 3 | 19 | 13 | 3 | p | 7 | 3 |
| 39 | 11 | 23 | 3 | 7 | p | 3 | 17 | 211 | 3 | 13 | 7 | 3 | p | p | 3 | p | 59 | 3 | 239 | 197 |
| 41 | 3 | 47 | 7 | 3 | p | p | 3 | 17 | p | 3 | 101 | 89 | 3 | 67 | p | 3 | 7 | 19 | 3 | 37 |
| 43 | 157 | 3 | 73 | p | 3 | p | 31 | 3 | 7 | 19 | 3 | p | 23 | 3 | p | 7 | 3 | 67 | 11 | 3 |
| 47 | 3 | 31 | 79 | 3 | p | p | 3 | p | p | 3 | 17 | 13 | 3 | 7 | 11 | 3 | 101 | p | 3 | p |
| 49 | p | 3 | 307 | p | 3 | 7 | p | 3 | p | p | 3 | 17 | 7 | 3 | 31 | p | 3 | 23 | 13 | 3 |
| 51 | 163 | p | 3 | p | 7 | 3 | p | 41 | 3 | p | 11 | 3 | 13 | 97 | 3 | 19 | p | 3 | 7 | 229 |
| 53 | 3 | p | p | 3 | 29 | 23 | 3 | 19 | 11 | 3 | 7 | p | 3 | 17 | 53 | 3 | 41 | 7 | 3 | 11 |
| 57 | p | 7 | 3 | 157 | 11 | 3 | 103 | 13 | 3 | 269 | 19 | 3 | p | 167 | 3 | 7 | 23 | 3 | p | p |
| 59 | 3 | 13 | 11 | 3 | 59 | p | 3 | 7 | 29 | 3 | 23 | 43 | 3 | 11 | 7 | 3 | 17 | 31 | 3 | p |
| 61 | 11 | 3 | p | 721 | 3 | p | 7 | 3 | 13 | p | 3 | 11 | p | 3 | p | p | 3 | 17 | 257 | 3 |
| 63 | p | 17 | 3 | 197 | p | 3 | 181 | 193 | 3 | 11 | p | 3 | 7 | 47 | 3 | 13 | 271 | 3 | 17 | 7 |
| 67 | 109 | 3 | 107 | 7 | 3 | 11 | 137 | 3 | 19 | 23 | 3 | 59 | p | 3 | p | 227 | 3 | 7 | 37 | 3 |
| 69 | 19 | p | 3 | 11 | 17 | 3 | 41 | 41 | 3 | 7 | 13 | 3 | 47 | p | 3 | p | 7 | 3 | p | 19 |
| 71 | 3 | 7 | 31 | 3 | 13 | 17 | 3 | p | 7 | 3 | p | 19 | 3 | 283 | p | 3 | 29 | 13 | 3 | p |
| 73 | 7 | 3 | p | 19 | 3 | p | 17 | 3 | p | 73 | 3 | 13 | p | 3 | 7 | 31 | 3 | p | p | 3 |
| 77 | 3 | 41 | 23 | 3 | p | 7 | 3 | p | 17 | 3 | 31 | p | 3 | 127 | 307 | 3 | 241 | 11 | 3 | 7 |
| 79 | p | 3 | 29 | p | 3 | 271 | 13 | 3 | 79 | 17 | 3 | 7 | p | 3 | p | 11 | 3 | 19 | 7 | 3 |
| 81 | 13 | 53 | 3 | 7 | 107 | 3 | 73 | p | 3 | 19 | 7 | 3 | 151 | 11 | 3 | p | 163 | 3 | p | 41 |
| 83 | 3 | 19 | 7 | 3 | p | p | 3 | 13 | 239 | 3 | p | 11 | 3 | p | p | 3 | 7 | p | 3 | 53 |
| 87 | 7 | 97 | 3 | 37 | 19 | 3 | p | 7 | 3 | 43 | p | 3 | p | 17 | 3 | 61 | 103 | 3 | 11 | p |
| 89 | 3 | 131 | 13 | 3 | 61 | 11 | 3 | p | p | 3 | p | p | 3 | 7 | 17 | 3 | 11 | p | 3 | p |
| 91 | 37 | 3 | p | 11 | 3 | 7 | 23 | 3 | 31 | 13 | 3 | p | 7 | 3 | 11 | 17 | 3 | p | p | 3 |
| 93 | 23 | 11 | 3 | 13 | 7 | 3 | p | p | 3 | p | p | 3 | 11 | p | 3 | 109 | 13 | 3 | 7 | 59 |
| 97 | 73 | 3 | 7 | p | 3 | p | 281 | 3 | 11 | 7 | 3 | 23 | 233 | 3 | 29 | p | 3 | 13 | 17 | 3 |
| 99 | p | 7 | 3 | p | 53 | 3 | 11 | 47 | 3 | p | 61 | 3 | 157 | 19 | 3 | 7 | 83 | 3 | 41 | 17 |

# INCOMPOSITS.

## TAB. XLIX.

| | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | p | 17 | 3 | 23 | p | 3 | p | 11 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | 11 | 47 |
| 03 | 3 | 7 | 17 | 3 | 149 | 11 | 3 | p | 7 | 3 | p | p | 3 | p | 257 | 3 | 11 | 41 | 3 | 13 |
| 07 | 19 | 11 | 3 | 193 | 17 | 3 | 7 | 13 | 3 | p | p | 3 | 11 | 7 | 3 | 281 | p | 3 | 47 | 19 |
| 09 | 3 | 3 | 23 | 3 | 229 | 7 | 3 | 97 | 131 | 3 | 11 | 19 | 3 | 31 | 13 | 3 | p | 199 | 3 | 7 |
| 11 | 67 | 3 | p | 19 | 3 | 103 | 17 | 3 | 11 | p | 3 | 7 | 41 | 3 | 29 | p | 3 | p | 7 | 3 |
| 13 | p | 223 | 3 | 7 | 67 | 3 | 11 | 17 | 3 | 199 | 7 | 3 | p | 23 | 3 | 13 | p | 3 | p | 179 |
| 17 | p | 3 | 11 | 13 | 3 | p | 79 | 3 | 7 | 17 | 3 | p | 67 | 3 | 61 | 7 | 3 | 19 | 29 | 3 |
| 19 | 7 | 277 | 3 | 61 | p | 3 | 53 | 7 | 3 | 19 | 13 | 3 | 191 | 307 | 3 | 113 | 31 | 3 | 23 | p |
| 21 | 3 | 19 | p | 3 | 13 | 263 | 3 | 311 | p | 3 | p | 17 | 3 | 7 | 37 | 3 | 41 | 13 | 3 | 181 |
| 23 | 131 | 3 | p | p | 3 | 7 | 23 | 3 | p | 103 | 3 | 13 | 7 | 3 | p | p | 3 | 79 | 11 | 3 |
| 27 | 3 | 97 | 41 | 3 | 211 | p | 3 | 197 | p | 3 | 7 | p | 3 | p | 11 | 3 | 233 | 7 | 3 | p |
| 29 | 109 | 3 | 7 | p | 3 | 83 | 13 | 3 | 37 | 7 | 3 | 23 | 11 | 3 | p | 17 | 3 | p | p | 3 |
| 31 | 13 | 7 | 3 | p | p | 3 | 71 | p | 3 | p | 11 | 3 | p | 13 | 3 | 7 | 17 | 3 | 19 | p |
| 33 | 3 | 251 | p | 3 | 73 | 37 | 3 | 7 | 11 | 3 | 19 | 137 | 3 | 131 | 7 | 3 | 89 | 17 | 3 | 11 |
| 37 | 137 | p | 3 | p | 11 | 3 | 41 | p | 3 | 31 | 23 | 3 | 7 | 19 | 3 | 11 | 163 | 3 | 227 | 7 |
| 39 | 3 | 127 | 11 | 3 | 7 | 19 | 3 | p | 179 | 3 | p | 7 | 3 | 11 | 139 | 3 | 251 | 43 | 3 | 37 |
| 41 | 11 | 3 | 157 | 7 | 3 | 29 | 241 | 3 | 113 | 13 | 3 | 11 | p | 3 | p | 103 | 3 | 7 | p | 3 |
| 43 | p | 79 | 3 | 13 | p | 3 | p | 89 | 3 | 7 | 53 | 3 | 47 | 311 | 3 | 23 | 7 | 3 | p | p |
| 47 | 7 | 3 | 109 | 23 | 3 | 11 | 127 | 3 | p | 29 | 3 | 19 | 31 | 3 | 7 | p | 3 | 13 | p | 3 |
| 49 | 139 | p | 3 | 11 | 43 | 3 | 7 | p | 3 | 67 | 107 | 3 | 79 | 7 | 3 | p | p | 3 | p | 41 |
| 51 | 3 | 11 | 29 | 3 | p | 7 | 3 | 31 | p | 3 | 37 | p | 3 | 67 | 19 | 3 | p | 239 | 3 | 7 |
| 53 | p | 3 | 101 | p | 3 | p | 19 | 3 | 23 | p | 3 | 7 | 13 | 3 | p | p | 3 | 67 | 7 | 3 |
| 57 | 3 | p | 7 | 3 | p | p | 3 | p | p | 3 | 71 | p | 3 | 13 | 41 | 3 | 7 | 11 | 3 | 23 |
| 59 | p | 3 | p | 167 | 3 | 223 | 163 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 29 | p | 3 |
| 61 | 7 | 13 | 3 | 173 | p | 3 | p | 7 | 3 | 47 | 31 | 3 | 19 | 11 | 3 | p | 61 | 3 | p | p |
| 63 | 3 | 23 | p | 3 | 19 | 61 | 3 | p | 13 | 3 | 29 | 11 | 3 | 7 | p | 3 | 127 | 59 | 3 | 163 |
| 67 | 17 | p | 3 | 29 | 7 | 3 | p | 11 | 3 | 13 | 113 | 3 | 23 | p | 3 | 43 | 101 | 3 | 7 | p |
| 69 | 3 | 17 | p | 3 | p | 11 | 3 | p | 157 | 3 | 7 | p | 3 | p | 29 | 3 | 11 | 7 | 3 | 313 |
| 71 | 23 | 3 | 7 | 11 | 3 | 269 | p | 3 | 73 | 7 | 3 | p | 211 | 3 | 11 | p | 3 | p | p | 3 |
| 73 | 191 | 7 | 3 | 17 | 13 | 3 | 277 | 29 | 3 | p | p | 3 | 11 | p | 3 | 7 | p | 3 | 97 | p |
| 77 | 29 | 3 | 43 | p | 3 | 13 | 7 | 3 | 11 | 37 | 3 | p | 89 | 3 | 107 | p | 3 | p | 13 | 3 |
| 79 | p | p | 3 | 31 | p | 3 | 11 | p | 3 | p | 193 | 3 | 7 | p | 3 | p | 19 | 3 | p | 7 |
| 81 | 3 | p | p | 3 | 7 | p | 3 | 17 | 19 | 3 | p | 7 | 3 | p | 43 | 3 | 23 | 277 | 3 | 13 |
| 83 | 13 | 3 | 11 | 7 | 3 | 59 | 109 | 3 | 17 | 293 | 3 | 157 | p | 3 | 71 | p | 3 | 7 | p | 3 |
| 87 | 3 | 7 | 73 | 3 | p | p | 3 | p | 7 | 3 | 17 | p | 3 | p | 3 | 3 | p | p | 3 | p |
| 89 | 7 | 3 | p | 113 | 3 | p | 31 | 3 | 13 | p | 3 | 17 | 271 | 3 | 7 | 23 | 3 | p | 11 | 3 |
| 91 | 307 | 43 | 3 | 41 | 47 | 3 | 7 | 151 | 3 | 23 | 79 | 3 | 17 | 7 | 3 | 13 | 11 | 3 | 53 | 29 |
| 93 | 3 | 29 | p | 3 | p | 7 | 3 | 43 | p | 3 | 151 | 83 | 3 | 17 | 11 | 3 | 211 | 19 | 3 | 7 |
| 97 | p | 19 | 3 | 7 | p | 3 | p | p | 3 | p | 7 | 3 | 149 | p | 3 | 17 | 151 | 3 | 223 | 43 |
| 99 | 3 | p | 7 | 3 | 13 | 29 | 3 | p | 11 | 3 | 89 | 37 | 3 | 173 | p | 3 | 7 | 13 | 3 | 11 |

# INCOMPOSITS.

## TAB. L.

| | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 3 | p | 283 | 3 | 19 | 13 | 3 | 89 | p | 3 | 7 | 113 | 3 | 199 | p | 3 | 103 | 7 | 3 | p |
| 03 | 23 | 3 | 7 | 197 | 3 | 137 | 151 | 3 | 29 | 7 | 3 | p | 13 | 3 | 107 | 19 | 3 | 179 | 11 | 3 |
| 07 | 3 | 17 | p | 3 | p | p | 3 | 7 | p | 3 | 181 | 23 | 3 | 13 | 7 | 3 | p | p | 3 | p |
| 09 | p | 3 | 17 | 37 | 3 | 23 | 7 | 3 | p | p | 3 | p | 11 | 3 | p | 151 | 3 | p | p | 3 |
| 11 | p | 13 | 3 | 17 | p | 3 | 31 | p | 3 | p | 11 | 3 | 7 | 47 | 3 | 191 | p | 3 | 151 | 7 |
| 13 | 3 | 41 | p | 3 | 7 | 29 | 3 | p | 11 | 3 | p | 7 | 3 | 19 | 89 | 3 | 23 | p | 3 | 11 |
| 17 | p | 59 | 3 | p | 11 | 3 | 17 | p | 3 | 7 | p | 3 | 47 | p | 3 | 11 | 7 | 3 | p | 41 |
| 19 | 3 | 7 | 11 | 3 | p | p | 3 | 17 | 7 | 3 | 83 | p | 3 | 11 | 37 | 3 | 13 | p | 3 | 163 |
| 21 | 7 | 3 | p | p | 3 | 83 | p | 3 | 17 | 31 | 3 | 11 | 313 | 3 | 7 | 23 | 3 | p | 173 | 3 |
| 23 | 83 | p | 3 | p | 13 | 3 | 7 | 269 | 3 | 11 | p | 3 | p | 7 | 3 | p | p | 3 | p | p |
| 27 | 61 | 3 | p | p | 3 | 11 | p | 3 | 37 | p | 3 | 7 | 67 | 3 | 19 | p | 3 | 31 | 7 | 3 |
| 29 | 167 | p | 3 | 7 | p | 3 | 19 | p | 3 | p | 7 | 3 | 13 | 71 | 3 | p | 67 | 3 | p | p |
| 31 | 3 | 11 | 7 | 3 | 257 | 37 | 3 | p | 23 | 3 | 167 | p | 3 | 17 | p | 3 | 7 | 19 | 3 | 13 |
| 33 | 13 | 3 | 23 | 107 | 3 | p | 53 | 3 | 7 | 19 | 3 | p | p | 3 | 17 | 7 | 3 | p | p | 3 |
| 37 | 3 | 13 | 193 | 3 | 173 | 211 | 3 | p | p | 3 | 97 | p | 3 | 7 | 13 | 3 | 17 | 11 | 3 | 37 |
| 39 | 17 | 3 | 31 | 29 | 3 | 7 | p | 3 | 13 | p | 3 | p | 7 | 3 | p | 11 | 3 | 17 | p | 3 |
| 41 | p | 17 | 3 | 43 | 7 | 3 | p | 293 | 3 | 163 | p | 3 | p | 11 | 3 | 13 | 37 | 3 | 7 | 139 |
| 43 | 3 | p | 17 | 3 | p | p | 3 | 19 | 97 | 3 | 7 | 11 | 3 | 41 | 77 | 3 | p | 7 | 3 | 17 |
| 47 | p | 7 | 3 | p | 17 | 3 | 23 | 11 | 3 | p | 13 | 3 | 61 | p | 3 | 7 | 251 | 3 | 11 | 89 |
| 49 | 3 | 61 | 19 | 3 | 13 | 11 | 3 | 7 | p | 3 | 37 | p | 3 | p | 7 | 3 | 11 | 13 | 3 | 127 |
| 51 | 71 | 3 | p | 11 | 3 | 139 | 7 | 3 | 41 | 53 | 3 | 13 | p | 3 | 11 | p | 3 | 23 | 31 | 3 |
| 53 | 31 | 11 | 3 | 59 | p | 3 | 47 | 17 | 3 | p | p | 3 | 7 | 73 | 3 | 113 | 227 | 3 | 13 | 7 |
| 57 | p | 3 | p | 7 | 3 | 67 | 13 | 3 | 11 | 17 | 3 | 229 | p | 3 | 271 | 29 | 3 | 7 | 61 | 3 |
| 59 | 13 | 103 | 3 | 41 | p | 3 | 11 | 61 | 3 | 7 | 17 | 3 | p | 13 | 3 | p | 7 | 3 | p | 19 |
| 61 | 3 | 7 | 97 | 3 | 11 | p | 3 | 13 | 7 | 3 | 23 | 17 | 3 | 67 | 79 | 3 | p | p | 3 | p |
| 63 | 7 | 3 | 11 | 19 | 3 | p | p | 3 | 109 | p | 3 | 53 | 17 | 3 | 7 | p | 3 | 67 | 37 | 3 |
| 67 | 3 | 89 | 13 | 3 | p | 7 | 3 | 283 | p | 3 | 157 | 131 | 3 | p | 17 | 3 | p | p | 3 | 7 |
| 69 | 281 | 3 | p | p | 3 | 241 | p | 3 | p | 13 | 3 | 7 | 53 | 3 | p | 17 | 3 | 19 | 7 | 3 |
| 71 | 101 | 127 | 3 | 7 | 59 | 3 | 79 | 43 | 3 | 19 | 7 | 3 | 37 | p | 3 | p | 11 | 3 | p | p |
| 73 | 3 | 19 | 7 | 3 | p | p | 3 | p | p | 3 | 13 | p | 3 | 43 | 11 | 3 | 7 | 17 | 3 | 257 |
| 77 | 7 | 31 | 3 | p | 19 | 3 | 101 | 7 | 3 | 29 | 11 | 3 | p | p | 3 | p | 263 | 3 | p | 17 |
| 79 | 3 | p | 23 | 3 | p | 13 | 3 | p | 11 | 3 | p | 41 | 3 | 7 | 31 | 3 | p | 113 | 3 | 11 |
| 81 | p | 3 | 29 | 131 | 3 | 7 | 11 | 3 | 61 | p | 3 | p | 7 | 3 | 53 | p | 3 | 11 | p | 3 |
| 83 | 43 | 47 | 3 | 37 | 7 | 3 | 13 | 173 | 3 | 31 | p | 3 | 101 | 23 | 3 | 11 | 83 | 3 | 7 | 13 |
| 87 | 11 | 3 | 7 | p | 3 | 311 | 29 | 3 | p | 7 | 3 | 11 | 43 | 3 | p | 53 | 3 | p | 59 | 3 |
| 89 | 47 | 7 | 3 | p | 149 | 3 | p | 223 | 3 | 11 | p | 3 | p | 19 | 3 | 7 | p | 3 | 23 | p |
| 91 | 3 | 149 | 227 | 3 | p | 19 | 3 | 7 | 13 | 3 | 197 | p | 3 | p | 7 | 3 | 131 | 73 | 3 | p |
| 93 | 233 | 3 | 13 | 61 | 3 | 11 | 7 | 3 | p | p | 3 | 281 | 31 | 3 | 37 | 13 | 3 | p | 191 | 3 |
| 97 | 3 | 11 | p | 3 | 7 | p | 3 | 31 | p | 3 | 41 | 7 | 3 | p | p | 3 | 13 | 23 | 3 | 19 |
| 99 | 263 | 3 | p | 7 | 3 | 43 | 229 | 3 | p | p | 3 | 19 | 109 | 2 | 29 | 137 | 3 | 7 | 283 | 3 |

INDEFEISIBLE, in our Law, ſignifies what cannot be defeated or made void: As a Good and Indefeiſible Eſtate.

INDEMNITIES. When a Church is Appropriate to an Abbey or College, then the Arch-Deacon loſeth his Induction Money for ever: In Recompence whereof he ſhall have yearly out of the Church ſo appropriate *One* or *Two* Shillings, more or leſs, for a Penſion, as was agreed at the Time of the *Appropriating*. And this Penſion is call'd an *Indemnity*.

INDIVISUM, in our Law, is uſed for that which two Perſons hold in common, without Partition. *Kitchin*, fol. 241. in theſe Words; He holds *pro Indiviſo*, &c.

INDORSEMENT, is any thing written on the Back of a Deed or Inſtrument; as a Condition, written on the Back of an Obligation, is commonly call'd *an Indorſement*.

INDUCTION. When a Clerk is Inſtituted into a Benefice, he is to exhibit his Mandate from the Biſhop to the Arch-Deacon, or other Perſon to whom it is directed; and hath a Right thereby to be *Inducted* into his Living: And if he be refuſed *Induction*, he hath a Remedy both in the Eccleſiaſtical Court, and alſo an Action of the Caſe in the Common Law, againſt the Arch-Deacon. If the *Inductor*, or Perſon to be Inducted, be kept out of the Church or Houſe by Lay-Men, the Writ *de Vi Laicâ* lies for the Clerk; which is directed out of the *Chancery* to the Sheriff of the County, to remove the Force, &c. If another Clergyman, preſented by the ſame Patron, keep Poſſeſſion, a *Spoliation* is grantable out of the Spiritual Court; whereby the Tithes, &c. ſhall be ſequeſtred till the Right be determined.

The Arch-Deacon rarely Inducts a Clerk by himſelf in Perſon, but iſſues out a Warrant to all Clerks and Letter'd Perſons within the Arch-Deaconry, impowering any of them to do it in his ſtead. The uſual Form and Manner of *Induction* is, for the *Inductor* to take the Clerk by the Hand, and then to lay it on the Key of the Church, which muſt be then in the Door, and to ſay; *By Virtue of this Inſtrument, which is the Arch-Deacon's Warrant, I Induct you into the Real, Actual, and Corporal Poſſeſſion of the Rectory or Vicarage of* A. *with all its Fruits, Profits, Members, and Appurtenances.* This done, he opens the Door, and puts the Clerk in Poſſeſſion of the Church, and ſhuts the Door upon him; who, after he hath tolled a Bell (if there be any) comes out, and deſires the *Inductor* to indorſe a Certificate of his *Induction* on the Arch-Deacon's Warrant, and that all preſent will ſignify it under their Hands.

If the Church Key cannot be had, 'tis ſufficient that the Clerk lay hold of the Ring of the Door, and within the time limited read the Common-Prayer and Thirty Nine Articles in the Church Porch. If there be no Church, he may lay his Hand on the Wall or Fence of the Church-Yard, &c. there being no neceſſity of Niceneſs as to the Form of *Induction*; only that he muſt have Witneſs that he was truly poſſeſs'd of it. Within two Months after this, the Clerk muſt read the Thirty Nine Articles, and all the Service of the Day both at Morning and Evening Prayers; and declare his Aſſent and Conſent; and he muſt then alſo read the Biſhop's *Engliſh Certificate*, in which is the Declaration of his Conformity; and of all this he muſt have two or three good Witneſſes; who muſt Sign that they heard him do it, and be ready to atteſt it *vivâ voce*, if required: And within three Months after *Induction* he muſt take alſo the Abjuration Oath at the Quarter-Seſſions, or in ſome one of the Courts in *Weſtminſter*.

INFANGETHEF, is a Liberty granted from the King to ſome Lords of Manors, to try all Thieves, which are their Tenants, within their own Courts.

INFERIOR *Planets*, are *Mercury* and *Venus*, ſo called, becauſe they are next the Sun, the Centre of the Planetary Syſtem. An Account of their Motion and *Phænomena* to an Eye placed at the Earth is as follows.

1. The *Periodical Times* of their Motion thro' the Ecliptic are plainly equal; which is contrary to what appears in the Motion of the Superior Planets: And their Progreſs through the Ecliptic is meaſured by the Motion of the Sun; ſo that if the apparent Motions of the *Sun*, *Venus*, and *Mercury*, be conſidered for many Years together, they will appear to run through the Zodiac in an equal Space of Time.

The Reaſon of this Diverſity between the Superior and Inferior Planets is not from any real *Difference* in their Motions, but ariſes ſolely from the different Poſition of this Earth which we inhabit.

All the Planets are circulated round the *Sun* in one and the ſame Ratio; the *more diſtant* requiring a longer time for their Revolution, than thoſe which are *more near*. Thus the Earth being farther from the Sun than *Venus*, is a longer time in moving round him; and *Venus* than *Mercury*: And to an Eye placed in the Sun the Motions of the Inferior and Superior Planets would appear alike uniform and proportionable to their Diſtance. But to an Eye at the Earth, as the *Superiors*, containing our Orbit within theirs, will appear to move ſometimes *ſlower*, and ſometimes *ſwifter*; now to be *ſtationary*, and now *retrograde*; ſo the Motions of the *Inferiors* will appear to depend upon the Motion of the Sun, to whom they are ſo nearly joined as it were; and to us, that are in an Orbit ſo far without them, will appear to be equal to the Motion of that Great Luminary.

2. The *Sun*, *Venus* and *Mercury*, ſingly conſidered, are each affected with ſuch an Inequality of Motion, that it is very rare for them all three, or indeed for any two of them, to agree in the ſame Degree of Velocity.

Indeed, if *Venus* and *Mercury* had no Motion of their own round the Sun, but kept an invariable Poſition with regard to him, it were reaſonable to ſuppoſe, that they ſhould move on almoſt equably, as the Sun doth. But ſince that *apparent Motion*, with which they annually run through the Zodiac, is derived from a double Fountain, *viz.* from their own proper Motion round the Sun, which is not very unequable in it ſelf; and from the Poſition of the Earth, which is continually various and changeable, in an Orbit that is without theirs; 'tis not ſtrange that each of the *Inferior Planets* ſhould appear to move unequally, and to go ſometimes ſlower, and ſometimes faſter, by turns.

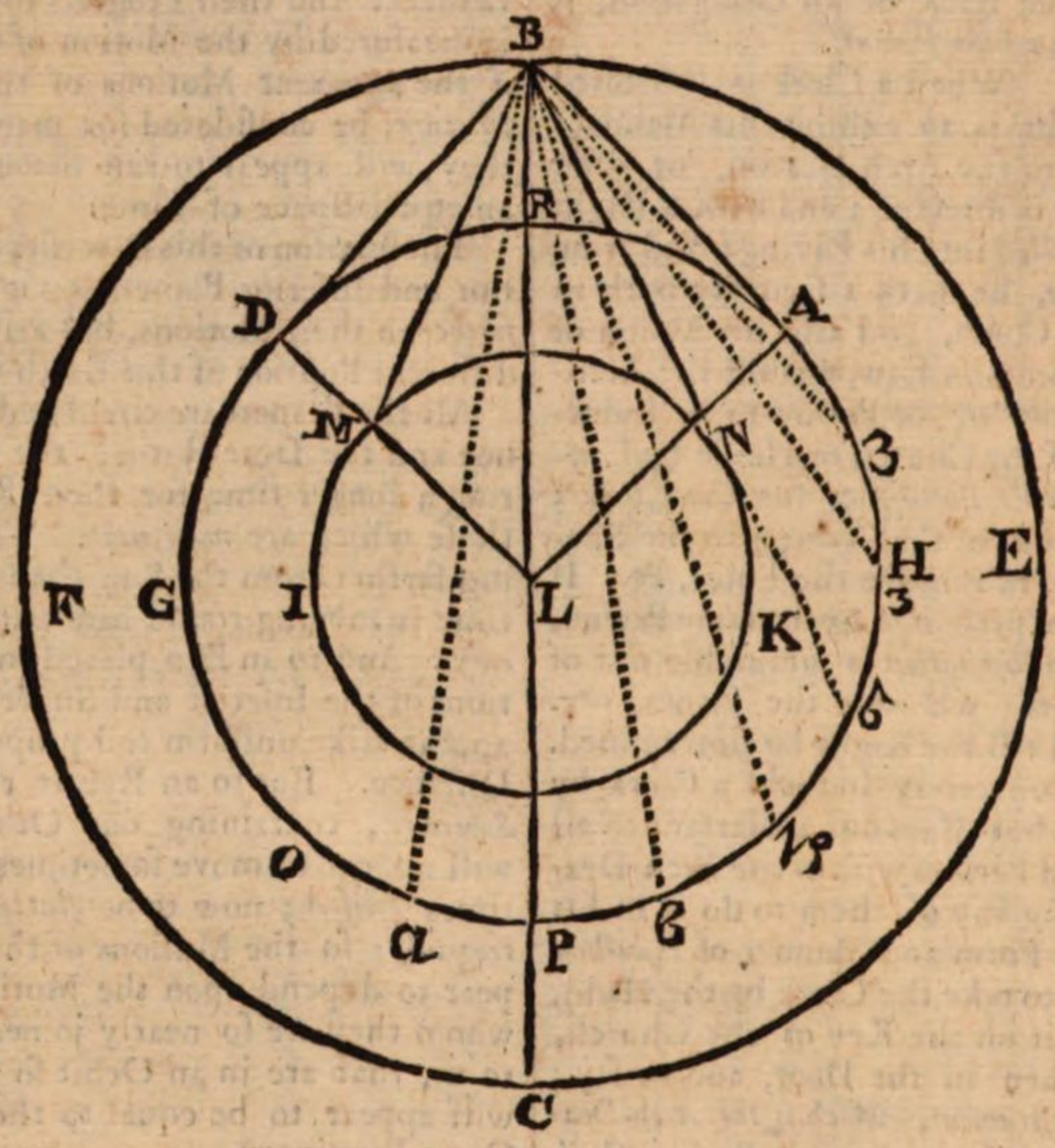
3. Although the Periodic Times of *Venus* and *Mercury* in the Ecliptic through the Courſe of the Year are thus accurately equal to one another; yet the Periodic Times of *Venus*, if reckon'd

from any one preſent Poſition to the Sun, to a like ſubſequent one, if compared with the Periodic Times of *Mercury* in a like Poſition, will appear to be of a much longer Length.

For this Inequality of the Periodic Times, according to the unequal Diſtance from the Sun, is agreeable to the eſtabliſhed Law of the Heavenly Bodies: For *Venus* is nearer to the Sun than the Earth, and *Mercury* than *Venus*. Wherefore the Periodic Times of *Venus*, conſidered in themſelves, and with regard to the fix'd Stars, are not a little ſhorter than thoſe of the Earth; and thoſe of *Mercury* ſhorter than the Periodic Times of *Venus*. And though theſe Motions ſhould be conſidered by a Spectator at the Earth, he would find in them the ſame Inequality: For the Motion of *Mercury* will be ſooner, and oftner *more ſwift*, than that of the Earth; and therefore their Periodic Times muſt be unequal.

4. Theſe Inferior Planets are never either in *Oppoſition* or in *Quadrature* to the Sun; but always more near to him, than to occaſion thoſe *Phænomena*: For *Mercury* goes no farther from the Sun than about 28 Degrees, and *Venus* not above 48 Degrees; ſometimes to the Eaſtward, and ſometimes to the Weſtward. That neither of theſe Planets can come to be in *Quadrature*, much leſs in *Oppoſition* to the Sun, will be plain from the following Scheme.

Let the Circle *BFCE* be the Earth's Annual Orbit; *ADGH* the Orbit of *Venus*; and *NMK*




that of *Mercury*. The greateſt Elongation of *Venus* from the Sun is determined by the Acute Angle *LBA*, made by the Line *BL* drawn from the Sun to the Earth, and the Line *BA*, which is a Tangent, to the Orbit of *Venus*. In like manner the Acute Angle *LBN* will determine the greateſt Elongation of *Mercury* from the Sun. Now the Quantity of theſe Angles, in a Proportion aſſign'd, may be had from the Semidiameters of the Orbits being found by Obſervation, and by Trigonometrical Calculation: Or, indeed, they will be diſcovered by Obſervation of the greateſt Elongations themſelves.

5. Our Modern Aſtronomers have obſerv'd, That *Venus* appears *bigger* when ſhe begins to recede from the Sun towards the Eaſt, and when ſhe is yet but a little diſtance from him; but, on the contrary, that ſhe appears *leſs* in her Approach towards the Sun, and when ſhe comes pretty near him: Whereas, when ſhe recedes from the Sun towards the Weſt, then ſhe appears *leſs*; but when ſhe approaches towards him again, ſhe again appears larger. And the ſame things have been obſerved of *Mercury*, by the uſe of long and good Teleſcopes.

Theſe *Phænomena* have quite overturn'd the *Ptolemaic Syſtem* of the Heavens, and may be accounted for thus: Since all the Planets, as well as the Earth, are Opake, Scabrous, and Spherical Bodies, reflecting every way from them the Rays of the Sun falling upon them; 'tis plain, that that Hemiſphere of any Planet only, which is turned towards the Sun, will be enlightened; the other Half of it remaining in Darkneſs. And, ſince alſo an Obſerver here can only ſee that Half or Hemiſphere of any Planet, which is obverted, or turned towards the Earth, where he ſtands; if it be conſidered *what Part* of *Venus* is enlighten'd by the Sun in her different Poſition or Situation towards him, and *what Part* is ſeen by an Eye at the Earth in its Annual Orbit *BFCE*; (*See the preceding Fig.*) it will be plain that *Venus* muſt appear *leaſt* to us when ſhe is in *R*; becauſe, tho' ſhe be then the moſt near to us poſſible, yet her obſcure Hemiſphere being towards us, there will be but very little of her enlighten'd part ſeen: But when ſhe comes into the Poſition *D*,

then ſome part of her illuminated Diſk will be turned towards the Eye in *B*; but a much greater part of her obſcure or dark Hemiſphere. And ſince ſhe is of a Spherical Figure, which to a diſtant Eye appears as a Plane, 'tis clear that the illuminated part of her Disk muſt appear in the form of Horns, turned from the Sun, or towards the Weſt. And this is her Appearance when *Venus* is our *Morning-Star*, as ſhe is commonly called. But this Planet moving on in her Orbit to *G*, very near one half of her illuminated Diſk will become viſible to the Eye at *B*; and, conſequently, ſhe will then appear in the form of an Half-Moon. When ſhe comes into the Poſition *O*, more than half of her enlighten'd Hemiſphere will be viſible, and ſo ſhe will appear *Gibboſe*: And when ſhe arrives at that part of her Orbit which *P* deſigns, to an Eye at *B*, as before, ſhe will appear, as we ſay of the Moon, at *Full*; that is, all her illuminated Diſk will be viſible. The ſame kinds of *Phaſes Venus* will put on, as ſhe moves forward in her Orbit through *Q*, *H*, *A*; that is, in *Q* ſhe will be Gibboſe; in *H* like an Half-Moon; in *A* horned again; but her Horns will be turned a contrary way to what they were in *D*; that is, now to the Eaſtward, but ſtill from the Sun: And this is her Appearance when ſhe is the *Evening-Star*.

The ſame kinds of *Phænomena* belong to *Mercury*; reſpect being had to his particular Orbit and Period of his Revolution.

But here we muſt take care that we be not deceived by the general Conſideration of her Phaſes only, ſo as to think that *Venus* will always appear brighteſt and largeſt in *P*, or in *Q* or *O*. The Appearance which *Venus* may ſeem to have in her *Oppoſition*, as it may be called in *P*, will be quite altered by her coming as near as ſhe can to the Sun: And as to the Places *O* and *Q*, tho' *Venus* will ſhine with near a full Face; yet ſhe will be then ſo far from the Earth, that her *Diſtance* from us will more than compenſate for the Quantity of her Light: Wherefore you may expect to ſee her appear moſt bright and ſplendid when ſhe is in *D* or *A*. For ſuppoſe her to move from *Q* to *H*; then will ſome part of her lucid Hemiſphere be turned from us in *B*, and ſo cannot be ſeen; and yet the remaining luminous part comes ſtill nearer to the Earth: And ſince her *Shining*, or apparent Light, increaſes in a Duplicate Ratio, or as the Square of her Diſtance from us diminiſhes, her Light will be much more increaſed by her Approach to the Earth, than it will be leſſened by our ſeeing leſs of her illuminated Diſk. So alſo ſuppoſe her to move from *H* to *A*, or yet farther on; here ſtill the Quantity of her illuminated part decreaſes, but the duplicate Increaſe of her Approach to the Earth will yet make her Splendour increaſe. But between *A* and *R*, the Decreaſe of her viſible Light will be greater than what her Acceſs towards the Earth can compenſate; and ſo her Light will continually diminiſh more and more, 'till ſhe will ſet *Heliacally*, and ſo become inviſible. Thus alſo while the Planet is moving from *P* towards *Q*, her Approach towards the Earth in *B* is inconſiderable, in compariſon of the Parts of her illuminated Diſk, which will be turned away from us; and, conſequently, ſhe will appear more obſcurely in *Q* than ſhe will in *P*: But between *Q* and *H*, and ſo towards *A*, her Approach to the Earth will very much increaſe her Splendor, tho' leſs and leſs of her lucid Disk become ſtill viſible. And from the whole it is plain, that while ſhe is moving in the Arch *H A*, ſhe will appear brighteſt and largeſt.

6. The greateſt Elongations of *Venus*, whether towards the Eaſt or Weſt, are unequal, and muſt be expreſs'd by an unequal Number of Degrees. And the ſame thing is alſo true of *Mercury*.

This *Phænomenon* hath a double Original or Cauſe; for it depends on the Excentricity of the Orbits both of *Venus* and of the Earth. For if the Diſtance *L A* (in the former *Fig.*) of *Venus* from the Sun; or if *L B*, the Diſtance of the Earth from the Sun, be unequal; it cannot be, but that the Angle *L B A*, in the Triangle *L B A*, which is called the greateſt Elongation, muſt alſo be unequal: And indeed both thoſe Lines are ſubject to ſuch an Inequality.

7. The ſame *Directions*, *Stations*, and *Retrogradations*, which we obſerve in the Courſe of the Superior Planets, are found to belong to theſe Inferiors; and with the ſame Circumſtances of Change.

For ſuppoſe the Earth, as before, in *B*, and immoveable there, and the Planet in *P*; 'tis then plain, that while the Planet moves Eaſterly from *P* to *Q*, to an Eye placed in *B*, it muſt appear *Direct*, or to move *in Conſequentia*, as they ſpeak; that is, according to the Order of the Signs: And ſo it will appear to do till it come to *A*. But yet, becauſe the Arches *P β*, *β γ*, *δ ε*, *ε ζ*, are equal; but the Angles that they ſubtend at *B*, are unequal; therefore the Planet will appear to move unequally through thoſe Arches: For it will ſeem to move ſwifteſt about *P*, and ſtill ſlower and ſlower, the nearer it comes to *A*: And there it will begin to appear *Stationary*, or not to move at all: And while it runs over the Arch *A R*, it will meet with the former Lines *B ζ*, *B ε*, *B δ*, *B γ*, and therefore muſt appear to be *Retrograde*, or to move backward, or *in Antecedentia*, as the Term is; that is, contrary to the Order of the Signs. Which apparent Retrograde Motion will continue till the Planet come to *D*; and then it will begin to be, or rather appear to be, *Stationary* again; and ſo on, as before.

And ſhould you ſuppoſe the Earth, as it is, moving in the Orbit *B F C E*; when the Planet moves faſter than the Earth, it will even then appear to be *Direct*; when at an equal Pace with it, *Stationary*; and when *ſlower* than it, it will appear *Retrograde*, as before; tho' the Times and Places of theſe *Directions*, *Stations*, and *Retrogradations* will not be the ſame, as if the Earth indeed ſtood ſtill: As will be eaſily underſtood by a little Conſideration of the Figure above; or by what is ſaid on this Head under the Words *Superior Planets* in this *Vol.* II.

8. The Planes of the Orbits of the Inferior Planets being inclined to that of the Ecliptick, the ſame *Phænomena* will ariſe from thence in kind, as in the ſame Caſe of the Superiors; only it is worth taking notice of, that the Plane of the Orbit of *Mercury* making an Angle with that of the Ecliptick of very near 7 Degrees, he hath the greateſt Latitude of any of the Planets; and there-

fore will be ſubject to the greateſt Anomalies of Latitude.

9. It is ſometimes, but rarely, obſerv'd of theſe two Inferior Planets, That their Bodies being interpoſed between us and the Sun, they appear like *Spots* in the Plane of his Disk.

And 'tis plain, that this will happen whenever their Conjunction with the Sun falls on, or near either of the Nodes of their Orbits: Juſt as the Moon appears to eclipſe or hide part of the Sun's Face, when her Conjunction happens in or near the Nodes of her Orbit.

INFINITELY *Infinite Fractions.* In *Phil. Collect.* N. 3. Dr. *Rihood* proves that *Infinitely Infinite Fractions*, or all the Powers of Fractions, whoſe Numerator is 1, are all of them together equal to Unity, or to an Unite.

The Demonſtration is Short and Univerſal.

And from hence he deduces, by way of *Corollary*, that there are not only *Infinite Progreſſions*, or *Progreſſions in Infinitum*; but alſo, infinitely further than one kind of Infinity. That theſe *Infinitely Infinite Progreſſions* are notwithſtanding computable and aggregable into one Sum; and that not only into a *Finite* Sum, but into one ſo ſmall, as to be leſs than any aſſignable Number. That of Infinite Quantities, ſome are equal, others unequal: That one Infinite Quantity may be equal to two, three, or more Quantities, whether Infinite or Finite.

INFINITE *Series.* In Vol. I. I have ſhewn that this Method of *Infinite Series* took its Riſe from the Arithmetick of Infinites, and hath been purſued with wonderful Sagacity and Penetration by ſeveral of our Excellent Modern Algebraiſts. The Uſe of this Method in the Extraction of Roots I have, in ſome meaſure, ſhewn in the former Volume, from the Ingenious Mr. *Ralphſon* and Mr. *Ward*: What here follows is more Univerſal; and is from *Parſons*'s and *Waſtell*'s Arithmetick.

Let $\begin{cases} A = \text{to the Abſolute Numb. in any Equation.} \\ n = \text{to the Exponent of the higheſt Power.} \\ x = \text{to Root or Quantity ſought.} \\ N = \text{any known Number taken at pleaſure.} \\ n = \text{an unknown Number.} \\ 1, p, q, r, s, \&c. = \text{to the reſpective Co-efficients of the given Equation.} \end{cases}$

Then will $N + n = x$; and

$\mp 1 \times x^n \mp p \times x^{n-1} \mp q x^{n-2} \mp r \times x^{n-3} \mp, \&c. = A$, repreſent any Equation whatſoever.

And becauſe $N + n$ is ſuppoſed equal to $x$, ſuch a General Equation may be thus expreſſed:

$$\mp 1 \times \overline{N+n}^n \mp p \times \overline{N+n}^{n-1} \mp q \times \overline{N+n}^{n-2} \mp r \times \overline{N+n}^{n-3} \mp, \&c. = A.$$

But to bring this into a *Series*, it is neceſſary firſt to prove, That every Power raiſed from a Binomial, (without regarding the Co-efficients) conſiſts, or is compoſed of two Ranks or *Series* of Powers; one increaſing from $n^{n-n}$, or 1, to $n^n$, and the other decreaſing from $N^n$ to $N^{n-1}$ or 1; and each Member in one is multiplied into its correſponding Member in the other reſpectively; as may appear thus:

$$\overline{N+n}^2 = \begin{cases} NN \\ 2\,Nn \\ nn \end{cases} = \begin{cases} N^n \times n^{n-n} \text{ or } 1. \\ N^{n-1} \times n^{n-1} \text{ twice} \\ N^{n-n} \times n^n \end{cases}$$

Again,

$$\overline{N+n}^3 = \begin{cases} NNN \\ 3NNn \\ 3\,Nnn \\ nnn \end{cases} = \begin{cases} N^n \times n^{n-n} \\ N^{n-2} \times n^{n-2} \\ N^{n-2} \times n^{n-} \\ N^{n-n} \times n^n \end{cases} \text{thrice}$$

And ſo it will always be *ad Infinitum*. *Q. E. D.* Hence theſe two *Corollaries*.

### *COROLLARY* I.

That the Co-efficient of the ſecond Term in any Power raiſed from a *Binomial*, is always $= n$ the Exponent of the higheſt Power.

### *COROLLARY* II.

That the Root or Side of $n^n$ the unknown Quantity is always multiplied into the ſecond Term of the known.

Now from the *latter*, it is evident we are (in this Caſe) but to make uſe of the two firſt Members of the Power of ſuch *Binomial*; and by the firſt we may expreſs the Co-efficient of the ſecond Term, by $n$ the Exponent of the Power: Therefore the former Equation will now ſtand thus;

$$\mp 1 \times N^n \mp n\,N^{n-1}\,n \mp p \times N^{n-1} \mp {}_{n-1}N^{n-2}$$
$$N \mp q \times N^{n-2} \mp {}_{n-2}N^{n-2}\,n \mp r \times$$
$$N^{n-3} \mp {}_{n-3}N^{n-4}\,n \mp, \&c. = A.$$

Now to find the Value of $n$, or the unknown Quantity, it is plain, that thoſe Members into which it is multiplied, will be the Diviſor with the ſame Signs, and the others the Dividend, but with contrary Signs, as being to be tranſpos'd to the other ſide of the Equation: Therefore firſt,

$$n = \frac{A \mp 1 \times N^n \mp p \times N^{n-1} \mp q \times N^{n-2} \mp r \times N^{n-3}, \&c.}{1 \times {}_nN^{n-1} \mp p \times {}_{n-1}N^{n-2} \mp q \times {}_{n-2}N^{n-3} \mp r \times {}_{n-3}N^{n-4}, \&c.}$$

Which

Which Theorem exhibits all poſſible particular ones, for extracting of Roots, according to the firſt ſort of Mr. *Ralphſon*'s; agreeing exactly with them, as will be found on Tryal; always remembring that the Signs in the Dividend muſt be contrary to thoſe in the Equation, and in the Diviſor the ſame reſpectively.

But $N \pm n = x$: Therefore ſecondly,

$$x = \frac{A \pm 1 \times {}_{n-1}N^{n} \pm p \times {}_{n-2}N^{n-1} \pm q \times {}_{n-3}N^{n-2} \pm r \times {}_{n-3}N^{n-3}, \&c.}{1 \times {}_{n}N^{n-1} \pm p \times {}_{n-1}N^{n-2} \pm q \times {}_{n-2}N^{n-3} \pm r \times {}_{n-3}N^{n-4}, \&c.}$$

Which gives us all thoſe of the *ſecond ſort* univerſally: But in this Caſe the Signs both in the Dividend and Diviſor will be the ſame as in the given Equation reſpectively: As likewiſe it may be proper to take notice, that if any Term be wanting in the Equation, the ſame muſt be omitted in either Theorem reſpectively.

Now from either of theſe *two Generals*, to deduce any *particular Theorem*, for finding the *Root* of any *given Equation*; we need only conſider, that $N^{n-n} = 1$, or $\frac{N^n}{N^n} = 1$, that Unity will neither multiply nor divide; as alſo that ${}_{n-n}N^n = 0$, or ${}_{n}N^{n} - {}_{n}N^{n} = 0$, and any Quantity, multiply'd into 0, is $= 0$; and when either Caſe happens (which always will, except where the laſt Term is wanting) the *Theorem* is determined.

Therefore,

| *Suppoſe any Equation, as* | *By the firſt General Theorem,* | *By the ſecond General Theor.* |
|---|---|---|
| $x^2 = A$ | $\frac{A - N^2}{2N}$ | $\frac{A + N^2}{2N}$ |
| $x^3 = A.$ | $\frac{A - N^3}{3N^2}$ | $\frac{A + 2N^3}{3N^2}$ |
| $x_4 = A.$ | $\frac{A - N^4}{4N^3}$ | $\frac{A + 3N^4}{4N^3}$ |
| $x^2 \pm px = A$ | $\frac{A - N^2 \mp pN}{2N \pm p}$ | $\frac{A + N^2}{2N \mp p}$ |
| $-x^2 \pm px = A$ | $\frac{A + N^2 - pN}{-2N + p}$ | $\frac{A - N^2}{-2N + p}$ |
| $x^4 \pm px^3 = A$ | $\frac{A - N^4 \mp pN^3}{4N^3 \mp 3pN^2}$ | $\frac{A + 3N^4 \mp 2pN^3}{4N^3 \mp 3pN^2}$ |
| $x^3 \pm px^2 \pm qx = A, \&c.$ | $\frac{A - N^3 \mp pN^2 \mp qN}{3N^2 \pm 2pN \pm q}$ | $\frac{A + 2N^3 \mp pN^2}{3N^2 \mp 2pN \mp q}$ |

Then we ſhall find $x =$ the left column $=$ the middle column $=$ the right column.

And after the ſame manner for any *Equation* whatſoever.

Thus having the particular *Theorem*, the *Application* in either Caſe is as follows:

Let $N$ be any *Number* taken at Pleaſure, as before.

$T$ be $=$ *Theorem*, in which $N$ muſt always be of its laſt Value found.

Then the Proceſs will be of the

| *Firſt General Theorem.* | *Second General Theorem.* |
|---|---|
| $N$ the 1ſt. $\pm T = N$ the 2d. Then | $T = N$ the 2d. Then |
| $N$ the 2d. $\pm T = N$ the 3d. Then | $T = N$ the 3d. Then |
| $N$ the 3d. $\pm T = N$ the 4th. Then | $T = N$ the 4th. Then |
| $N$ the 4th. $\pm T = N$ the 5th, *&c.* | $T = N$ the 5th, *&c.* |

Some of which Values of $N$ will terminate in the true Root ſought, if it have one: But if it be a Surd; then the Value of $N$ will proceed into an *Infinite Series*, but may be proſecuted nearer the Truth than any aſſignable: Which *Series*, each *Operation*, will proceed in *Number of Places*, in a *Geometrical Progreſſion*; whoſe firſt Term is 1, and *Ratio* $= 2$, *Viz.* Firſt 1, then 2, then 4, then 8, then 16, then 32, *&c.* Places.

It is likewiſe obſervable, That the *firſt* General Theorem *converges*, by finding out a *Number* to be added to, or ſubtracted from the *laſt* Value of $N$, (as it ſhall be affected with $+$ or $-$) until $N$ be $= x$ ſought. So the *laſt converges* by $N$ itſelf,

ſelf, whoſe Value, at each Operation, ſhall grow nearer and nearer, until it be = to $x$ ſought.

We may alſo take notice, that though $N$ be aſſumed never ſo far from the true Root, yet it will converge to it by renewing the Operation. But the Work may be much ſhortned, in caſe we point the given Equation (if it will admit of it) both in the *abſolute Number* and *Coefficients*, according to their reſpective Degrees of *Adfection*: And take firſt 1, then 2, then 4, &c. of thoſe *Points*, (from the firſt) each Operation: For it is evident, the Coefficients increaſe in their Powers, as the higheſt unknown Term decreaſes; therefore the *abſolute Number* is of the ſame Power with the higheſt unknown *Quantity*.

One Inſtance may be ſufficient to explain it: Suppoſe therefore this *Cubic Equation* were to be pointed;

*Viz.* $xxx + 25xx + 836x = 53297$
Or $xxx + pxx + qx = A$.

Then it would be $xxx + \dot{2}5xx + \dot{8}36x = 5\dot{3}297$
For the *abſolute Numb.* is a Cube
*Co-efficients* $q$ a Square } and are *pointed*
$p$ a Lateral } *accordingly*.

And the like Method for any other Equation, where it will admit of it.

Now to apply this laſt, we are to take
the *Firſt Operation* $xxx + 2xx + 8x = 53$
*Second Operation* $xxx + 25xx + 836x = 53297$

And conſequently the Value of the Coefficients as well as the abſolute Number alters, ſo long as there are *Punctations*.

But by a few *Numerical Operations*, the ſaid Notification, as well as the *Method* of the Proceſs of each *Theorem*, will be further illuſtrated: Therefore,

1. Suppoſe $xx = 2 = A$. Seek $x$ by the firſt General Theorem.

Then $n = \frac{A - A^2}{2N} = T$, and take $N = 1$;

Therefore $1 + T(=,5) = 1,5 = N$ the 2d.
$\therefore 1,5 - T(=-,083) = 1,417 = N$ the 3d.
$\therefore 1,417 - T(=-,002783) = 1,414217 = N$ the 4th.
$\therefore 1,414217 - T(=-,0000034376 22) = 1,41421356 2378 = N$ the 5th $= x$.

2. Suppoſe $xx = 2 = A$. Seek $x$ by the ſecond General Theorem.

Then $x = \frac{A + N^2}{2N} = T$, and take $N = 1$, as before.

Therefore $T = 1,5 = N$ the 2d.
$\therefore T = 1,416 = N$ the 3d.
$\therefore T = 1,414215 = N$ the 4th.
$\therefore T = 1,41421356 2373 = N$ the 5th. $= x$.

By which it is evident; *Firſt*, That both Theorems amount to the ſame thing; the Difference being only in the laſt Figure, which would be corrected the next Operation. *Secondly*, That $x$ will proceed into an *infinite Series*, if a Surd. *Thirdly*, That each Operation gives double the Number of Figures of the laſt.

3. Suppoſe $xxxx = 2839,8241 = A$. Seek $x$ by Theorem 1.

Then $n = \frac{A - N^4}{3N^3} = T$, and take $N = 10$.

Therefore $10 - T(=-3) = 7 = N$ the 2d.
$\therefore 7 + T(=+,4) = 7,4 = N$ the 3d.
$\therefore 7 - T(=-,1) = 7,3 = x$, the true Biquadratick Root ſought.

4. Suppoſe $xxxx = 2839,8241 = A$, as before. Seek $x$ by the ſecond Theorem.

Then $x = \frac{A + 3N^4}{4N^3} = T$, and take $N = 5$.

Therefore $T = 5,6 = N$ the 2d.
$\therefore T = 8,2 = N$ the 3d.
$\therefore T = 7,4 = N$ the 4th.
$\therefore T = 7,3 = N$ the 5th $= x =$ true *Root* ſought.

From which two laſt Examples it appears; *Firſt*, That *either Theorem* will find the *true Root*, if it have one. *Secondly*, That it *matters not*, whether $N$ be taken *above* or *below* the Root, nor how far from it.

5. Suppoſe $xx + \dot{5}\dot{8}\dot{7}x = 9\dot{8}\dot{7}\dot{4}\dot{5}9$ or $xx + px = A$. Seek $x$ by *Theor.* 1. (*i. e.*) $n = \frac{A - N^2 - pN}{2N + p} = T$.

Becauſe of the Punctations we are to take,

1. *Operation* $xx + 5x = 98$
2. $xx + 58x = 9874$ } And ſuppoſe $N = 8$.
3. $xx + 587x = 987459$

Therefore $8 - T(=-,2) = 78 = N$ the 2d.
$\therefore 78 - T(=-3,4) = 746 = N$ the 3d.
$\therefore 746 - T(=-3,34) = 742,66 = N$ the 4th.
$\therefore 742,66 - T(=-,012689) = 742,647311 = x$ ſought.

6. Suppoſe $xx - 20x = 53482$, or $xx - px = A$. Seek $x$ by the ſecond General Theorem.

Then $x = \frac{A + N^2}{2N - p} = T$, and take $N = 250$.

Therefore $T = 241 = N$ the 2d.
$\therefore T = 241,4 = N$ the 3d.
$\therefore T = 241,475 = N$ the 4th.
$\therefore T = 241,477860 = N$ the 5th. $= x$ ſought.

From theſe two laſt it is plain; *Firſt*, That there is no abſolute Neceſſity for Punctation. *Secondly*, That Punctation does nevertheleſs *ſhorten* the Work, where it can be done.

But

But I hope I have ſaid enough to make the whole Matter, as well as the Manner, of Proceeding plain and eaſy to the meaneſt Capacity: And tho' I have given *Numerical* Examples no farther than an *affected* Quadratic, yet 'tis the ſame to any *Degree* of Power or Affection whatſoever; regard being had to its proper and particular Theorem, deduc'd from either of the general ones.

INFINITESIMALS, (as ſome Writers call them) are ſuch Quantities as are ſuppoſed to be infinitely ſmall.

INFLECTION.

INFLEXION *of the Rays of Light.* Sir *Iſaac Newton*, in his Excellent *Opticks*, Book 3. makes theſe Experiments and Obſervations on this ſurprizing *Phænomenon*.

1. That in a well darken'd Room, a Hole, whoſe Diameter was $\frac{1}{42}$ of an Inch, being made with a Pin in a Plate of Lead, to let in the Sun's Rays; he found that the Shadows of Hairs, Threads, Pins, Straws, &c. placed in that Beam of Light, were very conſiderably broader than they ought to be, *if the Rays of Light had paſſed on by thoſe Bodies in Right Lines:* And for Inſtance, that the Hair of a Man's Head, whoſe Breadth was about the 280th part of an Inch, did, at the diſtance of 12 Foot from the Hole, and 4 Inches from the Hair, caſt a Shadow which was a 60th part of an Inch broad, or four times its own Breadth; at 2 Foot from the Hair, the Shadow was ten times as broad as the Hair; and at the diſtance of 10 Foot, it was 35 times as broad. And he found, that it was not material, whether the Hair was encompaſſed with *Air*, or with any other pellucid Subſtance: For if the Hair were placed between poliſhed Glaſſes, with Water between them, the Shadows were all one; as were alſo the Shadows of Scratches made on the Surface of poliſhed Plates of Glaſs, and of the *Veins* of ſuch Glaſſes: And therefore the great Breadth of theſe Shadows muſt ariſe from ſome *other Cauſe* than the *Refraction* of the Air. It is plain alſo from this Experiment, that the *Rays* are *bent*, and *turned aſide*, in paſſing by the Hair, &c. and that the Hair acts on the Rays of Light *at a good diſtance* as they paſs by it. And he ſhews, that the Action is *ſtrongeſt* on the Rays which paſs by at the leaſt Diſtances, and grows *weaker* as the Rays are further from it.

2. He obſerved that the Shadows of all Bodies in this Light were border'd with 3 parallel Fringes of colour'd Light; whereof that next the Shadow was luminous. It was difficult to diſtinguiſh the Colours, unleſs the Light paſs'd very obliquely on a white Paper, and then they exhibited Colours in this Order from the Shadows, *viz.* Violet, Indico, Pale-blue; Green, Yellow, Red; Blue, Yellow, Red; Pale-blue, Pale-yellow, Pale-red.

3. He took accurately the Meaſures of theſe Fringes, which he there gives in a Table.

And in the 4th *Obſervation* he ſhews, That the Breadth of the Fringes (when caſt obliquely on a ſmooth white Body) ſeem'd to be in the Progreſſion of the Numbers, $1\ \sqrt{\frac{1}{2}},\ \sqrt{\frac{1}{3}}$; and their Intervals in the ſame Proportion with them; *i. e.* the Fringes and their Intervals together to be in the continued Progreſſion of $1.\ \sqrt{\frac{1}{2}},\ \sqrt{\frac{1}{3}},\ \sqrt{\frac{1}{5}}$, or thereabouts.

5. The Sun ſhining into a darkened Room thro' a Hole $\frac{1}{4}$ of an Inch broad, at 2 or 3 Foot from it, he placed a Sheet of Paſtboard, black'd well all over; and which had in the middle a Hole about $\frac{1}{4}$ of an Inch ſquare for the Light to paſs through. Behind the Hole, on the Paſtboard, he faſtned with Pitch the Blade of a ſharp Knife, to intercept ſome part of the Light which paſſed through the Hole. Both Paſtboard and Knife were placed perpendicular to the Rays of Light. Then placing the Paſtboard ſo that all the Light fell upon the Hole in it, and part of it on the Blade of the Knife there placed, while the other Part went by the Edge; he let that part which paſſed by, fall on a white Paper, 2 or 3 Foot beyond the Knife; and there ſaw 2 *Streams of faint Light ſhoot out both ways from the Beam of Light into the Shadows, like the Tails of Comets.* Their whole Length, meaſured upon the Paper at the diſtance of 3 Foot from the Knife, was about 6 or 8 Inches; ſo that they ſubtended an Angle at the Edge of a Knife of about 12 Degrees.

6. He placed another by the former; ſo that their Edges were parallel and look'd towards one another; ſo that a Beam of Light might fall on both, and ſome of it paſs through between them. And when the Diſtance between their Edges was about the 400th part of an Inch in breadth, the Stream of Light that paſſed through *parted in the Middle*, and *left a Shadow* between the two Parts: And this Shadow was ſo black and dark, that all the Light which paſſed between the Knives, ſeem'd to be *bent* and *turned aſide* to the one hand or the other. As the Knives approach'd, the Shadow between the Streams of Light grew ſtill broader; till at laſt, on their Contact, the whole Light vaniſhed. Hence I gather (ſaith he) that the Light which is *left bent*, and goes to the *inner Ends* of the Streams, paſſes by the Edges of the Knives at the greateſt diſtance: And *this Diſtance*, when the Shadow begins to appear between the Streams, *is about the 800th part of an Inch:* And the Light, which paſſes by the Edges *at leſs Diſtances*, is *more bent*, and goes to thoſe Streams which are further from the direct *Light*.

7. The *Fringes* above mentioned alſo appear'd in this Experiment. And he gathers from this and the former Obſervation, that the Light of the firſt Fringe paſſed by the Edge of its Knife at a Diſtance greater than the 800th part of an Inch; and the Light of the two or three Fringes at ſtill greater Diſtances; and conſequently, that the Rays, which cauſed the *Streams* of Light, paſſed nearer to the Knives Edges than any other.

8. Two Knives, whoſe Edges were ground truly ſtrait, were placed ſo (by ſticking their Points into a Board, with their Edges towards one another) as to make an Angle of above 1°. 54'. Here thro' a Hole, the 42d part of an Inch wide, the Beam of Light was let into the dark Room; which made the Fringe appear, at the diſtance of 10 or 15 Foot from the Hole, and on a Ruler held obliquely, at the diſtance of half an Inch from the Knives, parallel to the Edges of the Shadows, and without growing ſenſibly broader till they met in Angles equal to that made by the

Edges

Edges of the Knives, where they met and join'd without croſſing. But when the Ruler was plac'd at a much *greater* diſtance, the Fringes grew broader as they approached, and after meeting croſs'd one another, and then grew yet much broader.

9. From hence he concludes, That the *Diſtances* at which the Fringes paſs by the Knives are *not increaſed nor altered* by the Approach of the Knives; but that the Angles, in which the Rays are there *bent*, are much increaſed by that Approach: And alſo, that the Edge of the Knife, which is neareſt any Ray, *determines which way the Ray ſhall be bent*, and *the other Knife increaſes the Flexure.* In obſerving,

10. He found, that when the Fringes of the Shadows of the Knives fell *perpendicularly* on a Paper at a great diſtance from the Knives, they were in the form of *Hyperbola's.*

11. When he placed a Priſm at the Hole (made with a ſmall Pin) to refract the Light, he found that the Shadows of all Bodies held in the colour'd Light between the Priſm and the Wall were bordered with Fringes of the Colour of that Light only in which they were held: And alſo, that the Fringes in the *Red* Light were *largeſt*, and thoſe in the *Violet*, *leaſt*. Wherefore, the Rays, which made theſe Fringes in the *Red* Light, paſs'd by the Hair at a *greater diſtance*, than thoſe which made the like Fringes in the *Violet*: And conſequently the Hair, in cauſing theſe Fringes, *acts alike* on the *Red Light*, or leaſt refrangible Rays, at a greater diſtance; and on the *Violet*, or moſt refrangible Rays, at a leſs diſtance; and *by thoſe Actions* diſpoſed the *Red* Light into larger, and the *Violet* into ſmaller, and the Lights of intermediate Colours into Fringes of intermediate Bigneſſes, *without changing the Colour* of any ſort of Light. When therefore the Hair, in the firſt and ſecond Obſervation, being held in the common white Light of the Sun, caſt a Shadow border'd with three Fringes of colour'd Light; thoſe *Colours* ('tis plain) did not ariſe from any *new Modifications* impreſs'd on the Rays of Light by the Hair, but only from the various *Inflections*, whereby the ſeveral ſorts of Rays were ſeparated from one another; which before Separation, by the Mixture of their Colours, compoſed the *White Beam* of the Sun's Light; but, whenever ſeparated, compoſe Lights of the ſeveral Colours which they are originally diſpoſed to exhibit. And this mightily confirms his Doctrine and Theory of Colours, as indeed all kinds of Experiments and Conſiderations do. See *Colours.*

Theſe wonderful Properties of the *Inflection of the Rays of Light* are cauſed by a Body acting at a diſtance on the Rays; and yet this Action of *Inflection* is the ſtronger, the leſs ſuch diſtance is: So that perhaps the Attraction which cauſes it don't exert its Sphere of Activity beyond ſuch a diſtance. The Rays of Light alſo themſelves, as they differ in Refrangibility, are diverſly *inflected*, and ſeparated into thoſe *three Fringes* of Colours mention'd by Sir *Iſ. Newton* in his excellent *Opticks*, *Lib.* 3. and before obſerved by *Grimaldus* to ariſe from any ſmall Bodies, ſuch as *Hairs*, *Wires*, &c. placed in the Sun's Rays, let into a well darkned Room, by a very ſmall Hole, made only by the Point of a Needle in a Plate of Metal. And theſe *Fimbriæ*, or colour'd Fringes, ſeem to be made by a kind of undulatory Motion or Inflection of the Rays, as they come near the Extremities of Bodies, the three different Colours of the Fringes ariſing from three ſuch different Inflections.

INGENUITAS *Regni*, was formerly uſed to ſignify the Freeholders, or Commonalty of the Kingdom, which were called *Ingenui*, *Liberi*, and *Legales Homines:* But the Word was not reſtrained only to *Plebeians*; ſince in the Reign of *Hen.* I. it was given to the *Chief Barons.*

INGENUOUS, in the Civil Law Senſe, is one that was born of a Woman that was made *Free* any time after his Conception, and before his Birth.

IN *Groſſe*, is a Term in Law for what belongs to the *Perſon* of any Lord, and not to the Manor, Lands, &c. as a *Villain in Groſſe*, an *Advowſon in Groſſe*, &c.

INHOC, the ſame antiently with what is now in the North called an *Intock*; and in *Oxfordſhire*, a *Hitchin*, or *Hitching*; being an Out-part or Corner of ſome common Field plow'd up and ſow'd (uſually with Oats or Tares) and ſometimes fenced off with a dry Foot Hedge, and within that Year in which the reſt of the Field lies fallow. It ſeems to be derived from *in*, within, and *Hoke*, a Corner.

INLAND, is an old Word found in *Doomſday* and other old Books, and ſignified that Part of any Land or Manor which lay next to the Manſion-Houſe, and which was uſed by the Lord himſelf; whence it was called *Terra Dominicalis*, *Demeſnes*, in oppoſition to *Utland* or *Outland*, which was in Tenancy. Theſe *Inlands* the Feudiſts call *Terras Curtas*, *ac intra Curtem*, *Court Lands*, or ſuch as were appropriated to the Court or Houſe of the Lord. So

INLANTAL, *Inland* or Demeſne, was oppoſed to *Delantal*, or *Out-land*, or *Land-Tenanted.*

INMATES, are ſuch Perſons as are admitted (for their Money) to live in the ſame Houſe with, and which go in at the ſame Door, jointly with others to whom the Houſe belongeth; and which are not able alſo to maintain themſelves. Theſe are inquirable in a *Court-Leet.* See *Kitchin*, Fol. 45.

INNATE IDEAS. Taking the Word *Idea* in the largeſt and moſt extenſive Senſe (ſee *Ideas* in Vol. II.) for whatſoever is the Object of our Underſtanding when we think; whether it be *Phantaſm*, *Notion*, *Species*, &c. or whatever it is, that the Mind can be employ'd about in Thinking.

The excellent Mr. *Locke*, in his moſt uſeful *Eſſay on Human Underſtanding*, hath plainly proved there are not any ſuch things as *Innate Ideas* or *Principles:* Tho' ſome Writers will needs have ſuch primary Notions, as have been called κοιναὶ ἔννοιαι, to be as it were Characters ſtampt on the Mind of Man, which the Soul receives in its very firſt Being, and brings into the World with it.

That which hath led Men into this Miſtake, ſeems to have been, *Firſt*, a Notion of the mighty Advantage of ſuch *Innate Ideas* for the due Direction and Regulation of the Human Mind; and therefore 'tis reaſonable to ſuppoſe our Gracious

cious Creator ſhould have furniſhed the Naſcent Mind with them: And, ſecondly, that there are many Truths to which we pay ſo early and ſpeedy an Aſſent, that they ſeem to be Innate, and interwoven as it were in our very Natures, and ſtampt and impreſs'd originally on our Minds.

To the former 'tis eaſy to anſwer; That, if the ſame Advantages will accrue to the Human Mind, from having a Power given it by God, by Study and Thought eaſily to gain ſuch Notion or Principles; there is then no need of ſuppoſing them *Innate*: And if this Power can and doth exert it ſelf early and eaſily, and enables us to aſſent to the Truth of ſuch *uſeful Notions and Principles*, as ſoon as ever the Terms expreſſing them are underſtood, 'tis much more eaſy and natural to ſuppoſe the Power of obtaining them *innate*, than the Propoſitions and Notions themſelves. Our Author might have thought it enough to Refute this Doctrine; by ſhewing (as he admirably and clearly doth) how we may attain to all the Knowledge we have, barely by the uſe of our natural Faculties, and without the help of any *innate* Impreſſions: For it ſeems as unreaſonable to attribute *Truths* to be owing to the Impreſſions of Nature and *innate* Characters, which we find we can gain by the Exerciſe of our Faculties; as to ſuppoſe thoſe *Colours* to be *innate* in our Eyes; which on opening our Eyelids will be painted there from external Objects, by the Operation and Action of Light.

But becauſe ſome prejudicate Notions have long prevail'd *per contra*, and which one can hardly oppoſe without Cenſure; he gives us the Reaſons at large, that made him doubt of the Truth of that received Opinion; which are in ſhort ſuch as theſe.

That ſhould they argue that there are certain Principles both *ſpeculative* and *practical*, which are univerſally agreed on by all Mankind: This doth not prove them *innate*, were it true in Fact, if another way can be aſſign'd how Men may come to ſuch an univerſal Agreement in the things they conſent to.

But indeed there are none ſuch, to which all Mankind give an univerſal Conſent. If you take the *Speculative Principles* into view; ſuch as, *Whatſoever is, is*: *'Tis impoſſible any thing ſhould be and not be at the ſame time*, &c. Though theſe have a ſettled Reputation as *Maxims*; and deſervedly; yet are they ſo far from having an univerſal Aſſent from Mankind, that a great Part of it doth not ſo much as *know* them: As all *Children* and Idiots, and indeed every one that is not uſed to *internal Reflexion*, and *abſtracted Reaſonings*. But *theſe* have Souls; and theſe Souls have theſe Impreſſions, it ſeems, ſtampt upon them; only the Stamp cannot be ſeen; the Impreſſion is *there*, but 'tis *inviſible*; the *Notion* is there, but they don't know it; the *Propoſition* is there, but the Mind is *ignorant* of its Truth! 'Tis plain therefore, *'tis there to no purpoſe*: Wherefore, he that hath a right Notion of the Wiſdom of GOD, will conclude it is not there at all.

If it be ſaid, *Theſe innate Principles lie dormant and inviſible there, till the Soul comes to the uſe of Reaſon*; 'tis plain they were there before to no purpoſe: And if it be fully made appear, that the Exerciſe of our Reaſoning Faculty will help us to them another way; 'tis highly probable they are *never* ſo *impreſſed*, and *innate*, at all.

And if our reaſoning Faculties, aſſenting to the Truth of theſe Principles, as ſoon as we underſtand the Words they are expreſs'd in, be an Argument that they are *innate*; it will prove *too much*: For it will conclude *all other Propoſitions to be ſo too*; which we conſent to as ſoon as we underſtand the Terms: Such as *two and two make four*, &c. *A Square is not a Circle*; *Redneſs is not Sweetneſs*, &c. and ten thouſand ſuch others, to whoſe Truth the Mind, at firſt propoſing, aſſents.

Beſides, no Propoſition can be *innate*, unleſs their Terms are *innate*; or thoſe Ideas which thoſe Terms expreſs. And as no one ever ſaid that Words and Terms are *innate*; ſo in the whole Courſe of his Book Mr. *Lock* ſhews, how and after what manner both Simple, Compounded, and Abſtract Ideas come into the Mind: And he ſhews, that the Notion of Principles being *innate*, came probably from hence: That there being abundance of plain and obvious Truths, to which the Mind pays a ready Aſſent as ſoon as the Terms that expreſs them are underſtood, it was a much eaſier and ſhorter way for Men to ſuppoſe them *innate* there, than to trouble themſelves about the Way and Manner of their coming into the Mind from without, by Obſervation and Expe-rience.

INORDINATE *Proportion*, is where the Order of the Terms are diſturbed.

INSCRIBED *Bodies*: On *Gunter's Sector*, are ſometimes placed two Lines anſwering one another, and called the *Lines of Inſcribed Bodies*, and are eaſily known there by the Letters *D*, *S*, *I*, *C*, *O*, *T*, which ſignify the *Dodecahedron*, *Sphere*, *Icoſihedron*, *Cube*, *Octahedron*, and *Tetrahedron*.

The *Uſes* of theſe Lines may be theſe.

1. *The Radius of a Sphere being given, to find the Sides of the Five Regular Bodies inſcribed in it.*

2. *The Side of any of the Five Regular Bodies given, to find the Radius of the Circumſcribing Sphere.*

If the Sphere be firſt given, apply its Radius over in the Points *S*, *S*, on each Leg of the Sector.

If any of the other Bodies be firſt given, apply its Side over between its proper Letters; ſo the Parallel taken between the Points of the other Bodies, ſhall be the Sides of thoſe Bodies, and may be inſcribed in the Sphere, whoſe Radius is the Diſtance between *S* and *S*.

INSCRIBED *Hyperbola*, is ſuch an one as lies entirely within the Angle of its Aſſymptotes; as the Conical Hyperbola doth.

INSECTIVOROUS *Animals*, are ſuch as feed on Inſects: See *Birds*.

INSECTS, a kind of living Creatures ſo called by *Ariſtotle* and *Pliny*; becauſe of their having certain *Inciſuræ*, Cuttings or Indentings, in and about their Bodies. The *Greeks* called them Ἔντομα. The Judicious Mr. *Ray* in his *Methodus Inſectorum* thus diſtinguiſhes the ſeveral Kinds of *Inſects*.

*Inſects* are (1.) either Ἀμεταμόρφωτα, or ſuch as do *not* change their Form; Or, (2.) Μεταμορφούμενα, ſuch as do really change their Form.

Thoſe that do not change their Form are either (1.) Ἄποδα without Feet, or (2.) *Pedata* with Feet; and of theſe there are ſome Kinds that caſt their Skins.

*Inſects* without Feet are either *Terreſtrial*, or *Land Inſects*, or *Aquatick*.

*Terreſtrial Inſects* are either ſuch as are produced on the *Land*, or in the *Earth*; and not in the *Water*; as the *Lumbrici Terreſtres*; which are either of the *larger ſort*, and are called *Dew-Worms*; or of a *ſmaller ſize*: And of theſe there are *Red* and *Green*, with Yellow Tails: Which laſt are commonly called *Gilt-Tails*.

Or ſuch as are found in the Bowels of *Animals*: And of theſe ſome are found in the *Inteſtines* of Men; as (1.) the *Lumbrici Teretes*; (2.) *Lumbrici Lati*, which are called alſo *Tæniæ*. (3.) *Cucurbitini*, which ſome will have to be only the Fragments of the *Tæniæ*: (See *Nich. Andri M. D. De Variis Vermium Speciebus.*) (4.) The *Aſcarides*, which are chiefly found in the *Rectum*.

Thoſe Worms that are found in the Inteſtines of Beaſts are of two ſorts, the *Oblongi* and *Pellucidi*, of the thickneſs of a Horſe-Hair; and therefore called *Vermiculi Setiformes*: And the *Breves* and *Craſſiores*, which often are found in Horſes, and are called the *Botts*.

To this *Genus* of *Terreſtrial Inſects* many Natural Hiſtorians refer *Snails*, whether with or without Shells.

*Water Inſects* without Feet, not changing Form, are either of the

*Greater ſort*, which have a peculiar way of moving, by firſt fixing their Head to the Ground, and then drawing up their Tail towards it, &c. Of theſe ſome are *Teretes*, round and ſmooth; of which are three ſorts; As the *Medicinal Hirudines*, or *Leaches*; the *common Black-Horſe-Leaches*, and the *Aſh-colour'd Sea-Leaches*: But there is alſo a ſort of this kind that is *ſmaller* and *flatter*, which is found ſticking to Stones in the Bottoms of little Brooks.

*Leſſer ſort*, which have a different way of crawling or moving from the former. Theſe alſo are either *Round* or *Flat*: Of the *Round* ſort there is one that is *Black*, with two ſmall Horns on its Head; and is found ſticking to wet Stones in the watery Tops of Hills: And another, which is *Red*, of about a Fingers's length, with a Forceps at the Tail, found at the Bottom of Fiſh-Ponds and ſtagnant Waters.

The *Flat ſort* are very ſmall and thin, and are called *Flukes*; being ſometimes found in Waters, and ſometimes in the Branches of the *Porus Bilarius* in Sheep.

*Inſects not changing Form, and having Feet*, are either (1.) *Hexapoda*, with ſix Feet; (2.) *Octapoda*, with eight Feet; (3.) with fourteen Feet; (4.) *Polypoda*, with many Feet.

Thoſe that have but ſix Feet are either,

1. *Terreſtrial*; and theſe of a *Larger kind*; As (1.) The Yellowiſh *Inſect* found in rotten decaying Oaks; (2.) The Black one on the Ground, called by *Mouffet*, *Vermivorous*; (3.) The Black one living under Ground, with a Forceps at the Tail; (4.) A White ſort, with ſquare black Spots on its Back; (5.) The *Farinarium*, bred in Meal, of a whitiſh Colour.

*Smaller ſort*: Some of which are found about the Bodies of *Animals*; As (1.) the *Cimex*, or *Wall-Louſe*, of a ſtinking Smell; (2.) *Ricinus*, the Tick; (3.) *Pediculus*, the Common Louſe; (4.) *Pediculus ferus* ſeu *Inguinalis*, the Crab-Louſe; (5.) *Pulex* the *Flea*; of all which there are various kinds.

Others are not troubleſome to Animals; as (1.) One that in Bigneſs and Figure reſembles a Louſe, but is very nimble and ſwift, and is found in Books and rotten Wood; (2.) Another there is with a very long Body, and a forcipitated Tail; (3.) The *Black Inſect*, found often in the Flowers of the *Chelidonium*; (4.) A Subterraneous ſort, a little whitiſh; (5.) One that skips like a Graſhopper, but is much leſs.

2. *Aquatick*. As (1.) the *Pediculus Marinus Grandis*, which adheres to Fiſhes; (2.) The *Squilla Fluviatilis*, with a Pyramidal Tail, and two Hairs, or Briſtles at the End.

*Inſects not changing Form, and having eight Feet*, are either *with a Tail*, as the *Scorpion*; or *without*, as the *Spider*; of which ſome ſpin no Web, have but two Eyes, and very long Legs, as the *Opilio*, or the Shepherd.

Some do ſpin a Web; and of theſe they count three ſorts: (1.) The *Aranea Colceſtrenſis Abdomine tumido, ſubrotundo & elato*; (2.) The *Spider* with the *Thorax*, or middle Part of its Body, as big as the *Abdomen*; (3.) The *Spider* with the long *Abdomen*, found among Reeds, Ruſhes, Graſs, &c.

2. The *Ricini Octopodes*, which are ſome more flat and compreſs'd; as the rambling Ticks that run o'er the Bodies of Animals, but don't faſten; and ſome more round and thick, which do adhere to the Skin.

3. The *Syrones* or Mites.

*Inſects not changing Form, and with fourteen Feet*, and therefore by Mr. *Ray* called Τεσσαρεσκαιδεκάποδα, are the *Aſelli*: Of which there are three ſorts: As,

1. The *Sea-Aſellus*; the longeſt and largeſt of all; living amongſt the Rocks.

2. *Aſellus Lividus*; which rolls itſelf up into a Ball. The Common Wood-Lice, Sows or Cheſs Buggs.

3. *Aſellus Aſininus*, with a forked Tail, not rolling itſelf up. To this Species may be added the *Aſellus Marinus Figuræ brevioris*, rolling itſelf up; (2.) *Aſellus Aquarum dulcium*, with long Legs, and two Briſtles on its Tail; (3.) *Pulex Aquaticus*, both in Freſh and Salt Water; (4.) *Pediculus Aquaticus*, which faſtens upon Fiſh.

*Inſects not changing Form, with twenty-four Feet.* Theſe have the eight Fore-Feet leſſer, and the ſixteen Hinder ones larger. There are two kinds of them obſerv'd, both with long Bodies, one larger, and of an obſcure Colour, among the Rocks by the Sea-ſides; the other of a Silver Colour, found in Houſes.

There

There is a Kind with thirty Feet, of an oblong Shape, Chesnut Colour, and full flattish Body, usually lying under Logs and Trunks of Trees. 'Tis very agile and swift.

*Insects not changing Form, with many Feet* (called πολύποδα) are some *on Land*; and either *roundish in Body*, with all their Legs rising out of the middle of the Belly (nearly) as the *Julus*; or more flat and compress'd, with their Legs not rising as before from a Point in the middle of their Body, but growing along on the Sides; as the *Scolopendra*. And some of this Kind are

*Aquatick*; of which Mr. *Ray* makes three Differences: (1.) the *Cornish Luggs*, used for Baits in catching Fish, with 38 Legs, and a smooth roundish Body; (2.) The *Scolopendra Marina, Corpore plano*; (3.) *Animalculum Bicorpor*, or rather *Bicaudatum*, lying in the Clefts of Stones under the Salt Water.

*Insects which do really undergo a Change of their Form* are called Μεταμορφόμενα; of which *Swammerdam* hath given the best Account: Tho' he shews that this Word is improperly used, since there is by no means any real Transformation, but only an Explication of the Parts of the Animal, latent before in Miniature (as it were in the *Ovum* or *Nympha*, like the Plant in the Seed) and an Encrease of all the Parts by proper Degrees.

The *first Species* of Transmutation or Change (which *Swammerdam* makes the *second*) is Instantaneous; there being no sensible *Rest* or *Stop* between the Old and the New Form. And the Insects of this *Order* don't lose their Motion at the Time that they shift the *Pellicula*, at least not to Appearance. And *Swammerdam* describes the second Order of Change to be, when the *Vermiculus* (leaving the former Shape of the *Nympha*, with which it appeared in the Egg, and subsisted without Food) now beginning to feed, hath its Members or Parts visibly increased, and stretched out, and takes the Form of a new *Nympha*, which is not without Motion; and from thence becomes a Flying *Insect*. Of this sort are,

1. The *Libellæ*, or *Perlæ*, which are produced from an *Insect* of six Feet, (*vid. Mouffet*, p. 322.) who takes it for the *Pulex Marinus*, as in the preceding Page he calls it the *Locusta Aquatica*. Out of the Crustaceous Skin, or Husk, of this *Insect*, the *Libella* breaks by a Fissure, which begins between the Eyes, and is continued to the Roots of the Wings, and is there join'd to the Lateral Fissures.

2. The *Cimices Silvestres*, whose Characteristick Marks (according to *Willoughby*) are (1.) A long *Proboscis*, not spiral, but strait; (2.) Their upper Wings to the middle are thick, and like Leather; thence to the Ends thin and membranous; (3.) There is the Figure of St. *Andrew*'s Cross on their Backs.

3. The *Locustæ*; which *Willoughby* refers to the *Insecta* Ἀμεταμόρφωτα.

4. The *Grylli Campestres*.

5. The *Grylli Domestici*, or *Crickets*.

6. The *Gryllo Talpa*, *Mole Cricket*.

7. The *Cicada*, or *Grashopper*.

8. The *Blatta*, according to *Swammerdam*.

9. The *Tipulæ Aquaticæ*, which run very swiftly on the Surface of the Water, and have a Sting in their Mouths like the *Cimices* or *Ticks*.

10. The *Scorpius Aquaticus*, with a Sting also in its Mouth.

11. The *Muscæ Aquaticæ*; called by *Androvandus*, *Apes Amphibiæ*.

12. The *Hemerobius*, or *Ephemera*, or *Diaria*, of *Swammerdam*.

13. The *Forficula*, or *Auricularia*. *Vid. Mouffet*, p. 175.

The *Second Species* of Transmutation includes such *Insects* as undergo a double Metamorphosis, or Change of Shape.

1. Into a *Chrysalis*, or something analogous to it.

2. Into a Flying *Insect*.

These Kinds of *Insects*, a while before their Change, lie quite still without Food or changing Place; and in respect of their Wings are

1. Κολεόπτερα, or *Vaginipennia*, as the *Scarabæi*, *Beetles*.

2. Ἀνέλυτρα, whose Wings are open and expanded: And the Wings of these are either *Farinaceous*, as the *Papiliones*, &c. or *Membranous*, as the *Apes*, *Muscæ*, &c. and these are either Δίπτερα, with two Wings, or Τετράπτερα, with four Wings.

The *Scarabæi* may be divided (1.) In respect of their Horns, into the *Nasicornis*, *Bucerota* and *Cervus Volans*, or *Taurus*. (2.) In respect of their *Antennæ*, they are of many kinds; of which the most eminent are those called *Capricorni*. (3.) With regard to their Motion, as the *Saltatrices*. (4.) With regard to their Colour, as *Cantharides*.

To the Beetle Kind may be referred the *Cicindela*, or Glow-Worm: The *Staphylinus*, called by *Willoughby* ἡμικολεόπτερον: The *Proscarabæus*, or *Oyl-Beetle*; so called from its emitting from its Joints a kind of Oyl, on its being pressed or squeezed.

The *Anelytra*, with farinaceous or mealy Wings, are called *Papiliones*, *Butter-flies*; and these are either *Diurnal*, or *Nocturnal*; or the *Phalæna*.

The Specifick Distinction of the *Diurnal* is, that they always settle with their Wings erect, are produced from an angulous *Aurelia*, and have their *Antennæ Studded* (*Clavatæ*.) Of these there are about 50 kinds observed in *England*.

The *Nocturnal* Butterflies, or the *Phalænæ*, are vastly numerous; and cannot very clearly be methodized. But for Memory and Distinction's sake they may be divided into,

1. The *Geometrigenæ*, which come from the *Eruca*, (called *Geometra*, from the manner of its Walk, which is *Ansatini*, by curling up its Back like the Handle of a Cup, &c.) with 8 or 10 Feet.

2. Such as come from *Erucæ*, with 14 Feet. Of this Kind, which is very numerous, there hath been distinguished the *Phalæna Fasciata*; whose Wings are in *Patches* or *Area's* of different Colours. *Phalæna Lineata*, whose Wings are marked with transverse Lines. *Phalæna Punctata*, whose Wings are mark'd with one or more Points. And these excepted, all the others are distinguished into *greater* and *lesser*, and of a middle size between both. One of the larger Kinds may be distinguish'd also by their inner Wings running out beyond the upper, when they sit or rest:

reſt: And another by the Appearance of the Figure of Eyes upon the Wings: And a third, by their long Tails and narrow ſharp Wings; which by ſome are called *Phalænæ Prædatrices*, or *Accipitrinæ*.

The *Anelytra*, with membranous Wings, are *Bees*, *Flies*, *Waſps*, *Bombylii*, *Crabrones*, &c. And to this Kind the *Culex Vulgaris* (*vid. Swammerdam*, p. 95. *Hiſt. Inſects*) or *Gnat* is referr'd; as alſo the *Formica*, or *Ant*.

And hither muſt be referr'd ſuch *Water Inſects* as are cover'd by a *Theca*; according to the Obſervations of *Willoughby*. And theſe have either

1. An *immoveable Theca*, or Caſe, which is fixed to the Stones; and this Caſe is either of a round Figure, or of one more compreſſed and flat.

2. A *moveable portable Theca*; and theſe are commonly called *Phryganea*.

And this *Theca* is either,

1. *Strait*; and that either compoſed of Straws and little *Feſtucæ*, lying parallel one to another; of which there are two kinds; a Greater, where the *Feſtucæ* are two Inches long; and a Leſſer, which is very common, and are called *Straw-Worms*: Or elſe the *Feſtucæ* lie tranſverſely, and are ſhorter; having ſometimes pieces of Shells and Stones intermix'd with them. Others, whoſe Caſes are *ſtrait* alſo, have no *Feſtucæ*; but always either Sand or Gravel. And of theſe, ſome have the *Thecæ round*, and are called *Cod-Baits*: Others are *flat* and *compreſſed*.

2. *Crooked or Horned*; which run tapering. Of theſe Mr. *Ray* reckons four kinds; a greater and leſſer Black ſort, and a greater and leſſer Aſh-colour'd one.

Theſe all produce Flies with large Wings, like Butter-flies.

The Third Species of *Tranſmutation* is a ſimple Change from a *Vermiculus* to a flying *Inſect*; but yet with a ſenſible ἀστία, *Reſt* or *Stop*, between one Form and the other.

This Change *Swammerdam* thus deſcribes:

" The *Vermicle*, excluded from the Egg, gets " Nouriſhment, by little and little, from with- " out; and under that *firſt Skin* or Covering hath " its Members increaſed by degrees; not ſlipping " it, or putting it off, as other *Vermiculi* do when " they change into *Nymphæ*, but aſſuming the " Figure of a *Nympha* in it: For a time 'tis quite " motionleſs, till the ſuperfluous Moiſture is eva- " porated, and then in a few Days recovers its " Motion again; and then caſting off this Skin, " which is as it were double, it becomes a Flie."

Of this Kind are our *Fleſh-Flies*; and all the *Nymphæ Vermiformes*; the *Veſpæ Ichneumones*, &c.

As to the *Generation* of *Inſects*, Dr. *George Gorden*, in *Philoſ. Tranſact.* N°. 237. from the Obſervations he had made about the true Origin of Caterpillars, concludes very well; (1.) That we ought not to believe that any *Inſects* are bred of Corruption, and not *ex Ovo*, only becauſe we cannot diſcern the particular Manner of their Propagation; becauſe there are and may be more full Diſcoveries made of that Kind accidentally, where the Proceſs is not viſible to the naked Eye. (2.) The Female *Inſects* of all Kinds of Flies and Butter-flies do put their Spawn near thoſe Places where the *Eruca's*, which are hatched out of them, are to have their Food. (3.) There is a kind of Gluten, by which the Female faſtens her Eggs to the bearing Buds of Trees, &c. ſo that the Rains cannot waſh them off. (4.) Theſe Eggs will not be hurt by the greateſt Froſt.

Mr. *Andry*, in his Book *De la Generation de Vers dans le Corps de l'Homme*, *Paris* 8vo. 1700. takes notice, that the Ancients were miſtaken in denying that *Inſects* did breath, on the Account of their wanting Lungs: For modern Obſervations do convince us, that *Inſects* have a greater Number of Lungs than other Animals. The Ancients thought alſo that *Inſects* had no Blood, becauſe many of them had no red Liquor like our Blood: But 'tis not the *Colour*, but the *Uſe* of the Liquor that is to be regarded. They believed alſo that *Inſects* had no *Hearts*; whereas our Microſcopes do now diſcover, that when *Inſects* have ſeveral Lungs, they have alſo ſeveral Hearts; and in particular 'tis found that Silk-Worms have a continued Chain of Hearts, from the Head almoſt to the very Extremity of the Tail. And 'tis this Number of Hearts and Lungs that occaſion thoſe *Inſects* to give Signs of Life a long while after they are divided into ſeveral Parts. He obſerves alſo that 'tis wrong to call *Inſects imperfect Animals*, ſince they want no Parts either neceſſary or convenient for their uſe, and to render them compleat in their Kind.

Mr. *Poupart* affirms that the Earth-Worms and Round-tail'd Worms, which are found in the Inteſtines of Men and Horſes, &c. alſo Snails and Horſe-Leaches, are *Hermophradites*; but that ſuch Worms as become Flies, and Silk-Worms, are not ſo, being of *no Sex*, but are Neſts full of real Animals, which we ſee in time come out with Wings. *Hiſtoire de l'Acadam. Royale des Sciences Anneé* 1699.

### Writers about Inſects.

*Hiſtoria Generalis Inſectorum, Pars prima.* By *J. Swammerdam. Ultraject.* 1669. 4to.

*Job. Goedartius de Inſectis cum Appendice.* By Dr. *Liſter.* 1682. 4to.

*Malpighius de Bombyce.*

*Experienze intorno alla Generatione de gl' Inſetti.* By *Fr. Redi.* 1668. 4to.

*Mouſeti Theatr. Inſectorum Lond.* 1634. *cum Fig.*

*Mart. Liſter Hiſtoriæ Animalium Angliæ Tres Tractatus: Unus de Uraneis; Alter de Cochleis, tum Terreſtribus tum Fluviatilibus; Tertius de Cochleis Marinis. Lond.* 1678. *Ejuſdem Exercitatio Anatomica de Cochleis & Limacibus. Lond.* 1694. 8vo.

INSINUATION *of a Will*, in the Civil Law, ſignifies the firſt Production of it, or the leaving it *Penes Regiſtrum*, in order to his Probate.

INSTALLMENT, is a Settlement or ſure Placing of any Perſon in his proper Place: See 20 *Car.* 2. *c.* 2. 'Tis ſometimes confounded in the Law with Abatement: The Word is chiefly uſed for the Induction of a Dean, Prebendary, or other Eccleſiaſtical Dignitary, into the Poſſeſſion of his *Stall*, or Proper Seat, in the Cathedral Church

Church to which he belongs. 'Tis ſometimes called *Inſtallation*.

INSTAURUM, is uſed in old Deeds for a Stock of Cattle; and was commonly taken for the whole Stock upon a Farm; as Cattle, Waggons, Ploughs, and all other Implements of Huſbandry. So *Inſtaurum Eccleſiæ* was uſed for the Books, Veſtments, and Utenſils belonging to a Church. And *Inſtaurata Terra* was Land ready ſtock'd with all things neceſſary for the Uſe of the Farmer. *Inſtauratio* is often uſed in this Senſe by our old Hiſtorians and M.S.

INSTITUTION, is the Act of the Biſhop, or one Commiſſioned to Act for him; whereby any Clerk is inveſted with the Spiritualities of a Rectory or Vicarage.

The Clerk kneels down before the Biſhop while he pronounces the Words of *Inſtitution*, (*Inſtituo te Rectorem Eccleſiæ de* A. B. *cum Cura Animarum, & accipe Curam tuam & meam*) and the Clerk holds the written Inſtrument, with the Epiſcopal Seal annexed, in his Hand during the Ceremony. But the Clerk muſt have *Induction* after this, without which he hath no Right to his *Temporalities*, if the Benefice be not a Donative.

Before the Clerk is Inſtituted, he muſt ſubſcribe the 39 *Articles of Religion*, in the Preſence of the Ordinary (or his Subſtitute:) And the Ordinary is not bound to Offer them, but the Clerk is to offer to Subſcribe them; and he muſt Subſcribe them without Reſerve, Exception or Qualification, or elſe his *Inſtitution* is *ipſo facto* void and null; and the Church is ſtill vacant.

At the ſame time the Ordinary requires the Clerk to ſubſcribe the other 2 *Articles* mention'd in *Can.* 26. about the King's Supremacy, and the Lawfulneſs and Uſe of the Liturgy.

The Clerk muſt alſo, before *Inſtitution*, ſubſcribe to that Part of the Declaration enjoin'd by the Act of Uniformity, 14 *Car.* 2. *c.* 4. *Viz. I will conform to the Liturgy of* England *as by Law eſtabliſh'd.*

Before *Inſtitution* he muſt alſo take the Oaths mention'd in the firſt *Statute* of *William* and *Mary*, c. 8. inſtead of the former Oaths of *Allegiance* and *Supremacy*, required by *Stat.* 1 *Eliz.* c. 1.

And then he muſt take the Oath againſt Simony, enjoin'd by *Can.* 40. and the Oath of Canonical Obedience. All this before *Inſtitution*.

And he is to have Certificates given him of his ſubſcribing the Declaration, contain'd in the Act of Uniformity, in *Engliſh*, in a diſtinct Inſtrument, under the Hand and Seal of the Biſhop; and of his other Subſcriptions and Oaths in *Latin*.

The Clerk ought to have, by all means, Witneſſes of his *Inſtitution*, his taking the Oaths, making Subſcriptions, *&c.* and therefore he ſhould deſire ſome preſent to write their Names on the Back of his Inſtruments; and make *Memorandums* who they are, and where they live.

The Church, by *Inſtitution*, is full, againſt all Perſons but the King; and the Clerk by it may enter upon the Glebe, and take the Tithes; but he cannot *Lett* or *Grant* them; nor *Sue* for them, if they are refuſed to be paid.

After *Inſtitution* the Clerk is to receive a written Mandate from the Ordinary to the Arch-Deacon, or other proper Perſon, in order to his *Induction*; which ſee.

INSTRUMENTS. Beſides the ſeveral uſeful *Inſtruments*, both Mathematical and Mechanical, which are deſcribed under their proper Names in this Volume and the former; I have at the End of this Volume given you the Figures and Deſcriptions of ſome others, which are not only very Curious and Accurate, but in a great meaſure alſo New and Non-deſcript.

INSULATA *Columna*, in Architecture, is a Pillar which ſtands alone, like an Iſland, as it were, in the vaſt Ocean of the Air. *Evelyn's Parallel.*

INSULT, is a Word uſed in the Military Art, for attacking any Poſt with open Force, without uſing Trenches, Saps, or any common Approaches. 'Tis uſual to *Inſult* thus the *Counterſcarp* of any Place, that they may not give the Enemy time to fire their Mines, which they have prepared.

INSUPER, is a Word uſed by the Auditors of the *Exchequer*: In their Accounts they ſay, So much remains *Inſuper* to ſuch an Accountant: That is, So much remains due on ſuch an Account.

INTAGLIO'S, are Precious Stones engraved with Heads of Great Men, or Inſcriptions, *&c.* ſuch as are often ſet in Rings, or Seals.

INTER *Canem & Lupum*, was an Expreſſion formerly uſed for *Twilight*. In the North this is called in ſome places *Day-light's Gate*; and in others, *betwixt Hawk and Buzzard*. In *Herefordſhire* 'tis called corruptly the *Muck-Shade*, i. e. *Mock-Shade*.

INTERDICT, was a Cenſure formerly inflicted by Biſhops or Ordinaries in Times of Popery; forbidding all Sacraments and Divine Offices (except Baptiſm to Children, and the Sacrament of the Euchariſt, and Extream Unction at the Point of Death) to be performed within any Pariſh, Town, Country, or Nation; and ſometimes they prohibited them within ſuch Places to be preſent at Divine Service in any other Place. This Cenſure was commonly inflicted on a Pretence that the Privileges of the *Church* had been violated by the Lords, Magiſtrates, or Princes of any Place or Nation. In the Reign of our King *John* this Kingdom lay under a Papal *Interdict* for above ſix Years together: It began *A. D.* 1208. In our Common Law the Word

INTERDICTION is uſed alſo in the ſame Senſe as in the Canon Law; where 'tis deſign'd to be *Cenſura Eccleſiaſtica prohibens adminiſtrationem divinorum*: And thus 'tis uſed 24 *H.* 8. c. 12.

INTEREST. Beſides the Ways of Computing *Intereſt*, both *Simple* and *Compound*, which you will find in Vol. I. I ſhall here give you another very plain, eaſy and ready Method, of Computing all *Simple Intereſt* and *Diſcount*; as alſo the Way to find the *Amount* or preſent Value of any Sum of Money; or of any *Annuity*, or other Yearly Payment, *&c.* for any *Term*, not exceeding an *Hundred Years*: And this from the Accurate and Uſeful Tables of Mr. *John Smart*, of the Town-Clerk's Office in *London*. And in order to this, the following Table of Shillings, Pence and Farthings, reduc'd to the Decimal Parts of a Pound, are previouſly neceſſary.

# SHILLINGS, PENCE, and FARTHINGS, reduc'd to the Decimal Parts of a POUND.

| s. | d. | Decimal Parts of a Pound. | s. | d. | Decimal Parts of a Pound. | s. | d. | Decimal Parts of a Pound. | s. | d. | Decimal Parts of a Pound. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | | — | — | | - 1 | - 2¼ | .059375 | - 1 | - 9½ | .089583 |
| — | —¼ | .001042 | — | - 7¼ | .030208 | - 1 | - 2½ | .060417 | - 1 | - 9¾ | .090625 |
| — | —½ | .002083 | — | - 7½ | .03125 | - 1 | - 2¾ | .061458 | - 1 | 10 | .091667 |
| — | —¾ | .003125 | — | - 7¾ | .032292 | - 1 | - 3 | .0625 | - 1 | 10¼ | .092708 |
| — | - 1 | .004167 | — | - 8 | .033333 | - 1 | - 3¼ | .063542 | - 1 | 10½ | .09375 |
| — | - 1¼ | .005208 | — | - 8¼ | .034375 | - 1 | - 3½ | .064583 | - 1 | 10¾ | .094792 |
| — | - 1½ | .00625 | — | - 8½ | .035417 | - 1 | - 3¾ | .065625 | - 1 | 11 | .095833 |
| — | - 1¾ | .007292 | — | - 8¾ | .036458 | - 1 | - 4 | .066667 | - 1 | 11¼ | .096875 |
| — | - 2 | .008333 | — | - 9 | .0375 | - 1 | - 4¼ | .067708 | - 1 | 11½ | .097917 |
| — | - 2¼ | .009375 | — | - 9¼ | .038542 | - 1 | - 4½ | .06875 | - 1 | 11¾ | .098958 |
| — | - 2½ | .010417 | — | - 9½ | .039583 | - 1 | - 4¾ | .069792 | - 2 | — | .1 |
| — | - 2¾ | .011458 | — | - 9¾ | .040625 | - 1 | - 5 | .070833 | - 3 | — | .15 |
| — | - 3 | .0125 | — | 10 | .041667 | - 1 | - 5¼ | .071875 | - 4 | — | .2 |
| — | - 3¼ | .013542 | — | 10¼ | .042708 | - 1 | - 5½ | .072917 | - 5 | — | .25 |
| — | - 3½ | .014583 | — | 10½ | .04375 | - 1 | - 5¾ | .073958 | - 6 | — | .3 |
| — | - 3¾ | .015625 | — | 10¾ | .044792 | - 1 | - 6 | .075 | - 7 | — | .35 |
| — | - 4 | .016667 | — | 11 | .045833 | - 1 | - 6¼ | .076042 | - 8 | — | .4 |
| — | - 4¼ | .017708 | — | 11¼ | .046875 | - 1 | - 6½ | .077083 | - 9 | — | .45 |
| — | - 4½ | .01875 | — | 11½ | .047917 | - 1 | - 6¾ | .078125 | 10 | — | .5 |
| — | - 4¾ | .019792 | — | 11¾ | .048958 | - 1 | - 7 | .079167 | 11 | — | .55 |
| — | - 5 | .020833 | - 1 | — | .05 | - 1 | - 7¼ | .080208 | 12 | — | .6 |
| — | - 5¼ | .021875 | - 1 | —¼ | .051042 | - 1 | - 7½ | .08125 | 13 | — | .65 |
| — | - 5½ | .022917 | - 1 | —½ | .052083 | - 1 | - 7¾ | .082292 | 14 | — | .7 |
| — | - 5¾ | .023958 | - 1 | —¾ | .053125 | - 1 | - 8 | .083333 | 15 | — | .75 |
| — | - 6 | .025 | - 1 | - 1 | .054167 | - 1 | - 8¼ | .084375 | 16 | — | .8 |
| — | - 6¼ | .026042 | - 1 | - 1¼ | .055208 | - 1 | - 8½ | .085417 | 17 | — | .85 |
| — | - 6½ | .027003 | - 1 | - 1½ | .05625 | - 1 | - 8¾ | .086458 | 18 | — | .9 |
| — | - 6¾ | .028125 | - 1 | - 1¾ | .057292 | - 1 | - 9 | .0875 | 19 | — | .95 |
| — | - 7 | .029167 | - 1 | - 2 | .058333 | - 1 | - 9¼ | .088542 | | | |

*Examples of the Use of the preceding* Table.

What Decimal Part of a Pound is 7 *d.*?
Look in the Table for 7 *d.* and even with it you will find .029167, which is the Decimal required.

What Decimal Part of a Pound is 17 *s.* 6 *d.*?
You will find the Decimal of 17 *s.* to be .85, and the Decimal of 6 *d.* to be .025; which added, makes .875, and answers the Question.

What is the Value of this Decimal .09375 in Shillings, Pence and Farthings?
Look in the Table, and you will find it to be 1 *s.* 10 *d.* ½.

*Note*, If you cannot find in the Table the exact Decimal sought for, take that which is neareſt to it, and you can never err above half a Farthing.

Knowing thus the Uſe of theſe Decimal Tables, all the Buſineſs of *Simple Intereſt* will very eaſily be underſtood and diſpatch'd as followeth.

## *Simple Intereſt.*

The *Yearly Intereſt* of any Sum of Money is had, by only multiplying the *Principal* Sum by the *Hundredth* part of the *Rate* of Intereſt: For the Product in Decimals is the true Anſwer.

### *Examples.*

1. *What is the Intereſt of* 75 *Pounds for one Year, at the Rate of* 6 l. per Cent.?

75 = Principal.
.06 = the Hundredth part of 6 *l.*

| *l.* | *s.* | *d.* |
|---|---|---|
| 4.50 the Product; which is 4 | 10 | 00 |

2. *What*

2. *What is the Yearly Intereſt of* 157 *l.* 17 *s.* 6 *d.* *at* 5 *l.* per Cent. ?

157.875 is the Decimal for 157 *l.* 17 *s.* 6 *d.*
.05 the Hundredth part of 5 Pounds.

7.89375 which is the Decimal anſwering to 7 *l.* 17 *s.* 10 ½ *d.* the Intereſt of 157 *l.* 17 *s.* 6 *d.* for one Year at 5 *l.* per Cent.

And ſo for any other *Rate* or Sum whatſoever.

When thus the Intereſt for one Year is found, divide it by 365; the Quotient will be the Intereſt for one Day.

Thus .01 being the Intereſt of one Pound for one Year; if you Divide that Decimal by 365 (continuing the Work as long as you pleaſe) you will have .0000273972602*8*, *&c.* —·— for a Quotient; which will be the Intereſt of *one* Pound for *one* Day; and at *one per Cent.*

Then will this Decimal .000027, *&c.* found as above; if you multiply it continually by the *Principal*, the *Number of Days*, and the *Rate of Intereſt*, become of itſelf an Intereſt Table for *any Sum* of Money, for *any Time*, and at *any Rate.*

*Example.*

*What is the Intereſt of* 150 *l. for* 365 *Days, at* 6 *l.* per Cent. ?

| | |
|---|---|
| .000027397260**2**8 | |
| | 150 |
| 4109589042**0**0 | |
| | 365 |
| 150000000033000 | |
| | 6 |
| 9.000000000198000 | |

Which Decimal gives the Anſwer near enough for any Uſe, to be 9 Pounds.

By the ſame Rule .02 Divided by 365, will give in the Quotient the Intereſt of one Pound for one Day, at 2 *per Cent.* and .03 Divided by 365, will do the ſame at 3 *per Cent.* And thus theſe Numbers following were found.

*The Intereſt of one Pound for one Day, at all Rates, from* 1, *to* 10 per Cent.

| | |
|---|---|
| At 1 *l. per Cent.* is | .0000273972602 *&c.* as above. |
| 2 | .0000547945**1**2 |
| 3 | .0000821917**8**1 |
| 4 | .0001095890**4**1 |
| 5 | .0001369863**0**1 |
| 6 | .0001643835**6**2 |
| 7 | .0001917808**2**2 |
| 8 | .0002191780**8**2 |
| 9 | .0002465753**4**2 |
| 10 | .0002739726**0**3 |
| | *&c.* |

And when thus the *Intereſt* of *one* Pound for *one* Day, and at any *Rate*, is found; Then that *Intereſt* multiplied by 2, 3, 4, 5, 6, 7, 8, and 9, *&c.* gives the Intereſt of any Sum of Money, at the ſame Rate.

*Take an Example at* 3 l. per Cent.

| | |
|---|---|
| Intereſt of 1 *l.* for one Day, is | .0000821917**8** |
| 2 | .0001643835**6** |
| 3 | .0002465753**4** |
| 4 | .0003287671**2** |
| 5 | .0004109589**0** |
| 6 | .0004931506**8** |
| 7 | .0005753424**6** |
| 8 | .0006575342**4** |
| 9 | .0007397260**2** |

And then 'tis eaſy to find, that the Intereſt of 1 *l.* being, as before, .000082, *&c.* That of

| | |
|---|---|
| 10 will be | .000822* |
| 100 | .008219 |
| 1000 | .082192* |
| 10000 | .821918* |
| 100000 | 8.219178 |
| 1000000 | 82.191781 |

Becauſe moving the Point of Separation ſtill one Place nearer to the Left Hand, multiplies any Decimal by 10, 100, 1000, *&c.* as is ſhewn under *Decimals.*

And thus the following Tables of *Daily Intereſt* were made.

The Reaſon of the Stars above, ſet to ſome of the Numbers, is only to ſhew that in the Contraction of a Decimal Fraction to fewer places, is is proper to add one to the laſt Figure retain'd, when the next Figure to it, which is omitted, exceeded 5.

## INTEREST for One Day, at 3, 4, 5, and 6 Pound *per Cent. per Annum.*

| *At 3 l. per Cent. per An.* | | *At 4 l. per Cent per An.* | | *At 5 l. per Cent. per An* | | *At 6 l. per Cent. per An.* | |
|---|---|---|---|---|---|---|---|
| Principal. | Interest. | Principal. | Interest. | Principal. | Interest. | Principal. | Interest. |
| 10000000 | 821.9178 | 10000000 | 1095.8904 | 10000000 | 1369.8630 | 10000000 | 1643.8356 |
| 9000000 | 739.7260 | 9000000 | 986.3014 | 9000000 | 1232.8767 | 9000000 | 1479.4521 |
| 8000000 | 657.5342 | 8000000 | 876.7123 | 8000000 | 1095.8904 | 8000000 | 1315.0685 |
| 7000000 | 575.3425 | 7000000 | 767.1233 | 7000000 | 958.9041 | 7000000 | 1150.6849 |
| 6000000 | 493.1507 | 6000000 | 657.5342 | 6000000 | 821.9178 | 6000000 | 986.3014 |
| 5000000 | 410.9589 | 5000000 | 547.9452 | 5000000 | 684.9315 | 5000000 | 821.9178 |
| 4000000 | 328.7671 | 4000000 | 438.3562 | 4000000 | 547.9452 | 4000000 | 657.5342 |
| 3000000 | 246.5753 | 3000000 | 328.7671 | 3000000 | 410.9589 | 3000000 | 493.1507 |
| 2000000 | 164.3836 | 2000000 | 219.1781 | 2000000 | 273.9726 | 2000000 | 328.7671 |
| 1000000 | 82.1918 | 1000000 | 109.5890 | 1000000 | 136.9863 | 1000000 | 164.3836 |
| 900000 | 73.9726 | 900000 | 98.6301 | 900000 | 123.2877 | 900000 | 147.9452 |
| 800000 | 65.7534 | 800000 | 87.6712 | 800000 | 109.5890 | 800000 | 131.5068 |
| 700000 | 57.5342 | 700000 | 76.7123 | 700000 | 95.8904 | 700000 | 115.0685 |
| 600000 | 49.3151 | 600000 | 65.7534 | 600000 | 82.1918 | 600000 | 98.6301 |
| 500000 | 41.0959 | 500000 | 54.7945 | 500000 | 68.4932 | 500000 | 82.1918 |
| 400000 | 32.8767 | 400000 | 43.8356 | 400000 | 54.5945 | 400000 | 65.7534 |
| 300000 | 24.6575 | 300000 | 32.8767 | 300000 | 41.0959 | 300000 | 49.3151 |
| 200000 | 16.4384 | 200000 | 21.9178 | 200000 | 27.3973 | 200000 | 32.8767 |
| 100000 | 8.2192 | 100000 | 10.9589 | 100000 | 13.6986 | 100000 | 16.4384 |
| 90000 | 7.3973 | 90000 | 9.8630 | 90000 | 12.3288 | 90000 | 14.7945 |
| 80000 | 6.5753 | 80000 | 8.7671 | 80000 | 10.9589 | 80000 | 13.1507 |
| 70000 | 5.7534 | 70000 | 7.6712 | 70000 | 9.5890 | 70000 | 11.5068 |
| 60000 | 4.9315 | 60000 | 6.5753 | 60000 | 8.2192 | 60000 | 9.8630 |
| 50000 | 4.1096 | 50000 | 5.4795 | 50000 | 6.8493 | 50000 | 8.2192 |
| 40000 | 3.2877 | 40000 | 4.3836 | 40000 | 5.4795 | 40000 | 6.5753 |
| 30000 | 2.4658 | 30000 | 3.2877 | 30000 | 4.1096 | 30000 | 4.9315 |
| 20000 | 1.6438 | 20000 | 2.1918 | 20000 | 2.7397 | 20000 | 3.2877 |
| 10000 | .8219 | 10000 | 1.0959 | 10000 | 1.3699 | 10000 | 1.6438 |
| 9000 | .7397 | 9000 | .9863 | 9000 | 1.2329 | 9000 | 1.4795 |
| 8000 | .6575 | 8000 | .8767 | 8000 | 1.0959 | 8000 | 1.3151 |
| 7000 | .5753 | 7000 | .7671 | 7000 | .9589 | 7000 | 1.1507 |
| 6000 | .4932 | 6000 | .6575 | 6000 | .8219 | 6000 | .9863 |
| 5000 | .4110 | 5000 | .5479 | 5000 | .6849 | 5000 | .8219 |
| 4000 | .3288 | 4000 | .4384 | 4000 | .5479 | 4000 | .6575 |
| 3000 | .2466 | 3000 | .3288 | 3000 | .4110 | 3000 | .4932 |
| 2000 | .1644 | 2000 | .2192 | 2000 | .2740 | 2000 | .3288 |
| 1000 | .0822 | 1000 | .1096 | 1000 | .1370 | 1000 | .1644 |
| 900 | .0740 | 900 | .0986 | 900 | .1233 | 900 | .1479 |
| 800 | .0658 | 800 | .0877 | 800 | .1096 | 800 | .1315 |
| 700 | .0575 | 700 | .0767 | 700 | .0959 | 700 | .1151 |
| 600 | .0493 | 600 | .0658 | 600 | .0822 | 600 | .0986 |
| 500 | .0411 | 500 | .0548 | 500 | .0685 | 500 | .0822 |
| 400 | .0329 | 400 | .0438 | 400 | .0548 | 400 | .0658 |
| 300 | .0247 | 300 | .0329 | 300 | .0411 | 300 | .0493 |
| 200 | .0164 | 200 | .0219 | 200 | .0274 | 200 | .0329 |
| 100 | .0082 | 100 | .0110 | 100 | .0137 | 100 | .0164 |
| 90 | .0074 | 90 | .0099 | 90 | .0123 | 90 | .0148 |
| 80 | .0066 | 80 | .0088 | 80 | .0110 | 80 | .0132 |
| 70 | .0058 | 70 | .0077 | 70 | .0096 | 70 | .0115 |
| 60 | .0049 | 60 | .0066 | 60 | .0082 | 60 | .0099 |
| 50 | .0041 | 50 | .0055 | 50 | .0068 | 50 | .0082 |
| 40 | .0033 | 40 | .0044 | 40 | .0055 | 40 | .0066 |
| 30 | .0025 | 30 | .0033 | 30 | .0041 | 30 | .0049 |
| 20 | .0016 | 20 | .0022 | 20 | .0027 | 20 | .0033 |
| 10 | .0008 | 10 | .0011 | 10 | .0014 | 10 | .0016 |
| 9 | .0007 | 9 | .0010 | 9 | .0012 | 9 | .0015 |
| 8 | .0007 | 8 | .0009 | 8 | .0011 | 8 | .0013 |
| 7 | .0006 | 7 | .0008 | 7 | .0010 | 7 | .0012 |
| 6 | .0005 | 6 | .0007 | 6 | .0008 | 6 | .0010 |
| 5 | .0004 | 5 | .0005 | 5 | .0007 | 5 | .0008 |
| 4 | .0003 | 4 | .0004 | 4 | .0005 | 4 | .0007 |
| 3 | .0002 | 3 | .0003 | 3 | .0004 | 3 | .0005 |
| 2 | .0002 | 2 | .0002 | 2 | .0003 | 2 | .0003 |
| 1 | .0001 | 1 | .0001 | 1 | .0001 | 1 | .0002 |

## INTEREST for One Day, at 7, 8, 9, and 10 Pound *per Cent. per Annum.*

| *At 7 l. per Cent. per An.* | | *At 8 l. per Cent per An.* | | *At 9 l. per Cent. per An* | | *At 10 l. per Cent. per An.* | |
|---|---|---|---|---|---|---|---|
| Principal. | Interest. | Principal. | Interest. | Principal. | Interest. | Principal. | Interest. |
| 10000000 | 917.8082 | 10000000 | 2191.7808 | 10000000 | 2465.7534 | 10000000 | 2739.7260 |
| 9000000 | 726.0274 | 9000000 | 1972.6027 | 9000000 | 2219.1781 | 9000000 | 2465.7534 |
| 8000000 | 1534.2466 | 8000000 | 1753.4247 | 8000000 | 1972.6027 | 8000000 | 2191.7808 |
| 7000000 | 1342.4658 | 7000000 | 1534.2466 | 7000000 | 1726.0274 | 7000000 | 1917.8082 |
| 6000000 | 1150.6849 | 6000000 | 1315.0685 | 6000000 | 1479.4521 | 6000000 | 1643.8356 |
| 5000000 | 958.9041 | 5000000 | 1095.8904 | 5000000 | 1232.8767 | 5000000 | 1369.8630 |
| 4000000 | 767.1233 | 4000000 | 876.7123 | 4000000 | 986.3014 | 4000000 | 1095.8904 |
| 3000000 | 575.3425 | 3000000 | 657.5342 | 3000000 | 739.7260 | 3000000 | 821.9178 |
| 2000000 | 383.5616 | 2000000 | 438.3562 | 2000000 | 493.1507 | 2000000 | 547.9452 |
| 1000000 | 191.7808 | 1000000 | 219.1781 | 1000000 | 246.5753 | 1000000 | 273.9726 |
| 900000 | 172.6027 | 900000 | 197.2603 | 900000 | 221.9178 | 900000 | 246.5753 |
| 800000 | 153.4247 | 800000 | 175.3425 | 800000 | 197.2603 | 800000 | 219.1781 |
| 700000 | 134.2466 | 700000 | 153.4247 | 700000 | 172.6027 | 700000 | 191.7808 |
| 600000 | 115.0685 | 600000 | 131.5068 | 600000 | 147.9452 | 600000 | 164.3836 |
| 500000 | 95.8904 | 500000 | 109.5890 | 500000 | 123.2877 | 500000 | 136.9863 |
| 400000 | 76.7123 | 400000 | 87.6712 | 400000 | 98.6301 | 400000 | 109.5890 |
| 300000 | 57.5342 | 300000 | 65.7534 | 300000 | 73.9726 | 300000 | 82.1918 |
| 200000 | 38.3562 | 200000 | 43.8356 | 200000 | 49.3151 | 200000 | 54.7945 |
| 100000 | 19.1781 | 100000 | 21.9178 | 100000 | 24.6575 | 100000 | 27.3973 |
| 90000 | 17.2603 | 90000 | 19.7260 | 90000 | 22.1918 | 90000 | 24.6575 |
| 80000 | 15.3425 | 80000 | 17.5342 | 80000 | 19.7260 | 80000 | 21.9178 |
| 70000 | 13.4247 | 70000 | 15.3425 | 70000 | 17.2603 | 70000 | 19.1781 |
| 60000 | 11.5068 | 60000 | 13.1507 | 60000 | 14.7945 | 60000 | 16.4384 |
| 50000 | 9.5890 | 50000 | 10.9589 | 50000 | 12.3288 | 50000 | 13.6986 |
| 40000 | 7.6712 | 40000 | 8.7671 | 40000 | 9.8630 | 40000 | 10.9589 |
| 30000 | 5.7534 | 30000 | 6.5753 | 30000 | 7.3973 | 30000 | 8.2192 |
| 20000 | 3.8356 | 20000 | 4.3836 | 20000 | 4.9315 | 20000 | 5.4795 |
| 10000 | 1.9178 | 10000 | 2.1918 | 10000 | 2.4658 | 10000 | 2.7397 |
| 9000 | 1.7260 | 9000 | 1.9726 | 9000 | 2.2192 | 9000 | 2.4658 |
| 8000 | 1.5342 | 8000 | 1.7534 | 8000 | 1.9726 | 8000 | 2.1918 |
| 7000 | 1.3425 | 7000 | 1.5342 | 7000 | 1.7260 | 7000 | 1.9178 |
| 6000 | 1.1507 | 6000 | 1.3151 | 6000 | 1.4795 | 6000 | 1.6438 |
| 5000 | .9589 | 5000 | 1.0959 | 5000 | 1.2329 | 5000 | 1.3699 |
| 4000 | .7671 | 4000 | .8767 | 4000 | .9863 | 4000 | 1.0959 |
| 3000 | .5753 | 3000 | .6575 | 3000 | .7397 | 3000 | .8219 |
| 2000 | .3836 | 2000 | .4384 | 2000 | .4932 | 2000 | .5479 |
| 1000 | .1918 | 1000 | .2192 | 1000 | .2466 | 1000 | .2740 |
| 900 | .1726 | 900 | .1973 | 900 | .2219 | 900 | .2466 |
| 800 | .1534 | 800 | .1753 | 800 | .1973 | 800 | .2192 |
| 700 | .1342 | 700 | .1534 | 700 | .1726 | 700 | .1918 |
| 600 | .1151 | 600 | .1315 | 600 | .1479 | 600 | .1644 |
| 500 | .0959 | 500 | .1096 | 500 | .1233 | 500 | .1370 |
| 400 | .0767 | 400 | .0877 | 400 | .0986 | 400 | .1096 |
| 300 | .0575 | 300 | .0658 | 300 | .0740 | 300 | .0822 |
| 200 | .0384 | 200 | .0438 | 200 | .0493 | 200 | .0548 |
| 100 | .0192 | 100 | .0219 | 100 | .0247 | 100 | .0274 |
| 90 | .0173 | 90 | .0197 | 90 | .0222 | 90 | .0247 |
| 80 | .0153 | 80 | .0175 | 80 | .0197 | 80 | .0219 |
| 70 | .0134 | 70 | .0153 | 70 | .0173 | 70 | .0192 |
| 60 | .0115 | 60 | .0132 | 60 | .0148 | 60 | .0164 |
| 50 | .0096 | 50 | .0110 | 50 | .0123 | 50 | .0137 |
| 40 | .0077 | 40 | .0088 | 40 | .0099 | 40 | .0110 |
| 30 | .0058 | 30 | .0066 | 30 | .0074 | 30 | .0082 |
| 20 | .0038 | 20 | .0044 | 20 | .0049 | 20 | .0055 |
| 10 | .0019 | 10 | .0022 | 10 | .0025 | 10 | .0027 |
| 9 | .0017 | 9 | .0020 | 9 | .0022 | 9 | .0025 |
| 8 | .0015 | 8 | .0018 | 8 | .0020 | 8 | .0022 |
| 7 | .0013 | 7 | .0015 | 7 | .0017 | 7 | .0019 |
| 6 | .0012 | 6 | .0013 | 6 | .0015 | 6 | .0016 |
| 5 | .0010 | 5 | .0011 | 5 | .0012 | 5 | .0014 |
| 4 | .0008 | 4 | .0009 | 4 | .0010 | 4 | .0011 |
| 3 | .0006 | 3 | .0007 | 3 | .0007 | 3 | .0008 |
| 2 | .0004 | 2 | .0004 | 2 | .0005 | 2 | .0005 |
| 1 | .0002 | 1 | .0002 | 1 | .0002 | 1 | .0003 |

*The Use of the preceding Tables.*

When the Intereſt of any Sum of Money is required for any Number of Days, multiply the Principal Sum by the Number of Days; and the Intereſt of that Product for one Day anſwers the Queſtion.

For, the Intereſt of one Pound for one hundred Days, is equal to the Intereſt of one hundred Pounds for one Day.

*Example.*

*What is the Intereſt of* 265 l. *for* 438 *Days, at* 6 l. per Cent. per Ann.?

265 *l.* Multiply'd by 438, (the Number of Days) the Product will be 116070 *l.* the Intereſt of which Sum take out of the Table of 6 *l. per Cent.* thus;

| | |
|---|---|
| The Intereſt for one Day of 100000 is | 16.4384 |
| 10000 is | 1.6438 |
| 6000 is | .9863 |
| 70 is | .0115 |
| Principal 116070 Int. | 19.0800 |

Anſwer 19 *l.* 1 *s.* 7¼ *d.*

And thus, by theſe Tables, the Intereſt of any Sum of Money, for any Time, and at any Rate of Intereſt, from 3 *l.* to 10 *l. per Cent. per Ann.* is readily found.

For the more eaſy finding the Number of Days, from any one time given, to any other, the following Table is made.

*The Number of Days from any Day in any one Month, to the ſame Day in any other Month.*

| From | January | Febru. | March | April | May | June | July | Auguſt | Septem. | Octob. | Novem. | Decem. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To | Feb. 31 | Mar. 28 | Apr. 31 | May 30 | June 31 | July 30 | Aug. 31 | Sept. 31 | Oct. 30 | Nov. 31 | Dec. 30 | Jan. 31 |
| | Mar. 59 | Apr. 59 | May 61 | June 61 | July 61 | Aug. 61 | Sept. 62 | Oct. 61 | Nov. 61 | Dec. 61 | Jan. 61 | Feb. 62 |
| | Apr. 90 | May 89 | June 92 | July 91 | Aug. 92 | Sept. 92 | Oct. 92 | Nov. 92 | Dec. 91 | Jan. 92 | Feb. 92 | Mar. 90 |
| | May 120 | June 120 | July 122 | Aug. 122 | Sept. 123 | Oct. 122 | Nov. 123 | Dec. 122 | Jan. 122 | Feb. 123 | Mar. 120 | Apr. 121 |
| | June 151 | July 150 | Aug. 153 | Sept. 153 | Oct. 153 | Nov. 153 | Dec. 153 | Jan. 153 | Feb. 153 | Mar. 151 | Apr. 151 | May 151 |
| | July 181 | Aug. 181 | Sep. 184 | Oct. 183 | Nov. 184 | Dec. 183 | Jan. 184 | Feb. 184 | Mar. 181 | Apr. 182 | May 181 | June 182 |
| | Aug. 212 | Sep. 212 | Oct. 214 | Nov. 214 | Dec. 214 | Jan. 214 | Feb. 215 | Mar. 212 | Apr. 212 | May 212 | June 212 | July 212 |
| | Sep. 243 | Oct. 242 | Nov. 245 | Dec. 244 | Jan. 245 | Feb. 245 | Mar. 243 | Apr. 243 | May 242 | June 243 | July 242 | Aug. 243 |
| | Oct. 273 | Nov. 273 | Dec. 275 | Jan. 275 | Feb. 276 | Mar. 273 | Apr. 274 | May 273 | June 273 | July 273 | Aug. 273 | Sept. 274 |
| | Nov. 304 | Dec. 303 | Jan. 306 | Feb. 306 | Mar. 304 | Apr. 304 | May 304 | June 304 | July 303 | Aug. 304 | Sept. 304 | Oct. 304 |
| | Dec. 334 | Jan. 334 | Feb. 337 | Mar. 334 | Apr. 335 | May 334 | June 335 | July 334 | Aug. 334 | Sept. 335 | Oct. 334 | Nov. 335 |
| | Jan. 365 | Feb. 365 | Mar. 365 | Apr. 365 | May 365 | June 365 | July 365 | Aug. 365 | Sept. 365 | Oct. 365 | Nov. 365 | Dec. 365 |

This Table ſhews the Number of Days, from any Day in any one Month, to the ſame Day in any other Month; as from the 1ſt, 5th, 10th, or 20th of *May*, to the 1ſt, 5th, 10th, or 20th of *November*, is 184 Days: Which is thus known.

I find *May* at the Head of one of the Columns; and looking down that Column, I find *November*, and even with it 184.

But if the Queſtion is from the 5th of *May*, to the 10th of *November*, I muſt add 5; and the Number of Days will be 189. On the contrary, if it be demanded from the 10th of *May*, to the 5th of *November*, 5 muſt be ſubtracted, and the Number will be 179. And thus any Number of Days, not exceeding a Year, are found by Inſpection.

If the Time exceed a Year; as from the 10th of *May* 1706, to the 10th of November 1707, add 365 to the Number found in the Table, and the Anſwer will be 549 Days.

And as you may thus very eaſily, and accurately enough, ſolve all Queſtions and Caſes of *Simple Intereſt*; ſo he next ſhews how to find *the Diſcount* of *any Sum* of Money for *any Time*, and at *any Rate* of *Intereſt*, thus.

1. To find the Annual Diſcount of one Pound, at 1 *l. per Cent.* Divide .01 by 1.01. If at 2 *per Cent.* Divide .02 by 1.02. At 3 *per Cent.* Divide .03 by 1.03, *&c.* and the Quotients will be the ſeveral *Diſcounts* required.

Thus the Diſcount of one Pound for one Year at

| | *l.* |
|---|---|
| 1 *per Cent.* | .009900990099 |
| 2 — — | .019607843137 |
| 3 — — | .029126213592 |
| 4 — — | .038461538462 |
| 5 — — | .047619047619 |
| 6 — — | .056603773585 |
| 7 — — | .065420560748 |
| 8 — — | .074074074074 |
| 9 — — | .082568807339 |
| 10 — — | .090909090909 |

And then the Diſcount of 1 *l.* being multiply'd by any *Principal Sum*, the Product will be the *Annual Diſcount* of that Principal.

*Example.*

*What is the Diſcount of* 100 l. *at* 6 l. per Cent. per Annum? .05660,

.05660, &c. being the Discount of 1 *l.* for one Year, at the Rate of 6 *per Cent.* as above; that multiplied by 100 *l.* will produce 5.5660377, &c. Which Decimal being reduced, gives us 5 *l.* 13 *s.* 2 $\frac{1}{2}$ *d.* and no more: And therefore that is to be look'd upon as the true Discount of 100 *l.* at 6 *l. per Cent.* for one Year.

And yet nothing is more common, than to allow 6 *l.* for the Discount of 100 *l.* for a Year, at 6 *l. per Cent.* But he that doth so, certainly wrongs himself: For he ought to receive so much Money as, at 6 *l. per Cent.* Interest, will amount to 100 *l.* in one Year, which less than 94 *l.* 6 *s.* 9 $\frac{1}{2}$ *d.* will not do.

The several Discounts of 1 *l.* for one Year (as above) and at the aforesaid Rates, being divided by 365, will give the Discounts for one Day, at the same Rates; *Viz.*

The Discount for one Day at

| | |
|---|---|
| 1 *l. per Cent.* | .000027126000 |
| 2 — — — | .000053720118 |
| 3 — — — | .000079797845 |
| 4 — — — | .000105374078 |
| 5 — — — | .000130463144 |
| 6 — — — | .000155078832 |
| 7 — — — | .000179234413 |
| 8 — — — | .000202942669 |
| 9 — — — | .000226215911 |
| 10 — — — | .000249066002 |

And when thus the Discount of *one Pound* for *one Day*, and at any *Rate*, is found; if you multiply that by 2, 3, 4, 5, 6, &c. it will give the Discount of any Sum of Money whatsoever at the same Rate.

*Examples at* 3 per Cent.

The Discount for one Day of

| | |
|---|---|
| 1 *l.* - is — | .000079797845 |
| 2 — — | .000159595691 |
| 3 — — | .000239393536 |
| 4 — — | .000319191382 |
| 5 — — | .000398989227 |
| 6 — — | .000478787073 |
| 7 — — | .000558584918 |
| 8 — — | .000638382764 |
| 9 — — | .000718180609 |
| 10 — — | .000797978455 |
| 100 — — | .007979784546 |
| 1000 — — | .079797845458 |

&c.

And after this manner the following Tables of Discount are framed.

# DISCOUNT for One Day, at 3, 4, 5, and 6 Pound *per Cent.* *per Annum.*

| *At 3 l. per Cent. per An.* | |
|---|---|
| Principal. | Discount. |
| 10000000 | 797.9785 |
| 9000000 | 718.1806 |
| 8000000 | 638.3828 |
| 7000000 | 558.5849 |
| 6000000 | 478.7871 |
| 5000000 | 398.9892 |
| 4000000 | 319.1914 |
| 3000000 | 239.3935 |
| 2000000 | 159.5957 |
| 1000000 | 79.7978 |
| 900000 | 71.8181 |
| 800000 | 63.8383 |
| 700000 | 55.8585 |
| 600000 | 47.8787 |
| 500000 | 39.8989 |
| 400000 | 31.9191 |
| 300000 | 23.9394 |
| 200000 | 15.9596 |
| 100000 | 7.9798 |
| 90000 | 7.1818 |
| 80000 | 6.3838 |
| 70000 | 5.5858 |
| 60000 | 4.7879 |
| 50000 | 3.9899 |
| 40000 | 3.1919 |
| 30000 | 2.3939 |
| 20000 | 1.5960 |
| 10000 | .7980 |
| 9000 | .7182 |
| 8000 | .6384 |
| 7000 | .5586 |
| 6000 | .4788 |
| 5000 | .3990 |
| 4000 | .3192 |
| 3000 | .2394 |
| 2000 | .1596 |
| 1000 | .0798 |
| 900 | .0718 |
| 800 | .0638 |
| 700 | .0559 |
| 600 | .0479 |
| 500 | .0399 |
| 400 | .0319 |
| 300 | .0239 |
| 200 | .0160 |
| 100 | .0080 |
| 90 | .0072 |
| 80 | .0064 |
| 70 | .0056 |
| 60 | .0048 |
| 50 | .0040 |
| 40 | .0032 |
| 30 | .0024 |
| 20 | .0016 |
| 10 | .0008 |
| 9 | .0007 |
| 8 | .0006 |
| 7 | .0006 |
| 6 | .0005 |
| 5 | .0004 |
| 4 | .0003 |
| 3 | .0002 |
| 2 | .0002 |
| 1 | .0001 |

| *At 4 l. per Cent. per An.* | |
|---|---|
| Principal. | Discount. |
| 10000000 | 1053.7408 |
| 9000000 | 948.3667 |
| 8000000 | 842.9926 |
| 7000000 | 737.6185 |
| 6000000 | 632.2445 |
| 5000000 | 526.8704 |
| 4000000 | 421.4963 |
| 3000000 | 316.1222 |
| 2000000 | 210.7482 |
| 1000000 | 105.3741 |
| 900000 | 94.8367 |
| 800000 | 84.2993 |
| 700000 | 73.7619 |
| 600000 | 63.2244 |
| 500000 | 52.6870 |
| 400000 | 42.1496 |
| 300000 | 31.6122 |
| 200000 | 21.0748 |
| 100000 | 10.5374 |
| 90000 | 9.4837 |
| 80000 | 8.4299 |
| 70000 | 7.3762 |
| 60000 | 6.3224 |
| 50000 | 5.2687 |
| 40000 | 4.2150 |
| 30000 | 3.1612 |
| 20000 | 2.1075 |
| 10000 | 1.0537 |
| 9000 | .9484 |
| 8000 | .8430 |
| 7000 | .7376 |
| 6000 | .6322 |
| 5000 | .5269 |
| 4000 | .4215 |
| 3000 | .3161 |
| 2000 | .2107 |
| 1000 | .1054 |
| 900 | .0948 |
| 800 | .0843 |
| 700 | .0738 |
| 600 | .0632 |
| 500 | .0527 |
| 400 | .0421 |
| 300 | .0316 |
| 200 | .0211 |
| 100 | .0105 |
| 90 | .0095 |
| 80 | .0084 |
| 70 | .0074 |
| 60 | .0063 |
| 50 | .0053 |
| 40 | .0042 |
| 30 | .0032 |
| 20 | .0021 |
| 10 | .0011 |
| 9 | .0009 |
| 8 | .0008 |
| 7 | .0007 |
| 6 | .0006 |
| 5 | .0005 |
| 4 | .0004 |
| 3 | .0003 |
| 2 | .0002 |
| 1 | .0001 |

| *At 5 l. per Cent. per An* | |
|---|---|
| Principal. | Discount. |
| 10000000 | 1304.6314 |
| 9000000 | 1174.1683 |
| 8000000 | 1043.7052 |
| 7000000 | 913.2420 |
| 6000000 | 782.7789 |
| 5000000 | 652.3157 |
| 4000000 | 521.8526 |
| 3000000 | 391.3894 |
| 2000000 | 260.9263 |
| 1000000 | 130.4631 |
| 900000 | 117.4168 |
| 800000 | 104.3705 |
| 700000 | 91.3242 |
| 600000 | 78.2779 |
| 500000 | 65.2316 |
| 400000 | 52.1853 |
| 300000 | 39.1389 |
| 200000 | 26.0926 |
| 100000 | 13.0463 |
| 90000 | 11.7417 |
| 80000 | 10.4371 |
| 70000 | 9.1324 |
| 60000 | 7.8278 |
| 50000 | 6.5232 |
| 40000 | 5.2185 |
| 30000 | 3.9139 |
| 20000 | 2.6093 |
| 10000 | 1.3046 |
| 9000 | 1.1742 |
| 8000 | 1.0437 |
| 7000 | .9132 |
| 6000 | .7828 |
| 5000 | .6523 |
| 4000 | .5219 |
| 3000 | .3914 |
| 2000 | .2609 |
| 1000 | .1305 |
| 900 | .1174 |
| 800 | .1044 |
| 700 | .0913 |
| 600 | .0783 |
| 500 | .0652 |
| 400 | .0522 |
| 300 | .0391 |
| 200 | .0261 |
| 100 | .0130 |
| 90 | .0117 |
| 80 | .0104 |
| 70 | .0091 |
| 60 | .0078 |
| 50 | .0065 |
| 40 | .0052 |
| 30 | .0039 |
| 20 | .0026 |
| 10 | .0013 |
| 9 | .0012 |
| 8 | .0010 |
| 7 | .0009 |
| 6 | .0008 |
| 5 | .0007 |
| 4 | .0005 |
| 3 | .0004 |
| 2 | .0003 |
| 1 | .0001 |

| *At 6 l. per Cent. per An.* | |
|---|---|
| Principal. | Discount. |
| 10000000 | 1550.7883 |
| 9000000 | 1395.7095 |
| 8000000 | 1240.6307 |
| 7000000 | 1085.5518 |
| 6000000 | 930.4730 |
| 5000000 | 775.3942 |
| 4000000 | 620.3153 |
| 3000000 | 465.2365 |
| 2000000 | 310.1577 |
| 1000000 | 155.0788 |
| 900000 | 139.5709 |
| 800000 | 124.0631 |
| 700000 | 108.5552 |
| 600000 | 93.0473 |
| 500000 | 77.5394 |
| 400000 | 62.0315 |
| 300000 | 46.5236 |
| 200000 | 31.0158 |
| 100000 | 15.5079 |
| 90000 | 13.9571 |
| 80000 | 12.4063 |
| 70000 | 10.8555 |
| 60000 | 9.3047 |
| 50000 | 7.7539 |
| 40000 | 6.2032 |
| 30000 | 4.6524 |
| 20000 | 3.1016 |
| 10000 | 1.5508 |
| 9000 | 1.3957 |
| 8000 | 1.2406 |
| 7000 | 1.0856 |
| 6000 | .9305 |
| 5000 | .7754 |
| 4000 | .6203 |
| 3000 | .4652 |
| 2000 | .3102 |
| 1000 | .1551 |
| 900 | .1396 |
| 800 | .1241 |
| 700 | .1086 |
| 600 | .0930 |
| 500 | .0775 |
| 400 | .0620 |
| 300 | .0465 |
| 200 | .0310 |
| 100 | .0155 |
| 90 | .0140 |
| 80 | .0124 |
| 70 | .0109 |
| 60 | .0093 |
| 50 | .0078 |
| 40 | .0062 |
| 30 | .0047 |
| 20 | .0031 |
| 10 | .0016 |
| 9 | .0014 |
| 8 | .0012 |
| 7 | .0011 |
| 6 | .0009 |
| 5 | .0008 |
| 4 | .0006 |
| 3 | .0005 |
| 2 | .0003 |
| 1 | .0002 |

## DISCOUNT for One Day, at 7, 8, 9, and 10 *per Cent. per Annum.*

| *At 7 l. per Cent. per An.* | | *At 8 l. per Cent per An.* | | *At 9 l. per Cent. per An* | | *At 10 l. per Cent. per An.* | |
|---|---|---|---|---|---|---|---|
| Principal | Discount. | Principal. | Discount. | Principal. | Discount. | Principal. | Discount. |
| 10000000 | 1792.3441 | 10000000 | 2029.4267 | 10000000 | 2262.1591 | 10000000 | 2490.6600 |
| 9000000 | 1613.1097 | 9000000 | 1826.4840 | 9000000 | 2035.9432 | 9000000 | 2241.5940 |
| 8000000 | 1433.8753 | 8000000 | 1623.5414 | 8000000 | 1809.7273 | 8000000 | 1992.5280 |
| 7000000 | 1254.6409 | 7000000 | 1420.5987 | 7000000 | 1583.5114 | 7000000 | 1743.4620 |
| 6000000 | 1075.4065 | 6000000 | 1217.6560 | 6000000 | 1357.2955 | 6000000 | 1494.3960 |
| 5000000 | 896.1721 | 5000000 | 1014.7133 | 5000000 | 1131.0796 | 5000000 | 1245.3300 |
| 4000000 | 716.9377 | 4000000 | 811.7707 | 4000000 | 904.8636 | 4000000 | 996.2640 |
| 3000000 | 537.7032 | 3000000 | 608.8280 | 3000000 | 678.6477 | 3000000 | 747.1980 |
| 2000000 | 358.4688 | 2000000 | 405.8853 | 2000000 | 452.4318 | 2000000 | 498.1320 |
| 1000000 | 179.2344 | 1000000 | 202.9427 | 1000000 | 226.2159 | 1000000 | 249.0660 |
| 900000 | 161.3110 | 900000 | 182.6484 | 900000 | 203.5943 | 900000 | 224.1594 |
| 800000 | 143.3875 | 800000 | 162.3541 | 800000 | 180.9727 | 800000 | 199.2528 |
| 700000 | 125.4641 | 700000 | 142.0599 | 700000 | 158.3511 | 700000 | 174.3462 |
| 600000 | 107.5406 | 600000 | 121.7656 | 600000 | 135.7295 | 600000 | 149.4396 |
| 500000 | 89.6172 | 500000 | 101.4713 | 500000 | 113.1080 | 500000 | 124.5330 |
| 400000 | 71.6938 | 400000 | 81.1771 | 400000 | 90.4864 | 400000 | 99.6264 |
| 300000 | 53.7703 | 300000 | 60.8828 | 300000 | 67.8648 | 300000 | 74.7198 |
| 200000 | 35.8469 | 200000 | 40.5885 | 200000 | 45.2432 | 200000 | 49.8132 |
| 100000 | 17.9234 | 100000 | 20.2943 | 100000 | 22.6216 | 100000 | 24.9066 |
| 90000 | 16.1311 | 90000 | 18.2648 | 90000 | 20.3594 | 90000 | 22.4159 |
| 80000 | 14.3388 | 80000 | 16.2354 | 80000 | 18.0973 | 80000 | 19.9253 |
| 70000 | 12.5464 | 70000 | 14.2060 | 70000 | 15.8351 | 70000 | 17.4346 |
| 60000 | 10.7541 | 60000 | 12.1766 | 60000 | 13.5730 | 60000 | 14.9440 |
| 50000 | 8.9617 | 50000 | 10.1471 | 50000 | 11.3108 | 50000 | 12.4533 |
| 40000 | 7.1694 | 40000 | 8.1177 | 40000 | 9.0486 | 40000 | 9.9626 |
| 30000 | 5.3770 | 30000 | 6.0883 | 30000 | 6.7865 | 30000 | 7.4720 |
| 20000 | 3.5847 | 20000 | 4.0589 | 20000 | 4.5243 | 20000 | 4.9813 |
| 10000 | 1.7923 | 10000 | 2.0294 | 10000 | 2.2622 | 10000 | 2.4907 |
| 9000 | 1.6131 | 9000 | 1.8265 | 9000 | 2.0359 | 9000 | 2.2416 |
| 8000 | 1.4339 | 8000 | 1.6235 | 8000 | 1.8097 | 8000 | 1.9925 |
| 7000 | 1.2546 | 7000 | 1.4206 | 7000 | 1.5835 | 7000 | 1.7435 |
| 6000 | 1.0754 | 6000 | 1.2177 | 6000 | 1.3573 | 6000 | 1.4944 |
| 5000 | .8962 | 5000 | 1.0147 | 5000 | 1.1311 | 5000 | 1.2453 |
| 4000 | .7169 | 4000 | .8118 | 4000 | .9049 | 4000 | .9963 |
| 3000 | .5377 | 3000 | .6088 | 3000 | .6786 | 3000 | .7472 |
| 2000 | .3585 | 2000 | .4059 | 2000 | .4524 | 2000 | .4981 |
| 1000 | .1792 | 1000 | .2029 | 1000 | .2262 | 1000 | .2491 |
| 900 | .1613 | 900 | .1826 | 900 | .2036 | 900 | .2242 |
| 800 | .1434 | 800 | .1624 | 800 | .1810 | 800 | .1993 |
| 700 | .1255 | 700 | .1421 | 700 | .1584 | 700 | .1743 |
| 600 | .1075 | 600 | .1218 | 600 | .1357 | 600 | .1494 |
| 500 | .0896 | 500 | .1015 | 500 | .1131 | 500 | .1245 |
| 400 | .0717 | 400 | .0812 | 400 | .0905 | 400 | .0996 |
| 300 | .0538 | 300 | .0609 | 300 | .0679 | 300 | .0747 |
| 200 | .0358 | 200 | .0406 | 200 | .0452 | 200 | .0498 |
| 100 | .0179 | 100 | .0203 | 100 | .0226 | 100 | .0249 |
| 90 | .0161 | 90 | .0183 | 90 | .0204 | 90 | .0224 |
| 80 | .0143 | 80 | .0162 | 80 | .0181 | 80 | .0199 |
| 70 | .0125 | 70 | .0142 | 70 | .0158 | 70 | .0174 |
| 60 | .0108 | 60 | .0122 | 60 | .0136 | 60 | .0149 |
| 50 | .0090 | 50 | .0101 | 50 | .0113 | 50 | .0125 |
| 40 | .0072 | 40 | .0081 | 40 | .0090 | 40 | .0100 |
| 30 | .0054 | 30 | .0061 | 30 | .0068 | 30 | .0075 |
| 20 | .0036 | 20 | .0041 | 20 | .0045 | 20 | .0050 |
| 10 | .0018 | 10 | .0020 | 10 | .0023 | 10 | .0025 |
| 9 | .0016 | 9 | .0018 | 9 | .0020 | 9 | .0022 |
| 8 | .0014 | 8 | .0016 | 8 | .0018 | 8 | .0020 |
| 7 | .0013 | 7 | .0014 | 7 | .0016 | 7 | .0017 |
| 6 | .0011 | 6 | .0012 | 6 | .0014 | 6 | .0015 |
| 5 | .0009 | 5 | .0010 | 5 | .0011 | 5 | .0012 |
| 4 | .0007 | 4 | .0008 | 4 | .0009 | 4 | .0010 |
| 3 | .0005 | 3 | .0006 | 3 | .0007 | 3 | .0007 |
| 2 | .0004 | 2 | .0004 | 2 | .0005 | 2 | .0005 |
| 1 | .0002 | 1 | .0002 | 1 | .0002 | 1 | .0002 |

*The Uſe of the preceding* Tables.

When the Diſcount of any Sum of Money is required for any Number of Days, multiply the principal Sum by the Number of Days, and the Diſcount of that Product for one Day anſwers the Queſtion.

*Example.*

*What is the Diſcount of* 265 l. *for* 438 *Days, at* 6 l. per Cent. per Annum?

265 *l.* Multiplied by 438, (the Number of Days) the Product will be 116070 *l.* the Diſcount of which Sum take out of the Table of 6*l. per Cent.* thus;

The Diſcount for one Day of 100000 is 15.5079
10000 is 1.5508
6000 is .9305
70 is .0109

Principal 116070. *Dif.* 18.0001

Anſwer 18 *l.*

And thus by theſe Tables, the Diſcount of any Sum of Money, for any Time, and at any Rate, from 3 *l.* to 10 *l. per Cent. per Ann.* is found readily.

*Compound Intereſt.*

The *Amount* of any Sum of Money in any Number of Years, at *Compound Intereſt*, will be always had by the continued Multiplication of the Principal by 1.03, if the Rate of Intereſt be 3 *l. per Cent.* by 1.04, if 4 *l. per Cent.* by 1.06, if the Rate be 6 *l. per Cent. &c.*

| | | | |
|---|---|---|---|
| So 1. | | 1.03 | 1ſt Year, |
| 1.03 | | 1.0609 | 2d Year, |
| 1.0609 | Multiply'd by 103, the | 1.092727 | 3d Year, |
| 1.092727 | Amount (at 3 *l. per* | 1.127509 | At the End of the 4th Year, |
| 1.125509 | *Cent.*) will be | 1.159274 | 5th Year, |
| 1.159274 | | 1.194052 | 6th Year, |
| 1.194052 | | 1.229874 | 7th Year. |

And thus Table the Firſt, following, of the Amount of 1 *l.* is form'd.

The *Preſent Value* of any Sum of Money, payable at the End of any Number, is found by the Reverſe of the former Method; *viz.* by the *continued Diviſion* of the Principal by 1.03, 1.04, 1.05, 1.06, *&c.* according to the Rate of Intereſt, is 3, 4, 5 or 6 *l. per Cent.*

| | | | |
|---|---|---|---|
| Thus 1. | | .970874 | 1ſt Year, |
| .970874 | | .942596 | 2d Year, |
| .942596 | Divided by 103; the | .915142 | 3d Year, |
| .915142 | preſent Value (at 3 *l.* | .888487 | Payable at the End of the 4th Year, |
| .888487 | *per Cent.*) will be | .862609 | 5th Year, |
| .862609 | | .837484 | 6th Year, |
| .837484 | | .813092 | 7th Year. |

And thus the Second of the following Tables may be form'd.

The Amount of any *Annuity* or other yearly Payment, in any Number of Years, at 3 *l. per Cent. per Ann.* Compound Intereſt, will be found thus:

Multiply the firſt yearly Payment by 1.03 (when as in this Caſe, the Rate of Intereſt is 3 *l. per Cent.* otherwiſe by 1.06, *&c.* whatever that be) and to the Product add the *ſecond Yearly Payment*; which Addition will give the Amount in two Years: Multiply that Amount again by 1.03, 1.06, *&c.* and to the Product add the third yearly Payment; which Addition will give the Amount in three Years, *&c.*

*Example of* 1 l. per Ann. *at* 3 *l.* per Cent.

First yearly Payment 1 *l.* the Amount in 1 Year.
Multiplied by 1.03

1.03
Second Yearly Paym. 1.

2.03 Amount in 2 Years.
Multiplied by 1.03

2.0909
Third Yearly Paym. 1.

3.0909 Amount in 3 Years.
Multiplied by -- 1.03

3.183627
Fourth Yearly Paym. 1.

4.183627 Amount in 4 Years, *&c.*

And thus the Third Table following is conſtructed.

The preſent Value of any Annuity, or other Yearly Payment, to *continue* any Number of Years, is thus found.

Find the preſent Value of that yearly Sum payable at the End of 1, 2, 3, 4, or 5, *&c.* Years by Diviſion; as is above directed; the firſt of which Values will be the preſent Value of that Annuity, or Yearly Payment for one Year: The firſt and ſecond of thoſe Values added together, will be the preſent Value for two Years: The firſt, ſecond, and third, ſo added, will give the Value for three Years, *&c.*

*Exam-*

*Example of* 1 l. per Ann. *at* ½ l. per Cent.

I find the preſent Value of 1 *l.* payable at the End of ſeveral Years, to be, as here under expreſs'd.

| At the End of | Year is |
|---|---|
| 1 | .970874 |
| 2 | .942596 |
| 3 | .915142 |
| 4 | .888487 |
| 5 | .862609 |
| 6 | .837484 |
| 7 | .813092, &c. |

Then the preſent Value of 1 *l. per Ann.* at 3 *l. per Cent.*

| For | Year is | being the | added together. |
|---|---|---|---|
| 1 | .870874 | 1ſt Number above, | |
| 2 | 1.913470 | 1, 2, | |
| 3 | 2.828612 | 1, 2, and 3, | |
| 4 | 3.717099 | 1, 2, 3, and 4, | |
| 5 | 4.579708 | 1, 2, 3, 4, and 5, | |
| 6 | 5.417192 | 1, 2, 3, 4, 5, and 6, | |
| 7 | 6.230284 | 1, 2, 3, 4, 5, 6, and 7, | |

And thus the Fourth Table following is Form'd and Compoſed.

TABLE

# TABLE I.

The Amount of One Pound in any Number of Years not exceeding 100, at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l.* *per Cent. per Ann.* Compound Intereſt.

| *Ye.* | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.030000 | 1.040000 | 1.050000 | 1.060000 | 1.070000 | 1.080000 | 1.090000 | 1.100000 |
| 2 | 1.060900 | 1.081600 | 1.102500 | 1.123600 | 1.144900 | 1.166400 | 1.188100 | 1.210000 |
| 3 | 1.092727 | 1.124864 | 1.157625 | 1.191016 | 1.225043 | 1.259712 | 1.295029 | 1.331000 |
| 4 | 1.125509 | 1.169859 | 1.215506 | 1.262477 | 1.310796 | 1.360489 | 1.411582 | 1.464100 |
| 5 | 1.159274 | 1.216653 | 1.276282 | 1.338226 | 1.402552 | 1.469328 | 1.538624 | 1.610510 |
| 6 | 1.194052 | 1.265319 | 1.340096 | 1.418519 | 1.500730 | 1.586874 | 1.677100 | 1.771561 |
| 7 | 1.229874 | 1.315932 | 1.407100 | 1.503630 | 1.605781 | 1.713824 | 1.828039 | 1.948717 |
| 8 | 1.266770 | 1.368569 | 1.477455 | 1.593848 | 1.718186 | 1.850930 | 1.992563 | 2.143589 |
| 9 | 1.804773 | 1.423312 | 1.551323 | 1.689479 | 1.838459 | 1.999005 | 2.171893 | 2.357948 |
| 10 | 1.343916 | 1.480244 | 1.628895 | 1.790848 | 1.967151 | 2.158925 | 2.367364 | 2.593742 |
| 11 | 1.384234 | 1.539454 | 1.710339 | 1.898299 | 2.104852 | 2.331639 | 2.580426 | 2.853117 |
| 12 | 1.425761 | 1.601032 | 1.795856 | 2.012196 | 2.252192 | 2.518170 | 2.812665 | 3.138428 |
| 13 | 1.468534 | 1.665074 | 1.885649 | 2.132928 | 2.409845 | 2.719624 | 3.065805 | 3.452271 |
| 14 | 1.512590 | 1.731676 | 1.979932 | 2.260904 | 2.578534 | 2.937194 | 3.341727 | 3.797498 |
| 15 | 1.557967 | 1.800944 | 2.078928 | 2.396558 | 2.759032 | 3.172169 | 3.642482 | 4.177248 |
| 16 | 1.604706 | 1.872981 | 2.182875 | 2.540352 | 2.952164 | 3.425943 | 3.970306 | 4.594973 |
| 17 | 1.652848 | 1.947900 | 2.292018 | 2.692773 | 3.158815 | 3.700018 | 4.327633 | 5.054470 |
| 18 | 1.702433 | 2.025817 | 2.406619 | 2.854339 | 3.379932 | 3.996019 | 4.717120 | 5.559917 |
| 19 | 1.753506 | 2.106849 | 2.526950 | 3.025600 | 3.616528 | 4.315701 | 5.141661 | 6.115909 |
| 20 | 1.806111 | 2.191123 | 2.653298 | 3.207135 | 3.869684 | 4.660957 | 5.604411 | 6.727500 |
| 21 | 1.860295 | 2.278768 | 2.785963 | 3.399564 | 4.140562 | 5.033834 | 6.108808 | 7.400250 |
| 22 | 1.916103 | 2.369919 | 2.925261 | 3.603537 | 4.430402 | 5.436540 | 6.658600 | 8.140275 |
| 23 | 1.973587 | 2.464716 | 3.071524 | 3.819750 | 4.740530 | 5.871464 | 7.257874 | 8.954302 |
| 24 | 2.032794 | 2.563304 | 3.225100 | 4.048935 | 5.072367 | 6.341181 | 7.911083 | 9.849733 |
| 25 | 2.093778 | 2.665836 | 3.386355 | 4.291871 | 5.427433 | 6.848475 | 8.623081 | 10.834700 |
| 26 | 2.156591 | 2.772470 | 3.555673 | 4.549383 | 5.807353 | 7.396353 | 9.399158 | 11.918177 |
| 27 | 2.221289 | 2.883369 | 3.733456 | 4.822346 | 6.213868 | 7.988001 | 10.245082 | 13.109994 |
| 28 | 2.287928 | 2.998703 | 3.920129 | 5.111687 | 6.648838 | 8.627106 | 11.167139 | 14.420994 |
| 29 | 2.356566 | 3.118651 | 4.116136 | 5.418388 | 7.114257 | 9.317275 | 12.172182 | 15.863093 |
| 30 | 2.427262 | 3.243398 | 4.321942 | 5.743491 | 7.612255 | 10.062657 | 13.267678 | 17.449402 |
| 31 | 2.500080 | 3.373133 | 4.538039 | 6.088101 | 8.145113 | 10.867669 | 14.461769 | 19.194342 |
| 32 | 2.575083 | 3.508059 | 4.764941 | 6.453387 | 8.715271 | 11.737083 | 15.763329 | 21.113777 |
| 33 | 2.652335 | 3.648381 | 5.003189 | 6.840590 | 9.325340 | 12.676050 | 17.182028 | 23.225155 |
| 34 | 2.731905 | 3.794316 | 5.253348 | 7.251025 | 9.978114 | 13.690134 | 18.728411 | 25.547671 |
| 35 | 2.813862 | 3.946089 | 5.516015 | 7.686087 | 10.676581 | 14.785344 | 20.413968 | 28.102438 |
| 36 | 2.898278 | 4.103933 | 5.791816 | 8.147252 | 11.423942 | 15.968172 | 22.251225 | 30.912681 |
| 37 | 2.985227 | 4.268090 | 6.081407 | 8.636087 | 12.223618 | 17.245626 | 24.253835 | 34.003949 |
| 38 | 3.074783 | 4.438813 | 6.385477 | 9.154252 | 13.079271 | 18.625276 | 26.436680 | 37.404344 |
| 39 | 3.167027 | 4.616366 | 6.704751 | 9.703507 | 13.994820 | 20.115298 | 28.815982 | 41.144779 |
| 40 | 3.262038 | 4.801021 | 7.039989 | 10.285718 | 14.974458 | 21.724521 | 31.409420 | 45.259257 |
| 41 | 3.359899 | 4.993061 | 7.391988 | 10.902861 | 16.022670 | 23.462483 | 34.236268 | 49.785182 |
| 42 | 3.460696 | 5.192784 | 7.761588 | 11.557033 | 17.144257 | 25.339482 | 37.317532 | 54.763701 |
| 43 | 3.564517 | 5.400495 | 8.149667 | 12.250455 | 18.344355 | 27.366640 | 40.676110 | 60.240071 |
| 44 | 3.671452 | 5.616515 | 8.557150 | 12.985482 | 19.628460 | 29.555972 | 44.336960 | 66.264078 |
| 45 | 3.781596 | 5.841176 | 8.985008 | 13.764611 | 21.002452 | 31.920449 | 48.327286 | 72.890486 |
| 46 | 3.895044 | 6.074823 | 9.434258 | 14.590487 | 22.472623 | 34.474085 | 52.676742 | 80.179534 |
| 47 | 4.011895 | 6.317816 | 9.905971 | 15.465917 | 24.045707 | 37.232012 | 57.417649 | 88.197488 |
| 48 | 4.132252 | 6.570528 | 10.401270 | 16.393872 | 25.728907 | 40.210573 | 62.585237 | 97.017236 |
| 49 | 4.256219 | 6.833349 | 10.921333 | 17.377504 | 27.529930 | 43.427419 | 68.217908 | 106.718960 |

## TABLE I. continu'd.

Being the Amount of One Pound, in any Number of Years, from 50 to 100, at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Intereſt.

| *Ye.* | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 50 | 4.383906 | 7.106983 | 11.467400 | 18.420154 | 29.457025 | 46.901612 | 74.357520 | 117.300806 |
| 51 | 4.515423 | 7.390951 | 12.040770 | 19.525363 | 31.519017 | 50.653741 | 81.049697 | 129.129942 |
| 52 | 4.650886 | 7.686589 | 12.642808 | 20.696885 | 33.725348 | 54.706041 | 88.344170 | 142.042936 |
| 53 | 4.790412 | 7.994052 | 13.274949 | 21.938698 | 36.086122 | 59.082524 | 96.295145 | 156.247229 |
| 54 | 4.934125 | 8.313814 | 13.938696 | 23.255020 | 38.612151 | 63.809126 | 104.961708 | 171.871952 |
| 55 | 5.082149 | 8.646367 | 14.635631 | 24.650322 | 41.315001 | 68.913856 | 114.408262 | 189.059147 |
| 56 | 5.234613 | 8.992222 | 15.367412 | 26.129341 | 44.207052 | 74.426964 | 124.705005 | 207.965062 |
| 57 | 5.391651 | 9.351910 | 16.135783 | 27.697101 | 47.301545 | 80.381182 | 135.928456 | 228.761568 |
| 58 | 5.553401 | 9.725987 | 16.942572 | 29.358927 | 50.612653 | 86.811611 | 148.162017 | 251.637725 |
| 59 | 5.720003 | 10.115026 | 17.789701 | 31.120463 | 54.155539 | 93.756540 | 161.496598 | 276.801498 |
| 60 | 5.891603 | 10.519627 | 18.679186 | 32.987691 | 57.946427 | 101.257064 | 176.031292 | 304.481648 |
| 61 | 6.068351 | 10.940413 | 19.613145 | 34.966952 | 62.002677 | 109.357629 | 191.874108 | 334.929812 |
| 62 | 6.250402 | 11.378029 | 20.593802 | 37.064969 | 66.342864 | 118.106239 | 209.142778 | 368.422794 |
| 63 | 6.437914 | 11.833150 | 21.623493 | 39.288868 | 70.986865 | 127.554738 | 227.965628 | 405.265073 |
| 64 | 6.631051 | 12.306476 | 22.704667 | 41.646200 | 75.955945 | 137.759117 | 248.482535 | 445.791580 |
| 65 | 6.829982 | 12.798735 | 23.839901 | 44.144972 | 81.272861 | 148.779846 | 270.845963 | 490.370728 |
| 66 | 7.034882 | 13.310685 | 25.031896 | 46.793670 | 86.961962 | 160.682234 | 295.222099 | 539.407812 |
| 67 | 7.245929 | 13.843112 | 26.283490 | 49.601290 | 93.049299 | 173.536813 | 321.792088 | 593.348593 |
| 68 | 7.463307 | 14.396836 | 27.597665 | 52.577368 | 99.562750 | 187.419758 | 350.753376 | 652.683453 |
| 69 | 7.687206 | 14.972710 | 28.977548 | 55.732010 | 106.532142 | 202.413338 | 382.321180 | 717.951798 |
| 70 | 7.917822 | 15.571618 | 30.426426 | 59.075930 | 113.989392 | 218.606406 | 416.730086 | 789.746978 |
| 71 | 8.155357 | 16.194483 | 31.947747 | 62.620486 | 121.968650 | 236.094918 | 454.235794 | 868.721675 |
| 72 | 8.400017 | 16.842262 | 33.545134 | 66.377715 | 130.506455 | 254.982511 | 495.117016 | 955.593843 |
| 73 | 8.652018 | 17.515953 | 35.222391 | 70.360378 | 139.641907 | 275.381112 | 539.677547 | 1051.153227 |
| 74 | 8.911578 | 18.216591 | 36.983510 | 74.582001 | 149.416840 | 297.411601 | 588.248526 | 1156.268550 |
| 75 | 9.178926 | 18.945255 | 38.832686 | 79.056921 | 159.876019 | 321.204529 | 641.190894 | 1271.895405 |
| 76 | 9.454293 | 19.703065 | 40.774320 | 83.800336 | 171.067341 | 346.900892 | 698.898074 | 1399.084945 |
| 77 | 9.737922 | 20.491187 | 42.813036 | 88.828356 | 183.042054 | 374.652963 | 761.798901 | 1538.993440 |
| 78 | 10.030060 | 21.310835 | 44.953688 | 94.158058 | 195.854998 | 404.625200 | 830.360802 | 1692.892784 |
| 79 | 10.330962 | 22.163269 | 47.201372 | 98.807541 | 209.564848 | 436.995216 | 905.093274 | 1862.182062 |
| 80 | 10.640891 | 23.049799 | 49.561441 | 105.795993 | 224.234388 | 471.954834 | 986.551660 | 2048.400269 |
| 81 | 10.960117 | 23.971791 | 52.039513 | 112.143753 | 239.930795 | 509.711220 | 1075.341319 | 2253.240295 |
| 82 | 11.288921 | 24.930663 | 54.641489 | 118.872378 | 256.725950 | 550.488118 | 1172.122037 | 2478.564325 |
| 83 | 11.627588 | 25.927889 | 57.373563 | 126.004721 | 274.696767 | 594.527167 | 1277.613021 | 2726.420757 |
| 84 | 11.976416 | 26.965005 | 60.242241 | 133.565004 | 293.925540 | 642.089341 | 1392.598193 | 2999.062833 |
| 85 | 12.335709 | 28.043605 | 63.254353 | 141.578904 | 314.500328 | 693.456488 | 1517.932030 | 3298.969117 |
| 86 | 12.705780 | 29.165349 | 66.417071 | 150.073639 | 336.515351 | 748.933007 | 1654.545913 | 3628.866028 |
| 87 | 13.086953 | 30.331963 | 69.737925 | 159.078057 | 360.071426 | 808.847648 | 1803.455045 | 3991.752631 |
| 88 | 13.479562 | 31.545242 | 73.224821 | 168.622741 | 385.276426 | 873.555459 | 1965.765999 | 4390.927894 |
| 89 | 13.883949 | 32.807051 | 76.886062 | 178.740105 | 412.245776 | 943.439896 | 2142.684939 | 4830.020684 |
| 90 | 14.300467 | 34.119333 | 80.730365 | 189.464511 | 441.102980 | 1018.915088 | 2335.526583 | 5313.022752 |
| 91 | 14.729481 | 35.484107 | 84.766883 | 200.832382 | 471.980188 | 1100.428295 | 2545.723976 | 5844.325027 |
| 92 | 15.171366 | 36.903471 | 89.005227 | 212.882325 | 505.018802 | 1188.462558 | 2774.839134 | 6428.757530 |
| 93 | 15.626507 | 38.379610 | 93.455489 | 225.655264 | 540.370118 | 1283.539563 | 3024.574656 | 7071.633283 |
| 94 | 16.095302 | 39.914794 | 98.128263 | 239.194580 | 578.196026 | 1386.222728 | 3296.786375 | 7778.796611 |
| 95 | 16.578161 | 41.511386 | 103.034676 | 253.546255 | 618.669748 | 1497.120546 | 3593.497148 | 8556.676272 |
| 96 | 17.075506 | 43.171841 | 108.186410 | 268.759030 | 661.976630 | 1616.890190 | 3916.911892 | 9412.343899 |
| 97 | 17.587771 | 44.898715 | 113.595731 | 284.884572 | 708.314994 | 1746.241405 | 4269.433962 | 10353.578289 |
| 98 | 18.115404 | 46.694664 | 119.275517 | 301.977646 | 757.897044 | 1885.940718 | 4653.683018 | 11388.936118 |
| 99 | 18.658866 | 48.562450 | 125.239293 | 320.096305 | 810.949837 | 2036.815975 | 5072.51449c | 12527.829730 |
| 100 | 19.218632 | 50.504948 | 131.501258 | 339.302084 | 867.716325 | 2109.761253 | 5529.040791 | 13780.612703 |

## TABLE II.

The Preſent Value of One Pound, payable at the End of any Number of Years not exceeding 100, Diſcounting at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Intereſt.

| *Ye.* | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 1 | .970874 | .961539 | .952381 | .943396 | .934579 | .925926 | .917431 | .909091 |
| 2 | .942596 | .924556 | .907029 | .889997 | .873439 | .857339 | .841680 | .826446 |
| 3 | .915142 | .888996 | .863838 | .839619 | .816298 | .793832 | .772184 | .751315 |
| 4 | .888487 | .854804 | .822702 | .792094 | .762895 | .735030 | .708425 | .683013 |
| 5 | .862609 | .821927 | .783526 | .747258 | .712986 | .680583 | .649931 | .620921 |
| 6 | .837484 | .790315 | .746216 | .704960 | .666342 | .630170 | .596267 | .564474 |
| 7 | .813092 | .759918 | .710682 | .665057 | .622750 | .583491 | .547034 | .513158 |
| 8 | .789409 | .730690 | .676839 | .627412 | .582009 | .540269 | .501866 | .466507 |
| 9 | .766417 | .702587 | .644609 | .591898 | .543934 | .500249 | .460428 | .424098 |
| 10 | .744094 | .675564 | .613913 | .558395 | .508349 | .463194 | .422411 | .385543 |
| 11 | .722421 | .649581 | .584679 | .526787 | .475093 | .428883 | .387533 | .350494 |
| 12 | .701380 | .624597 | .556837 | .496969 | .444012 | .397114 | .355535 | .318631 |
| 13 | .680951 | .600574 | .530321 | .468839 | .414965 | .367698 | .326179 | .289664 |
| 14 | .661118 | .577475 | .505068 | .442301 | .387817 | .340461 | .299246 | .263331 |
| 15 | .641862 | .555265 | .481017 | .417265 | .362446 | .315242 | .274538 | .239392 |
| 16 | .623167 | .533908 | .458112 | .393646 | .338735 | .291891 | .251870 | .217629 |
| 17 | .605017 | .513373 | .436297 | .371314 | .316574 | .270269 | .231073 | .197845 |
| 18 | .587395 | .493628 | .415521 | .350344 | .295864 | .250249 | .211994 | .179859 |
| 19 | .570286 | .474643 | .395734 | .330513 | .276508 | .231712 | .194490 | .163508 |
| 20 | .553676 | .456387 | .376890 | .311805 | .258419 | .214548 | .178431 | .148644 |
| 21 | .537549 | .438834 | .358942 | .294155 | .241513 | .198657 | .163698 | .135131 |
| 22 | .521892 | .421955 | .341850 | .277505 | .225713 | .183941 | .150182 | .122846 |
| 23 | .506692 | .405726 | .325571 | .261797 | .210947 | .170315 | .137781 | .111678 |
| 24 | .491934 | .390121 | .310068 | .246979 | .197147 | .157699 | .126405 | .101526 |
| 25 | .477606 | .315717 | .295303 | .232999 | .184249 | .146018 | .115968 | .092296 |
| 26 | .463695 | .360689 | .281241 | .219810 | .172196 | .135202 | .106392 | .083905 |
| 27 | .450189 | .346816 | .267848 | .207368 | .160930 | .125187 | .097607 | .076278 |
| 28 | .437077 | .333477 | .255094 | .195630 | .150402 | .115914 | .089548 | .069343 |
| 29 | .424346 | .320651 | .242946 | .184557 | .140563 | .107328 | .082155 | .063039 |
| 30 | .411987 | .308319 | .231377 | .174110 | .131367 | .099377 | .075371 | .057309 |
| 31 | .399987 | .296460 | .220359 | .164255 | .122773 | .092016 | .069148 | .052099 |
| 32 | .388337 | .285052 | .209866 | .154957 | .114741 | .085200 | .063438 | .047362 |
| 33 | .377026 | .274094 | .199873 | .146186 | .107235 | .078889 | .058200 | .043057 |
| 34 | .366045 | .263552 | .190355 | .137012 | .100219 | .073045 | .054395 | .039143 |
| 35 | .355383 | .253416 | .181290 | .130105 | .093663 | .067635 | .048986 | .035584 |
| 36 | .345032 | .243669 | .172657 | .122741 | .087535 | .062625 | .044941 | .032349 |
| 37 | .334983 | .234297 | .164436 | .115793 | .081809 | .057986 | .041231 | .029408 |
| 38 | .325226 | .225295 | .156605 | .109238 | .076457 | .053690 | .037826 | .026735 |
| 39 | .315754 | .216621 | .149148 | .103056 | .071455 | .049713 | .034703 | .024304 |
| 40 | .306557 | .208289 | .142046 | .097222 | .066780 | .046031 | .031838 | .022095 |
| 41 | .297658 | .200278 | .135282 | .091719 | .062412 | .042621 | .029209 | .020086 |
| 42 | .288959 | .192575 | .128840 | .086527 | .058329 | .039464 | .026797 | .018260 |
| 43 | .280543 | .185168 | .122704 | .081630 | .054513 | .036541 | .024584 | .016600 |
| 44 | .272372 | .178046 | .116861 | .077009 | .050946 | .033834 | .022555 | .015091 |
| 45 | .264439 | .171198 | .111297 | .072650 | .047614 | .031328 | .020692 | .013719 |
| 46 | .256737 | .164614 | .105997 | .068538 | .044499 | .029007 | .018984 | .012472 |
| 47 | .249259 | .158283 | .100949 | .064658 | .041587 | .026859 | .017416 | .011338 |
| 48 | .241999 | .152195 | .096142 | .060998 | .038867 | .024869 | .015978 | .010307 |
| 49 | .234950 | .146341 | .091564 | .057546 | .036324 | .023027 | .014659 | .009370 |
| 50 | .228107 | .140713 | .087204 | .054288 | .033948 | .021321 | .013449 | .008519 |

## TABLE II. continu'd.

Being the preſent Value of One Pound, payable at the End of any Number of Years from 51 to 100, Diſcounting at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Intereſt.

| Ye. | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 51 | .221463 | .135301 | .083051 | .051215 | .031727 | .019742 | .012338 | .007744 |
| 52 | .215013 | .130097 | .079096 | .048316 | .029651 | .018280 | .011319 | .007040 |
| 53 | .208750 | .125093 | .075330 | .045582 | .027711 | .016925 | .010385 | .006400 |
| 54 | .202670 | .120282 | .071743 | .043001 | .025899 | .015672 | .009527 | .005818 |
| 55 | .196767 | .115656 | .068326 | .040567 | .024204 | .014511 | .008741 | .005289 |
| 56 | .191036 | .111207 | .065073 | .038271 | .022621 | .013436 | .008019 | .004808 |
| 57 | .185472 | .106930 | .061974 | .036105 | .021141 | .012441 | .007357 | .004371 |
| 58 | .180070 | .102817 | .059023 | .034061 | .019758 | .011519 | .006749 | .003974 |
| 59 | .174825 | .098863 | .056212 | .032133 | .018465 | .010666 | .006192 | .003613 |
| 60 | .169733 | .095060 | .053536 | .030314 | .017257 | .009876 | .005681 | .003284 |
| 61 | .164789 | .091404 | .050986 | .028598 | .016128 | .009144 | .005212 | .002986 |
| 62 | .159990 | .087889 | .048558 | .026980 | .015073 | .008467 | .004781 | .002714 |
| 63 | .155330 | .084508 | .046246 | .025453 | .014087 | .007840 | .004387 | .002468 |
| 64 | .150806 | .081258 | .044044 | .024012 | .013166 | .007259 | .004024 | .002243 |
| 65 | .146413 | .078133 | .041946 | .022653 | .012304 | .006721 | .003692 | .002039 |
| 66 | .142149 | .075128 | .039949 | .021370 | .011497 | .006223 | .003387 | .001854 |
| 67 | .138009 | .072238 | .038047 | .020161 | .010747 | .005762 | .003108 | .001685 |
| 68 | .133989 | .069460 | .036235 | .019020 | .010044 | .005336 | .002851 | .001532 |
| 69 | .130086 | .066788 | .034509 | .017943 | .009387 | .004940 | .002616 | .001393 |
| 70 | .126297 | .064219 | .032866 | .016927 | .008773 | .004574 | .002400 | .001266 |
| 71 | .122619 | .061749 | .031301 | .015969 | .008199 | .004236 | .002202 | .001151 |
| 72 | .119047 | .059374 | .029811 | .015065 | .007662 | .003922 | .002020 | .001046 |
| 73 | .115580 | .057091 | .028391 | .014213 | .007161 | .003631 | .001853 | .000951 |
| 74 | .112214 | .054895 | .027039 | .013408 | .006693 | .003362 | .001700 | .000865 |
| 75 | .108945 | .052784 | .025752 | .012649 | .006255 | .003113 | .001560 | .000786 |
| 76 | .105772 | .050754 | .024525 | .011933 | .005846 | .002883 | .001431 | .000715 |
| 77 | .102691 | .048801 | .023357 | .011258 | .005463 | .002669 | .001313 | .000649 |
| 78 | .099700 | .046924 | .022245 | .010620 | .005106 | .002471 | .001204 | .000591 |
| 79 | .096796 | .045120 | .021186 | .010019 | .004772 | .002288 | .001105 | .000537 |
| 80 | .093997 | .043384 | .020177 | .009452 | .004460 | .002119 | .001014 | .000488 |
| 81 | .091240 | .041716 | .019216 | .008917 | .004168 | .001962 | .000930 | .000444 |
| 82 | .088582 | .040111 | .018301 | .008412 | .003895 | .001817 | .000853 | .000403 |
| 83 | .086002 | .038569 | .017430 | .007936 | .003640 | .001682 | .000783 | .000367 |
| 84 | .083497 | .037085 | .016600 | .007487 | .003402 | .001557 | .000718 | .000333 |
| 85 | .081065 | .035659 | .015809 | .007063 | .003180 | .001442 | .000659 | .000303 |
| 86 | .078704 | .034287 | .015056 | .006663 | .002972 | .001335 | .000604 | .000276 |
| 87 | .076412 | .032969 | .014339 | .006286 | .002777 | .001236 | .000554 | .000251 |
| 88 | .074186 | .031701 | .013657 | .005930 | .002596 | .001145 | .000509 | .000228 |
| 89 | .072026 | .030481 | .013006 | .005595 | .002426 | .001060 | .000467 | .000207 |
| 90 | .069928 | .029309 | .012387 | .005278 | .002267 | .000981 | .000428 | .000188 |
| 91 | .067891 | .028182 | .011797 | .004979 | .002119 | .000909 | .000393 | .000171 |
| 92 | .065914 | .027098 | .011235 | .004697 | .001980 | .000841 | .000360 | .000156 |
| 93 | .063994 | .026056 | .010700 | .004432 | .001851 | .000779 | .000331 | .000141 |
| 94 | .062130 | .025053 | .010191 | .004181 | .001730 | .000721 | .000303 | .000129 |
| 95 | .060320 | .024090 | .009705 | .003944 | .001616 | .000668 | .000278 | .000117 |
| 96 | .058563 | .023163 | .009243 | .003721 | .001511 | .000618 | .000255 | .000106 |
| 97 | .056858 | .022272 | .008803 | .003510 | .001412 | .000573 | .000234 | .000097 |
| 98 | .055202 | .021416 | .008384 | .003312 | .001319 | .000530 | .000215 | .000088 |
| 99 | .053594 | .020592 | .007985 | .003124 | .001233 | .000491 | .000197 | .000080 |
| 100 | .052033 | .019800 | .007604 | .002947 | .001152 | .000455 | .000181 | .000073 |

## TABLE III.

The Amount of One Pound in any Number of Years not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Interest.

| Ye. | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 | 1.000000 |
| 2 | 2.030000 | 2.040000 | 2.050000 | 2.060000 | 2.070000 | 2.080000 | 2.090000 | 2.100000 |
| 3 | 3.090900 | 3.121600 | 3.152500 | 3.183600 | 3.214900 | 3.246400 | 3.278100 | 3.310000 |
| 4 | 4.183627 | 4.246464 | 4.310125 | 4.374616 | 4.439943 | 4.506112 | 4.573129 | 4.641000 |
| 5 | 5.309136 | 5.416323 | 5.525631 | 5.637093 | 5.750739 | 5.866601 | 5.984711 | 6.105100 |
| 6 | 6.468410 | 6.632975 | 6.801913 | 6.975319 | 7.153291 | 7.335929 | 7.523335 | 7.715610 |
| 7 | 7.662462 | 7.898294 | 8.142008 | 8.393838 | 8.654021 | 8.922803 | 9.200435 | 9.487171 |
| 8 | 8.892336 | 9.214226 | 9.549109 | 9.897468 | 10.259803 | 10.636628 | 11.028474 | 11.435888 |
| 9 | 10.159106 | 10.582795 | 11.026564 | 11.491316 | 11.977989 | 12.487558 | 13.021036 | 13.579477 |
| 10 | 11.463879 | 12.006107 | 12.577893 | 13.180795 | 13.816448 | 14.486562 | 15.192930 | 15.937425 |
| 11 | 12.807796 | 13.486351 | 14.206787 | 14.971643 | 15.783599 | 16.645487 | 17.560293 | 18.531167 |
| 12 | 14.192030 | 15.025805 | 15.917127 | 16.869941 | 17.888451 | 18.977126 | 20.140720 | 21.384284 |
| 13 | 15.617790 | 16.626838 | 17.712983 | 18.882138 | 20.140643 | 21.495297 | 22.953385 | 24.522712 |
| 14 | 17.086324 | 18.291911 | 19.598632 | 21.015066 | 22.550488 | 24.214920 | 26.019189 | 27.974983 |
| 15 | 18.598914 | 20.023588 | 21.578564 | 23.275970 | 25.129022 | 27.152114 | 29.360916 | 31.772482 |
| 16 | 20.156881 | 21.824531 | 23.657492 | 25.672528 | 27.888054 | 30.324283 | 33.003399 | 35.949730 |
| 17 | 21.761588 | 23.697512 | 25.840366 | 28.212880 | 30.840217 | 33.750226 | 36.973704 | 40.544703 |
| 18 | 23.414435 | 25.645413 | 28.132385 | 30.905653 | 33.999033 | 37.450244 | 41.301338 | 45.599173 |
| 19 | 25.116868 | 27.671229 | 30.539004 | 33.759992 | 37.378965 | 41.446263 | 46.018458 | 51.159090 |
| 20 | 26.870374 | 29.778079 | 33.065954 | 36.785591 | 40.995492 | 45.761964 | 51.160119 | 57.274999 |
| 21 | 28.676486 | 31.969202 | 35.719252 | 39.992727 | 44.865177 | 50.422921 | 56.764530 | 64.002499 |
| 22 | 30.536780 | 34.247970 | 38.505214 | 43.392290 | 49.005739 | 55.456755 | 62.873338 | 71.402749 |
| 23 | 32.452884 | 36.617889 | 41.430475 | 46.995828 | 53.436141 | 60.893296 | 69.531938 | 79.543024 |
| 24 | 34.426470 | 39.082604 | 44.501999 | 50.815577 | 58.176671 | 66.764759 | 76.789813 | 88.497327 |
| 25 | 36.459264 | 41.645908 | 47.727099 | 54.864512 | 63.249038 | 73.105940 | 84.700896 | 98.347059 |
| 26 | 38.553042 | 44.311745 | 51.113454 | 59.156383 | 68.676470 | 79.954415 | 98.323977 | 109.181765 |
| 27 | 40.709633 | 47.084214 | 54.669126 | 63.705766 | 74.483823 | 87.350768 | 102.723134 | 121.099942 |
| 28 | 42.930922 | 49.967583 | 58.402583 | 68.528112 | 80.697691 | 95.338830 | 112.968216 | 134.209936 |
| 29 | 45.218850 | 52.966286 | 62.322712 | 73.639798 | 87.346529 | 103.965936 | 124.135356 | 148.630930 |
| 30 | 47.575416 | 56.084938 | 66.438848 | 79.058186 | 94.460786 | 113.283211 | 136.307538 | 164.494023 |
| 31 | 50.002678 | 59.328335 | 70.760790 | 84.801677 | 102.073041 | 123.345868 | 149.575216 | 181.943425 |
| 32 | 52.502759 | 62.701469 | 75.298829 | 90.889778 | 110.218154 | 134.213537 | 164.036986 | 201.137773 |
| 33 | 55.077841 | 66.209527 | 80.063771 | 97.343165 | 118.933425 | 145.950620 | 179.800315 | 222.251550 |
| 34 | 57.730177 | 69.857909 | 85.066959 | 104.183755 | 128.258765 | 158.626670 | 196.982343 | 245.476705 |
| 35 | 60.462082 | 73.652225 | 90.320307 | 111.434780 | 138.236878 | 172.316804 | 215.710754 | 271.024376 |
| 36 | 63.275944 | 77.598314 | 95.839323 | 119.120867 | 148.913460 | 187.102148 | 236.124722 | 299.126813 |
| 37 | 66.174223 | 81.702246 | 101.628139 | 127.268119 | 160.337402 | 203.070320 | 258.375947 | 330.039495 |
| 38 | 69.159449 | 85.970336 | 107.709546 | 135.904206 | 172.561020 | 220.315945 | 282.629782 | 364.043444 |
| 39 | 72.234233 | 90.409150 | 114.095023 | 145.058458 | 185.640292 | 238.941221 | 309.066463 | 401.447789 |
| 40 | 75.401260 | 95.025516 | 120.799774 | 154.761966 | 199.635112 | 259.056519 | 337.882444 | 442.592568 |
| 41 | 78.663298 | 99.826536 | 127.839763 | 165.047684 | 214.609570 | 280.781040 | 369.291864 | 487.851824 |
| 42 | 82.023197 | 104.819598 | 135.231751 | 175.950545 | 230.632240 | 304.243523 | 403.528132 | 537.637007 |
| 43 | 85.483892 | 110.012382 | 142.993339 | 187.507577 | 247.776496 | 329.583005 | 440.845664 | 592.400707 |
| 44 | 89.048409 | 115.412877 | 151.143006 | 199.758032 | 266.120851 | 356.949645 | 481.421775 | 652.640778 |
| 45 | 92.719861 | 121.029392 | 159.700156 | 212.743514 | 285.749311 | 386.505617 | 525.858735 | 718.904856 |
| 46 | 96.501457 | 126.870568 | 168.685164 | 226.508125 | 306.751763 | 418.426066 | 574.186021 | 791.795342 |
| 47 | 100.396501 | 132.945390 | 178.119422 | 241.098612 | 329.224386 | 452.900152 | 626.862763 | 871.974876 |
| 48 | 104.408396 | 139.263206 | 188.025393 | 256.564529 | 353.270093 | 490.132164 | 684.280411 | 960.172363 |
| 49 | 108.540648 | 145.833734 | 198.426663 | 272.958401 | 378.998999 | 530.342737 | 746.865648 | 1057.189600 |
| 50 | 112.796867 | 152.667084 | 209.347996 | 290.335905 | 406.528929 | 573.770156 | 815.083557 | 1163.908560 |

## TABLE III. continu'd.

Being the Amount of One Pound, in any Number of Years, not exceeding 100, at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Intereſt.

| Ye. | 3 per Cent. | 4 per Cent. | 5 per Cent. | 6 per Cent. | 7 per Cent. | 8 per Cent. | 9 per Cent. | 10 per Cent. |
|---|---|---|---|---|---|---|---|---|
| 51 | 117.180773 | 159.773767 | 220.815395 | 308.756059 | 435.985955 | 620.671768 | 889.441077 | 1281.299416 |
| 52 | 121.696197 | 167.164718 | 232.856165 | 328.281422 | 467.504971 | 671.325510 | 970.490774 | 1410.429357 |
| 53 | 126.347083 | 174.851306 | 245.498974 | 348.978308 | 501.230319 | 726.031550 | 1058.834943 | 1552.472293 |
| 54 | 131.137495 | 182.845359 | 258.773922 | 370.917006 | 537.316442 | 785.114074 | 1155.130088 | 1708.719522 |
| 55 | 136.071620 | 191.159172 | 272.712618 | 394.172027 | 575.928593 | 848.923200 | 1260.091796 | 1880.591474 |
| 56 | 141.153768 | 199.805540 | 287.348249 | 418.822348 | 617.253594 | 917.837056 | 1374.500058 | 2069.650622 |
| 57 | 146.388381 | 208.797762 | 302.715662 | 444.951689 | 661.450646 | 992.264021 | 1499.205063 | 2277.615684 |
| 58 | 151.780033 | 218.149672 | 318.851445 | 472.648790 | 708.752191 | 1072.645143 | 1635.133519 | 2506.377252 |
| 59 | 157.333434 | 227.875659 | 335.794017 | 502.007718 | 759.364844 | 1159.456754 | 1783.295535 | 2758.014978 |
| 60 | 163.053437 | 237.990685 | 353.583718 | 533.128181 | 813.520383 | 1253.213294 | 1944.792134 | 3034.816476 |
| 61 | 168.945040 | 248.510313 | 372.262904 | 566.115872 | 871.466810 | 1354.470358 | 2120.823426 | 3339.298123 |
| 62 | 175.013391 | 259.450725 | 391.876049 | 601.082824 | 933.469487 | 1463.827986 | 2312.697534 | 3674.227935 |
| 63 | 181.263793 | 270.828754 | 412.469851 | 638.147793 | 999.812351 | 1581.934225 | 2521.840312 | 4042.650729 |
| 64 | 187.701707 | 282.661904 | 434.093344 | 677.436661 | 1070.799215 | 1709.488963 | 2749.805940 | 4447.915802 |
| 65 | 194.332758 | 294.968380 | 456.789011 | 719.082861 | 1146.755161 | 1847.248080 | 2998.288475 | 4893.707382 |
| 66 | 201.162741 | 307.767116 | 480.637912 | 763.227832 | 1228.028022 | 1996.027927 | 3269.134438 | 5384.078120 |
| 67 | 208.197623 | 321.077800 | 505.669807 | 810.021502 | 1314.989983 | 2156.710161 | 3564.356537 | 5923.485932 |
| 68 | 215.443552 | 334.920912 | 531.953298 | 859.622792 | 1408.039282 | 2330.246974 | 3886.148625 | 6516.834526 |
| 69 | 222.906858 | 349.317749 | 559.550963 | 912.200160 | 1507.602032 | 2517.666731 | 4236.902002 | 7169.517978 |
| 70 | 230.594064 | 364.290459 | 588.528511 | 967.932170 | 1614.134173 | 2720.080070 | 4619.223182 | 7887.469776 |
| 71 | 238.511886 | 379.862077 | 618.954936 | 1027.008100 | 1728.123566 | 2938.686476 | 5035.953268 | 8677.216754 |
| 72 | 246.667242 | 396.056560 | 650.902683 | 1089.628586 | 1850.092216 | 3174.781394 | 5490.189062 | 9545.938429 |
| 73 | 255.067260 | 412.898823 | 684.447817 | 1156.006301 | 1980.598671 | 3429.763905 | 5985.306078 | 10501.532272 |
| 74 | 263.719277 | 430.414775 | 719.670208 | 1226.366679 | 2120.240578 | 3705.145017 | 6524.983625 | 11552.685499 |
| 75 | 272.630856 | 448.631366 | 756.653718 | 1300.948680 | 2269.657418 | 4002.556619 | 7113.232151 | 12708.954049 |
| 76 | 281.809781 | 467.576621 | 795.486404 | 1380.005601 | 2429.533438 | 4323.761148 | 7754.423045 | 13980.849454 |
| 77 | 291.264075 | 487.279686 | 836.260724 | 1463.805937 | 2600.600778 | 4670.662040 | 8453.321119 | 15379.934399 |
| 78 | 301.001997 | 507.770873 | 879.073761 | 1552.634293 | 2783.642833 | 5045.315003 | 9215.120019 | 16918.927839 |
| 79 | 311.032057 | 529.081708 | 924.027449 | 1646.792350 | 2979.497831 | 5449.940204 | 10045.480821 | 18611.820623 |
| 80 | 321.363019 | 551.244977 | 971.228821 | 1746.599891 | 3189.062679 | 5886.935420 | 10950.574095 | 20474.002686 |
| 81 | 332.003909 | 574.294776 | 1020.790262 | 1852.395885 | 3413.297067 | 6358.890253 | 11937.125764 | 22522.402954 |
| 82 | 342.964027 | 598.266567 | 1072.829775 | 1964.539638 | 3653.227862 | 6868.601474 | 13012.467082 | 24775.643250 |
| 83 | 354.252947 | 623.197229 | 1127.471264 | 2083.412016 | 3909.953812 | 7419.089592 | 14184.589120 | 27254.207575 |
| 84 | 365.880536 | 649.125119 | 1184.844827 | 2209.416737 | 4184.650579 | 8013.616759 | 15462.202141 | 29980.628332 |
| 85 | 377.856952 | 676.090123 | 1245.087069 | 2342.981741 | 4478.576119 | 8655.706100 | 16854.800333 | 32979.691165 |
| 86 | 390.192660 | 704.133728 | 1308.341422 | 2484.560646 | 4793.076448 | 9349.162587 | 18372.732363 | 36278.660282 |
| 87 | 402.898440 | 733.299078 | 1374.758493 | 2634.634285 | 5129.591799 | 10098.095594 | 20027.278276 | 39907.526310 |
| 88 | 415.985393 | 763.631041 | 1444.496418 | 2793.712342 | 5489.663225 | 10906.943242 | 21830.733321 | 43899.278941 |
| 89 | 429.464955 | 795.176282 | 1517.721239 | 2962.335082 | 5874.939651 | 11780.498701 | 23796.499320 | 48290.006835 |
| 90 | 443.348904 | 827.983334 | 1594.607301 | 3141.075187 | 6287.185426 | 12723.938597 | 25939.184258 | 53120.227519 |
| 91 | 457.649371 | 862.102667 | 1675.337666 | 3330.539698 | 6728.288406 | 13742.853685 | 28274.710842 | 58433.250271 |
| 92 | 472.378852 | 897.586774 | 1760.104549 | 3531.372080 | 7200.268594 | 14843.281980 | 30820.434817 | 64277.575298 |
| 93 | 487.550218 | 934.490244 | 1849.109776 | 3744.254405 | 7705.287396 | 16031.744538 | 33595.273951 | 70706.322827 |
| 94 | 503.176724 | 972.869854 | 1942.565265 | 3969.909669 | 8245.657514 | 17315.284101 | 36619.848607 | 77777.966110 |
| 95 | 519.272026 | 1012.784648 | 2040.693528 | 4209.104250 | 8823.853540 | 18701.506829 | 39916.634981 | 85556.762721 |
| 96 | 535.850187 | 1054.296034 | 2143.728205 | 4462.650504 | 9442.523288 | 20198.627376 | 43510.132130 | 94113.438993 |
| 97 | 552.925692 | 1097.467876 | 2251.914615 | 4731.409535 | 10104.499918 | 21815.517566 | 47427.044021 | 103525.782892 |
| 98 | 570.513463 | 1142.366591 | 2365.510346 | 5016.294107 | 10812.814912 | 23561.758971 | 51696.477983 | 113879.361182 |
| 99 | 588.628867 | 1189.061254 | 2484.785863 | 5318.271753 | 11570.711950 | 25447.699689 | 56350.161002 | 125268.297300 |
| 100 | 607.287733 | 1237.623705 | 2610.025156 | 5638.368058 | 12381.661793 | 27484.515664 | 61422.675492 | 137796.127030 |

## TABLE IV.

The Present Value of One Pound *per Annum*, for any Number of Years to come, not exceeding 100, at the several Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Interest.

| Ye. | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 1 | .970874 | .961539 | .952381 | .943396 | .934579 | .925926 | .917431 | .909091 |
| 2 | 1.913370 | 1.886095 | 1.859410 | 1.833393 | 1.808018 | 1.783265 | 1.759111 | 1.735537 |
| 3 | 2.828612 | 2.775091 | 2.723248 | 2.673012 | 2.624316 | 2.577097 | 2.531295 | 2.486852 |
| 4 | 3.717099 | 3.629896 | 3.545950 | 3.465106 | 3.387211 | 3.312127 | 3.239720 | 3.169865 |
| 5 | 4.579707 | 4.451823 | 4.329477 | 4.212364 | 4.100198 | 3.992710 | 3.889651 | 3.790787 |
| 6 | 5.497192 | 5.242137 | 5.075612 | 4.917325 | 4.766540 | 4.622880 | 4.485919 | 4.355261 |
| 7 | 6.230283 | 6.002055 | 5.786374 | 5.582382 | 5.389290 | 5.206371 | 5.032953 | 4.868419 |
| 8 | 7.019693 | 6.732745 | 6.463213 | 6.209794 | 5.971299 | 5.746640 | 5.534819 | 5.334926 |
| 9 | 7.7861.9 | 7.435332 | 7.107822 | 6.801692 | 6.515233 | 6.246889 | 5.995247 | 5.759024 |
| 10 | 8.530203 | 8.110896 | 7.721735 | 7.360087 | 7.023582 | 6.710082 | 6.417658 | 6.144567 |
| 11 | 9.252625 | 8.760477 | 8.306415 | 7.886875 | 7.498675 | 7.138965 | 6.805191 | 6.495061 |
| 12 | 9.954005 | 9 385074 | 8.863252 | 8.383844 | 7.942687 | 7.536079 | 7.160725 | 6.813692 |
| 13 | 10.634956 | 9.985648 | 9.393573 | 8.852683 | 8.357652 | 7.903777 | 7.486904 | 7.103356 |
| 14 | 11.296074 | 10.563124 | 9.898641 | 9.294984 | 8.745459 | 8.244238 | 7.786151 | 7.366683 |
| 15 | 11.937936 | 11.118388 | 10.379658 | 9.712249 | 9.107915 | 8.559480 | 8.060689 | 7.606080 |
| 16 | 12.561103 | 11.652297 | 10.837770 | 10.105895 | 9.446649 | 8.851370 | 8.312559 | 7.823709 |
| 17 | 13.166120 | 12.165670 | 11.274067 | 10.477260 | 9.763224 | 9.121639 | 8.543632 | 8.021553 |
| 18 | 13.753515 | 12.659298 | 11.689587 | 10.827603 | 10.059088 | 9.371888 | 8.755625 | 8.201412 |
| 19 | 14.323801 | 13.133941 | 12.085321 | 11.158116 | 10.335595 | 9.603601 | 8.950115 | 8.364920 |
| 20 | 14.877476 | 13.590328 | 12.462211 | 11.469921 | 10.594016 | 9.818149 | 9.128546 | 8.513564 |
| 21 | 15.415026 | 14.029162 | 12.821153 | 11.764077 | 10.835525 | 10.016805 | 9.292244 | 8.648694 |
| 22 | 15.938918 | 14.451117 | 13.163003 | 12.041582 | 11.061242 | 10.200745 | 9.442426 | 8.771540 |
| 23 | 16.443610 | 14.856843 | 13.488574 | 12.303379 | 11.272189 | 10.371061 | 9.580207 | 8.883218 |
| 24 | 16.935544 | 15.246965 | 13.798642 | 12.550357 | 11.469335 | 10.528760 | 9.706612 | 8.984744 |
| 25 | 17.413149 | 15.622082 | 14.093945 | 12.783356 | 11.653585 | 10.674778 | 9.822580 | 9.077040 |
| 26 | 17.876844 | 15.982771 | 14.375185 | 13.003166 | 11.825780 | 10.809980 | 9.928973 | 9.160945 |
| 27 | 18.327033 | 16.329587 | 14.643034 | 13.210534 | 11.986710 | 10.935167 | 10.026580 | 9.237223 |
| 28 | 18.764110 | 16.663065 | 14.898128 | 13.406164 | 12.137113 | 11.051081 | 10.116128 | 9.306566 |
| 29 | 19.188456 | 16.983716 | 15.141074 | 13.590721 | 12.277676 | 11.158408 | 10.198283 | 9.369606 |
| 30 | 19.600443 | 17.292035 | 15.372452 | 13.764831 | 12.409043 | 11.257785 | 10.273654 | 9.426914 |
| 31 | 20.000430 | 17.588495 | 15.592811 | 13.929086 | 12.531816 | 11.349802 | 10.342802 | 9.479013 |
| 32 | 20.388767 | 17.873553 | 15.802677 | 14.084043 | 12.646557 | 11.435002 | 10.406240 | 9.526376 |
| 33 | 20.765793 | 18.147647 | 16.002550 | 14.230229 | 12.753792 | 11.513891 | 10.464441 | 9.569432 |
| 34 | 21.131838 | 18.411199 | 16.192905 | 14.368141 | 12.854011 | 11.586936 | 10.517836 | 9.608575 |
| 35 | 21.487222 | 18.664615 | 16.374195 | 14.498246 | 12.947674 | 11.654570 | 10.566822 | 9.644159 |
| 36 | 21.832254 | 18.908284 | 16.546852 | 14.620987 | 13.035209 | 11.717195 | 10.611763 | 9.676508 |
| 37 | 22.167237 | 19.142580 | 16.711288 | 14.736780 | 13.117018 | 11.775181 | 10.652994 | 9.705917 |
| 38 | 22.492464 | 19.367866 | 16.867893 | 14.846019 | 13.193475 | 11.828871 | 10.690820 | 9.732651 |
| 39 | 22.808217 | 19.584486 | 17.017041 | 14.949074 | 13.264930 | 11.878585 | 10.725523 | 9.756956 |
| 40 | 23.114774 | 19.792775 | 17.159087 | 15.046297 | 13.331710 | 11.924615 | 10.757360 | 9.779051 |
| 41 | 23.412402 | 19.993053 | 17.294369 | 15.138016 | 13.394122 | 11.967237 | 10.786569 | 9.799137 |
| 42 | 23.701361 | 20.185628 | 17.423208 | 15.224543 | 13.452451 | 12.006701 | 10.813366 | 9.817397 |
| 43 | 23.981904 | 20.370797 | 17.545913 | 15.306173 | 13.506963 | 12.043242 | 10.837951 | 9.833998 |
| 44 | 24.254276 | 20.548843 | 17.662774 | 15.383182 | 13.557910 | 12.077076 | 10.860505 | 9.849089 |
| 45 | 24.518715 | 20.720041 | 17.774070 | 15.455832 | 13.605523 | 12.108404 | 10.881197 | 9.862808 |
| 46 | 24.775451 | 20.834655 | 17.880067 | 15.524370 | 13.650022 | 12.137411 | 10.900181 | 9.875280 |
| 47 | 25.024710 | 21.042938 | 17.981016 | 15.589028 | 13.691609 | 12.164269 | 10.917597 | 9.886618 |
| 48 | 25.266709 | 21.195133 | 18.077158 | 15.650026 | 13.730476 | 12.189139 | 10.933576 | 9.896925 |
| 49 | 25.501659 | 21.341474 | 18.168722 | 15.707572 | 13.766800 | 12.212165 | 10.948235 | 9.906296 |
| 50 | 25.729766 | 21.482186 | 18.255925 | 15.761860 | 13.800748 | 12.233487 | 10.961683 | 9.914814 |

## TABLE IV. continu'd.

Being the Preſent Value of One Pound *per Annum*, for any Number of Years to come, not exceeding 100, at the ſeveral Rates of 3, 4, 5, 6, 7, 8, 9, and 10 *l. per Cent. per Ann.* Compound Intereſt.

| Ye. | 3 *per Cent.* | 4 *per Cent.* | 5 *per Cent.* | 6 *per Cent.* | 7 *per Cent.* | 8 *per Cent.* | 9 *per Cent.* | 10 *per Cent.* |
|---|---|---|---|---|---|---|---|---|
| 51 | 25.951230 | 21.617487 | 18.338977 | 15.813076 | 13.832475 | 12.253229 | 10.974021 | 9.922558 |
| 52 | 26.166242 | 21.747584 | 18.418074 | 15.861392 | 13.862126 | 12.271508 | 10.985341 | 9.929599 |
| 53 | 26.374993 | 21.872677 | 18.493403 | 15.906974 | 13.889838 | 12.288434 | 10.995725 | 9.935999 |
| 54 | 26.577663 | 21.992958 | 18.565146 | 15.949975 | 13.915736 | 12.304105 | 11.005253 | 9.941817 |
| 55 | 26.774430 | 22.108614 | 18.633472 | 15.990543 | 13.939941 | 12.318616 | 11.013993 | 9.947106 |
| 56 | 26.965466 | 22.219821 | 18.698545 | 16.028814 | 13.962561 | 12.332052 | 11.022012 | 9.951915 |
| 57 | 27.150938 | 22.326751 | 18.760519 | 16.064919 | 13.983702 | 12.344493 | 11.029369 | 9.956286 |
| 58 | 27.331008 | 22.429568 | 18.819542 | 16.098980 | 14.003460 | 12.356012 | 11.036118 | 9.960260 |
| 59 | 27.505833 | 22.528431 | 18.875754 | 16.131113 | 14.021926 | 12.366678 | 11.042310 | 9.963873 |
| 60 | 27.675566 | 22.623491 | 18.929290 | 16.161428 | 14.039185 | 12.376554 | 11.047991 | 9.967157 |
| 61 | 27.840356 | 22.714896 | 18.980276 | 16.190026 | 14.055311 | 12.385698 | 11.053203 | 9.970143 |
| 62 | 28.000346 | 22.802784 | 19.028834 | 16.217006 | 14.070384 | 12.394165 | 11.057984 | 9.972857 |
| 63 | 28.155675 | 22.887293 | 19.075080 | 16.242458 | 14.084371 | 12.402005 | 11.062371 | 9.975325 |
| 64 | 28.306481 | 22.968551 | 19.119124 | 16.266470 | 14.097637 | 12.409264 | 11.066395 | 9.977568 |
| 65 | 28.452894 | 23.046683 | 19.161071 | 16.289123 | 14.109941 | 12.415989 | 11.070087 | 9.979607 |
| 66 | 28.595043 | 23.121811 | 19.201020 | 16.310493 | 14.121440 | 12.422209 | 11.073475 | 9.981461 |
| 67 | 28.733052 | 23.194049 | 19.239066 | 16.330654 | 14.132187 | 12.427971 | 11.076582 | 9.983146 |
| 68 | 28.867041 | 23.263509 | 19.275301 | 16.349673 | 14.142231 | 12.433307 | 11.079433 | 9.984679 |
| 69 | 28.967127 | 23.330297 | 19.309811 | 16.367616 | 14.151618 | 12.438247 | 11.082049 | 9.986071 |
| 70 | 29.123424 | 23.394516 | 19.342677 | 16.384544 | 14.160391 | 12.442822 | 11.084448 | 9.987338 |
| 71 | 29.246043 | 23.456266 | 19.373978 | 16.400513 | 14.168590 | 12.447057 | 11.086650 | 9.988489 |
| 72 | 29.365090 | 23.515640 | 19.403789 | 16.415578 | 14.176252 | 12.450979 | 11.988670 | 9.989535 |
| 73 | 29.480670 | 23.572731 | 19.432180 | 16.429791 | 14.183413 | 12.454610 | 11.090523 | 9.990487 |
| 74 | 29.592884 | 23.627626 | 19.459219 | 16.443199 | 14.190106 | 12.457973 | 11.092223 | 9.991351 |
| 75 | 29.701829 | 23.680410 | 19.484970 | 16.455848 | 14.196361 | 12.461086 | 11.093782 | 9.992138 |
| 76 | 29.807601 | 23.731163 | 19.509495 | 16.467781 | 14.202207 | 12.463969 | 11.095213 | 9.992852 |
| 77 | 29.910293 | 23.779965 | 19.532853 | 16.479039 | 14.207670 | 12.466638 | 11.096526 | 9.993502 |
| 78 | 30.009993 | 23.826889 | 19.555098 | 16.489659 | 14.212776 | 12.469109 | 11.097730 | 9.994093 |
| 79 | 30.106789 | 23.872009 | 19.576284 | 16.499678 | 14.217547 | 12.471397 | 11.098835 | 9.994630 |
| 80 | 30.200766 | 23.915393 | 19.596461 | 16.509131 | 14.222007 | 12.473516 | 11.099849 | 9.995118 |
| 81 | 30.292006 | 23.957109 | 19.615677 | 16.518048 | 14.226175 | 12.475478 | 11.100778 | 9.995562 |
| 82 | 30.380589 | 23.997220 | 19.633978 | 16.526460 | 14.230070 | 12.477295 | 11.101632 | 9.995965 |
| 83 | 30.466591 | 24.035789 | 19.651408 | 16.534396 | 14.233710 | 12.478977 | 11.102414 | 9.996332 |
| 84 | 30.550088 | 24.072874 | 19.668007 | 16.541883 | 14.237113 | 12.480534 | 11.103132 | 9.996665 |
| 85 | 30.631154 | 24.108533 | 19.683816 | 16.548947 | 14.240292 | 12.481076 | 11.103791 | 9.996969 |
| 86 | 30.709858 | 24.142820 | 19.698873 | 16.555610 | 14.243264 | 12.483311 | 11.104396 | 9.997244 |
| 87 | 30.786270 | 24.175788 | 19.713212 | 16.561896 | 14.246041 | 12.484548 | 11.104950 | 9.997495 |
| 88 | 30.860457 | 24.207489 | 19.729869 | 16.567827 | 14.248637 | 12.485692 | 11.105459 | 9.997723 |
| 89 | 30.932482 | 24.237970 | 19.739875 | 16.573421 | 14.251062 | 12.486751 | 11.105925 | 9.997930 |
| 90 | 31.002410 | 24.267279 | 19.752262 | 16.578699 | 14.253329 | 12.487734 | 11.106354 | 9.998118 |
| 91 | 31.070301 | 24.295461 | 19.764059 | 16.583679 | 14.255448 | 12.488642 | 11.106746 | 9.998289 |
| 92 | 31.136215 | 24.322558 | 19.775294 | 16.588376 | 14.257428 | 12.489484 | 11.107107 | 9.998444 |
| 93 | 31.200209 | 24.348614 | 19.785994 | 16.592808 | 14.259279 | 12.490263 | 11.107437 | 9.998586 |
| 94 | 31.262338 | 24.373667 | 19.796185 | 16.596988 | 14.261008 | 12.490984 | 11.107741 | 9.968714 |
| 95 | 31.322659 | 24.397757 | 19.805891 | 16.600932 | 14.262625 | 12.491652 | 11.108019 | 9.998831 |
| 96 | 31.381222 | 24.420900 | 19.815134 | 16.604653 | 14.264135 | 12.492271 | 11.108274 | 9.998937 |
| 97 | 31.438080 | 24.443193 | 19.823937 | 16.608163 | 14.265547 | 12.492843 | 11.108509 | 9.999034 |
| 98 | 31.493281 | 24.464608 | 19.832321 | 16.611475 | 14.266866 | 12.493373 | 11.108723 | 9.999122 |
| 99 | 31.546875 | 24.485200 | 19.840306 | 16.614599 | 14.268099 | 12.493864 | 11.108921 | 9.999202 |
| 100 | 31.598908 | 24.505000 | 19.847910 | 16.617546 | 14.269252 | 12.494319 | 11.109101 | 9.999274 |
| F.S. | 33.333333 | 25.000000 | 20.000000 | 16.666667 | 14.285714 | 12.500000 | 11.111111 | 10.000000 |

*The Uſe of the preceding* Tables.

The Amount or preſent Value of any Sum of Money, for any Number of Years, not exceeding 100, at any of the aforeſaid Rates of Intereſt, is thus found:

Look in the firſt or ſecond Table for the Number of Years, and even with that Number, under the Rate of Intereſt, is the Amount or preſent Value of 1 *l.* which Amount or preſent Value ſo found, being multiply'd by the principal Sum, the Product is the Amount or preſent Value requir'd.

After the ſame manner, the Amount or preſent Value of any Annuity, or other yearly Payment, is found by the third or fourth Table.

*Examples.*

Queſt 1. *What will* 125 l. *amount unto in* 15 *Years*, at 5 *l.* per Cent. per Ann. *Compound Intereſt?*

In *Table* I. even with 15 Years, and under 5 *l. per Cent.* I find the Amount of 1 *l.* to be } 2.078928
Which multiply'd by the Principal - - 125

The Product will be - - - 259.866, &c.

*Anſw.* 259 *l.* 17 *s.* 4 *d.*

Queſt. 2. *What is the preſent Value of* 259 l. 17 s. 4 d. *to be paid at the End of* 15 *Years, diſcounting at the Rate of* 5 l. per Cent. per. Ann. *Compound Intereſt?*

In *Table* II. even with 15 Years, and under 5 *l. per Cent.* I find the preſent Value of 1 *l.* to be } .481017
Which multiply'd by the Principal } 259.8667

The Product will be - - - 125.000, &c.

*Anſw.* 125 *l.*

Queſt. 3. *What will* 15 l. per Ann. *amount unto in* 21 *Years, at* 8 l. per Cent. per Ann. *Compound Intereſt?*

In *Table* III. even with 21 Years, and under 8 *l. per Cent.* I find the Amount of 1 *l. per Ann.* to be } 50.422921
Which multiply'd by - - - - - - - - 15

The Product will be - - - 756.343815

*Anſw.* 756 *l.* 6 *s.* 10 ½ *d.*

Queſt. 4. *What is the preſent Value of* 15 l. per Ann. *for* 21 *Years to come, at* 8 l. per Cent. per Ann. *Compound Intereſt?*

In *Table* IV. even with 21 Years, and under 8 *l. per Cent.* I find the preſent Value of 1 *l. per Ann.* to be } 10.016805
Which multiply'd by - - - - - - - - 15

The Product will be - - - 150.252075

*Anſw.* 150 *l.* 5 *s.* 0 ½ *d.*

Queſt. 5. *What will* 150 *l.* 5 *s.* 0 ½ *d. amount unto in* 21 *Years, at* 8 l. per Cent. per Ann. *Compound Intereſt?*

In *Table* I. even with 21 Years, and under 8 *l. per Cent.* I find the Amount of 1 *l.* to be } 5.033834
Which multiply'd by - - - - - 150.252

The Product will be - - - 756.343, &c.

*Anſw.* 756 *l.* 6 *s.* 10 ½ *d.*

Which Anſwer is the ſame with that given to the third Queſtion, and ſhews the Agreement of the Tables one with the other.

Queſt. 6. *One having the Leaſe of an Eſtate, Value* 60 l. per Ann. *more than the reſerv'd Rent,* 12 *Years to come, would know what Sum ought to be paid, to add* 28 *Years to the Term, and thereby make it* 40 *Years to come, computing at the Rate of* 6 l. per Cent. per Ann. *Compound Intereſt?*

I find in *Tab.* IV. the preſent Value of 1 *l. per Ann.* for 40 Years to come, at 6 *l. per Cent. per Ann.* to be } 15.046297
I find in the ſame *Table* the Value of 1 *l. per Ann.* for 12 Years to come, at the ſame Rate, to be } 8.383844

The Difference is - - - - 6.662453
Which multiply'd by - - - - 60

The Product will be - - 399.747180

*Anſw.* 399 *l.* 14 *s.* 11 ¼ *d.*

Queſt. 7. A *has the Poſſeſſion of an Eſtate of* 100 l. per Ann. 15 *Years to come,* B *has the Reverſion of the ſame Eſtate for ever, after the Expiration of the ſaid* 15 *Years. It is demanded, What is the preſent Value of* A's *Term of* 15 *Years? And, What the preſent Value of* B's *Reverſion, computing at the Rate of* 5 l. per Cent. per Ann. *Compound Intereſt?*

I find in the laſt Line of *Table* IV. under 5 *l. per Cent.* the Fee Simple of 1 *l. per Ann.* to be worth 20 *l.* which multiply'd by 100, the Product is } 2000.
I find in the ſame *Table*, the Value of 1 *l. per Ann.* 15 Years to come, at the ſame Rate, to be 10.379658; which multiply'd by 100. the Product is } 1037.9658

The Difference is - - - 962.0342

*Anſw.* 1037 *l.* 19 *s.* 3 ¾ *d.* the Poſſeſſ. 15 Ys. to come.
962 *l.* 0 *s.* 8 ¼ *d.* the Reverſ. after the ſaid (15 Years.
2000 *l.* - - the Fee Simple.

Queſt. 8. *For a Leaſe of certain Profits for ſeven Years,* A *makes two Offers, either to pay* 150 l. *as a Fine, and* 300 l. per Ann. *or* 1700 l. *Fine, without any Rent.* B *bids* 650 l. *Fine, and* 200 l. per Ann. *And* C 200 l. *Fine, and* 405 l. per Ann. *The*

*The Queſtion is, which is the beſt Offer, and what the Difference, computing at the Rate of* 5 l. per Cent. per Ann. *Compound Intereſt?*

| | |
|---|---|
| The Amount of 1 *l.* in 7 Years at 5 *l. per Cent.* (in *Table* I.) multiply'd by 150 *l.* is | *l.* *s.* *d.* 211 01 03½ |
| The Amount of 1 *l. per Ann.* in 7 Years, at 5 *l. per Cent.* (in *Table* III.) multiply'd by 300 *l.* is | 2442 12 00½ |
| Therefore *A*'s firſt Offer, at the End of 7 Years, will amount unto | 2653 13 04 |
| The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 1700 *l.* is what *A*'s 2d Offer will amount to in the ſame time | 2392 01 05 |
| The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 650 *l.* is | 914 12 03½ |
| The Amount of 1 *l. per Ann* in 7 Years, at 5 *l. per Cent.* multiply'd by 200 *l.* is | 1628 08 00½ |
| Therefore *B*'s Offer, at the End of 7 Years, will amount unto | 2543 00 04 |
| The Amount of 1 *l.* in 7 Years, at 5 *l. per Cent.* multiply'd by 200 *l.* is | 281 08 05 |
| The Amount of 1 *l. per Ann.* in 7 Years, at 5 *l. per Cent.* multiply'd by 405 *l.* is | 3297 10 03 |
| Therefore *C*'s Offer, at the End of 7 Years, will amount unto | 3578 18 08 |

The Amounts of the ſaid Offers, at the End of the ſaid Term, being thus known, look (in *Tab.* II.) for the preſent Value of 1 *l.* payable at the End of 7 Years, at 5 *l. per Cent.* which will be found to be .710682. Which ſaid Value being multiply'd by the ſaid ſeveral Amounts, the Products will be the preſent Value of the ſaid ſeveral Offers, *Viz.*

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| The preſent Value of *A*'s 1ſt will be | 1885 | 18 | 03 |
| *A*'s 2d | 1700 | 00 | 00 |
| *B*'s | 1807 | 05 | 06 |
| *C*'s | 2543 | 09 | 08 |

Therefore the preſent Value of what *C* offers is more than *A*'s 1ſt. 657 11 05
*A*'s 2d. 843 09 08
*B*'s 736 04 02

Which anſwers the Queſtion.

Or thus;

| | | | |
|---|---|---|---|
| *A*'s 1ſt Offer is 300 *l. per Ann.* | *l.* | *s.* | *d.* |
| the preſent Value of which, for 7 Years, at 5 *l. per Cent.* is | 1735 | 03 | 06 |
| And a Fine of — — | 150 | 00 | 00 |
| | 1885 | 18 | 03 |
| *A*'s 2d Offer is a Fine of | 1700 | 00 | 00 |

| | |
|---|---|
| *B*'s Offer is 200 *l. per Ann*, the preſent Value of which, for 7 Years, at 5 *l. per Cent.* is | 1157 05 06 |
| And a Fine of — — | 650 00 00 |
| | 1807 05 06 |
| *C*'s Offer is 405 *l. per Cent.* the preſent Value of which, for 7 Years, at 5 *l. per Cent.* is | 2343 09 00 |
| And a Fine of — — | 200 00 00 |
| | 2543 09 08 |

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| Therefore *C*'s is more than *A*'s 1ſt | 657 | 11 | 05 |
| *A*'s 2d | 843 | 09 | 08 |
| *B*'s — | 736 | 04 | 02 |

Queſt. 9. A *gives* 1550 l. *for an Annuity of* 100 l. per Ann. *for* 99 *Years.* B *puts* 1550 l. *out at Intereſt. It is requir'd to know, which will amount to the greateſt Sum, at the End of the ſaid* 99 *Years, at the Rate of* 6 l. per Cent. per Ann. *Compound Intereſt?*

| | | | |
|---|---|---|---|
| The Amount of 1 *l. per Ann.* in 99 Years, at 6 *l. per Cent.* (in *Tab.* III.) multiply'd by 100 *l.* is | *l.* 531827 | *s.* 03 | *d.* 06 |
| The Amount of 1 *l.* in 99 Years, at 6 *l. per Cent.* (in *Tab.* I.) multiply'd by 1550 *l.* is | 496149 | 05 | 5½ |
| Therefore *A*'s 100 *l. per Ann.* will amount to more than *B*'s 1550 *l.* in that Term. | 35677 | 18 | 0½ |

Which anſwers the Queſtion.

If the preſent Value of that Difference is required, find the preſent Value of 1 *l.* payable at the End of 99 Years, at 6 *l. per Cent.* (in *Table* II.) which multiply'd by the Difference, the Product will be the preſent Value thereof, *viz.* 111 *l.* 9 *s.* 2 *d.*

The preſent Value of the Difference is likewiſe thus found:

| | |
|---|---|
| Find the preſent Value of 1 *l. per Ann.* for 99 Years to come, at 6 *l. per Cent.* (in *Tab.* IV.) which multiply'd by 100 *l.* the Product will be | 1661 09 02 |
| Which is the preſent Value of 100 *l. per Ann.* for 99 Years, at 6 *l. per Cent.* | |
| And from which ſubtract | 1550 00 00 |
| There will remain — — | 111 09 02 |

Which is the preſent Value of the Difference.

Or thus:

The Intereſt of *B*'s 1550 *l.* at 6 *l. per Cent.* is 93 *l. per Ann.* Therefore *A* receives 7 *l. per Ann.* more than *B.*

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| The preſent Value of 7 *l. per Ann.* for 99 Years to come, at 6 *l. per Cent.* is | 116 | 06 | 0 |

| | l. | s. | d. |
|---|---|---|---|
| The preſent Value of 1550*l.* to be paid at the End of 99 Years, is | 4 | 16 | 10 |
| Therefore the preſent Value of the Difference, is | 111 | 09 | 03 |

After the ſame manner, moſt other uſeful Queſtions in *Compound Intereſt*, are eaſily anſwerd.

INTERTIES in a Building, are thoſe ſmall Pieces of Timber that lie horizontally between the Sommers; or between *them* and the *Sell* or *Reaſon*.

INTERVAL of the Fits of eaſy Reflexion, and of eaſy Tranſmiſſion of the Rays of Light, is the Spaces between every Return of the Fit, and the next Return.

Theſe *Intervals* Sir *Iſ. Newton* ſhews how to collect, and thence to determine whether the Rays ſhall be reflected or tranſmitted at their ſubſequent Incidence on any pellucid *Medium*. (See *Light*, *&c.* and *Newton's Opticks*, Book 2. Part 3.)

INTESTINES, are a long and large Pipe, which by ſeveral Turnings and Windings reaches from the *Pylorus* to the *Anus*: They are knit all along the Edge of a Membrane call'd the *Meſentery*, and are uſually ſix times as long as the Body to which they belong; that ſo the Chyle, which eſcapes the Lacteals of one of the Guts, may be taken up by thoſe in the next. They have three Coats, of which the inmoſt is made up of ſhort Fibres bound together by fine Blood-Veſſels, and diſpoſed as thoſe of the Stomach: For the Length of a Fibre is the Thickneſs of the Coat. This Coat being much larger than the other, lies in Wrinkles or Plaits, which are call'd *Valvulæ Conniventes*. It hath alſo a great Number of little Glands, which in the ſmall Guts lie in Cluſters every where, but where they are knit to the *Meſentery*, Theſe Glands ſeem to ſeparate a Liquor for the diluting of the thick Chyle, that it may the more eaſily enter the ſmall Orifices of the Lacteals. The ſecond Coat is made up of two Orders of Muſcular Fibres, one running ſtraight, according to the Length of the Guts; the other goes round, deſcribing rather a ſpiral than a circular Line. By the ſucceſſive Motion of theſe two Orders of the Fibres, the Guts are in a continual Undulation; which is called the *Vermicular* or *Periſtaltick* Motion of the *Inteſtines*. The third and external Coat is common, and comes from the *Peritonæum*.

The *Inteſtines*, tho' properly but one continued Pipe, yet are divided into ſix Parts; three thin and ſmall, and three thick and great. The thin and ſmall are the *Duodenum*, the *Jejunum*, and *Ileum*. Thick and great *Guts* are the *Cæcum*, *Colon*, and *Rectum*: See thoſe Words.

INTESTINE *Motion* of the Parts of Fluids. Where the attracting Corpuſcles of any Fluid are elaſtick, they muſt neceſſarily produce an *Inteſtine Motion*; and this greater or leſſer, according to the Degrees of their Elaſticity and attractive Forces.

For two elaſtick Particles, after meeting, will fly from one another (abſtracting from the Reſiſtance of the *Medium*) with the ſame Degree of Velocity that they met together with. (See *Elaſticity*.) But when in leaping back from one another they approach other Particles, their *Velocity* will be encreaſed.

INTRENCHMENTS, are all Sorts of Works made to fortify any Poſt againſt an Enemy: There is uſually a Ditch with a Parapet, or Rows of Faſcines loaded with Earth, Gabions, Sand-Bags, or Hogſheads filled with Earth to cover the Men from the Fire.

INVADIATIONES, was a Term formerly uſed in the Law for *Mortgages and Pledges*: And ſo *Invadiare*, was to *Mortgage Land*.

INVENTION, in Painting, Sculpture, *&c.* is the Art of finding out proper Objects for a Picture, by the Help of Hiſtory or ancient Fables, *&c.*

INVENTIONES, was the Term formerly for what is now call'd *Treaſure-Trove*, *viz.* Money or Goods found by any Perſon, and not challeng'd by any Owner: Which therefore by Common Law was due to the King (whence that old Rhyme uſed to this Day in many Countries by the Children, *Who has loſt? I have found, In the King's Holy Ground.*)
And King *Edw.* I. we find, granted to the *Barons of the Ports*, *Inventiones ſuas per Mare & Terras*, *&c.*

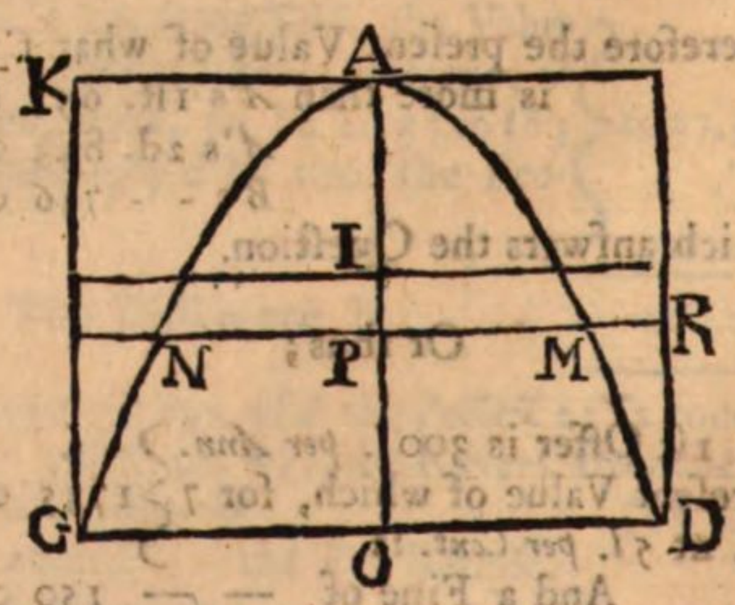
INVERSE *Method of Fluxions*, is the Method of finding the *Flowing Quantity* from the *Fluxion* given; and is the ſame with what the foreign Mathematicians call the *Calculus Integralis*: On which Subject there is a Treatiſe publiſh'd in *French* by Mr. *Carré*, *A. D.* 1700, Printed at *Paris*.

Some call it *Summatory Arithmetick*; and the Reaſon and Foundation of it Mr. *Hayes* ſhews in his Book of *Fluxions*.

He had, in *Prop.* 2. of his fourth Section, been ſhewing how to *inveſtigate the Area's of Hyperboliform Figures*: And in *Cor.* 3. of that *Propoſition*, he ſhews that 'tis manifeſt, that any *Parabola*, or the Complement of any *Parabola*, to the circumſcribed Parallelogram; or an *Hyperbola* being given: And ſuppoſing the Ordinate (*See Fig.* 2. *annex'd*) $PM = y$; the Abſciſſa $AP = x$; $PR = OD = b$; the Axis $OA = c$: That all the $PR$, or $b$'s are: to all the $PM$, or $y$'s: : as $m \div 1$: is to $m$.

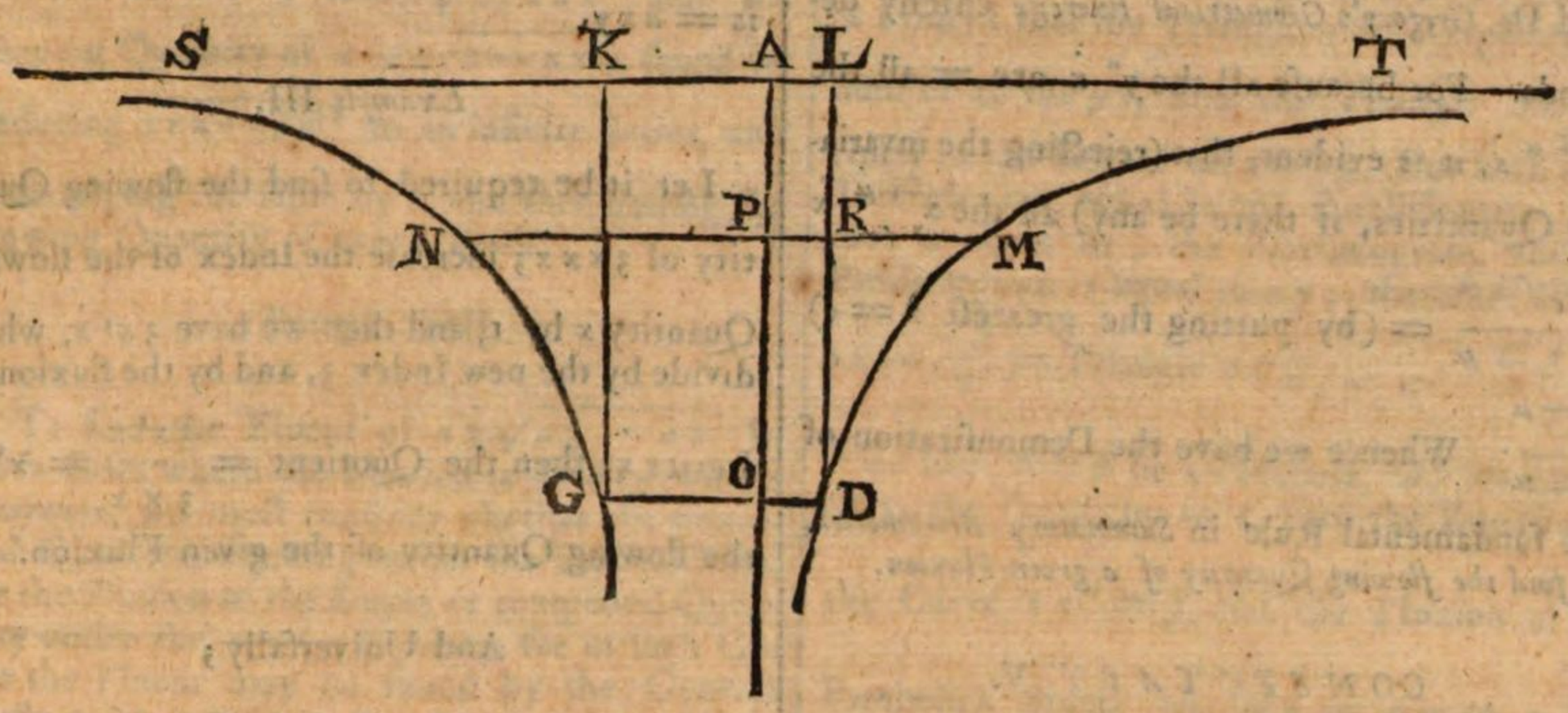
And if it be required to find what Proportion all the $b$'s, advanced to any Power $n$, has to all the $y$'s advanced to the ſame Power $n$, it may be thus inveſtigated.

Suppoſe the new Curve $NG$ to be deſcribed, ſo that $PN$ be always equal or proportional to $\overline{PM}^{n}$ or $y^{n}$, then it is manifeſt that the Sum of




all the $y^{n}$ is equal to the Sum of all the $PN$, or to the curvilineal Space $OAGN$: And becauſe $y^{n}$ is always equal or proportional to $PN$, and $PN$ becomes equal to $OG$, at the ſame time that

that $y^n$ becomes equal to $b^n = \overline{OD}|^n$; 'tis likewise manifeſt, that the Sum of all the $b^n$ is equal or proportional to the Sum of all the $OG$, or the Parallelogram $AOGK$. Whence it appears, that to inveſtigate the Proportion of all the $y^n$ to all the $b^n$ is the ſame thing as to inveſtigate the Proportion of the Curvilineal Space $AOGN$ to the Parallelogram $AOGK$. Which may be done




thus: In Paraboloids and Hyperboloids, the General Equation expreſſing the Nature of ſuch Curves is $y^m = x$, and conſequently $y^n = x^{\frac{n}{m}}$. Now ſuppoſe $y^n = z$, then $z = x^{\frac{n}{m}}$, and $z^m = x^n$, which is an Equation, expreſſing the Nature of a Paraboliform, or Hyperboliform Curve.

Let the ſaid Curve be $ANG$, and $AP = x$, $AO = c$, $PN = z$, and $OG = d$. Then (*Hayes*, Sect. 3. Art. 90.) $\frac{m}{n} \mp 1 : \frac{m}{n} :: (m \mp n : m)$ all the $d$: to all the $z$. And becauſe $z$ was put equal to $y^n$; therefore when $z$ or $PN$ becomes $OG$ or $d$, then $y^n$ becomes $b^n$; and conſequently $d$ is $= b^n$; therefore $m \mp n : m :: S : b^n : S : y^n$.

*Hence we may eaſily deduce the* 64*th* Prop. Arith. Infinit. *firſt diſcovered by the Learned Dr.* Wallis.

## CONSECTARY I.

1. For we found before $z = x^{\frac{n}{m}}$, and it is alſo $m : m + n :: 1 : 1 + \frac{n}{m} :: y^n : b^n$. *in the direct Series*, and $1 : 1 - \frac{n}{m} ::$ all the $y^n$ : all the $b^n$. *in the Negative Series.* Whence it is evident, that if the Exponent of the Power of the intercepted Diameter $x$, be taken for the Index of the *Series*, it will be as 1 is to the Power of the intercepted Diameter or Index of the *Series* (becauſe $z = y^n = x^{\frac{n}{m}}$; and conſequently, $x^{\frac{n}{m}}$ repreſents $y^n$ in the Dimenſion requir'd) *increas'd by Unity*; ſo are all the $y^n$ to all the $b^n$.

## CONSECTARY II.

2. Hitherto we have found the Proportion of all the $y^n$, or (multiplying both by the Fluxion $\dot{x}$) $y^n \dot{x}$ to all the $b^n \dot{x}$, their abſolute Value may be found thus: It was by the preceding *Corollary*, $m : m \mp n ::$ all the $z\dot{x}$ : all the $d\dot{x}$; that is, ſo is the Space $AOGN$, to the Rectangle $AOGK = dc$: Therefore $\frac{m\,dc}{m \mp n} =$ all the $z\dot{x} = S : \dot{y}^n \dot{x}$, (becauſe $z = y^n$.) But $b^n = d$; Therefore $S : y^n \dot{x} = \frac{m\,dc}{m \mp n} = \frac{m\,c\,b^n}{m \mp n} = \frac{1\,c\,b^n}{1 \mp \frac{n}{m}}$.

## CONSECTARY III.

3. And if we ſuppoſe the Index $\mp \frac{n}{m} = \mp \mu$, then the Value of all the $y^n \dot{x}$ is $= \frac{1\,c\,b^n}{1 \mp \mu}$; and again, If in the Place of $b^n$ we ſubſtitute $c^{\mp \mu}$ (becauſe $y^n = x^{\mp \frac{n}{m}}$, that is, when $y$ becomes $= b$,

and $x = c, c^{\mp\frac{n}{m}} = b^n = c^{\mp\mu}$) we shall have all the $y^n \dot{x} = \frac{c^{1\mp\mu}}{1\mp\mu}$.

### CONSECTARY IV.

4°. Hence *Mercator's Lem. Prop. 16. Logarithmotechn.* may be deduced, upon which the Learned Dr. *Gregory's Geometrical Exercise* chiefly depends. For because all the $y^n \dot{x}$ are = all the $x^{\mp\mu}\dot{x}$, it is evident, that (rejecting the invariable Quantities, if there be any) all the $x^{\mp\mu}\dot{x} = \frac{c^{1\mp\mu}}{1\mp\mu} =$ (by putting the greatest $x = c$) $\frac{x^{1-\mu}}{1\mp\mu}$. Whence we have the Demonstration of the fundamental Rule in *Summatory Arithmetick, to find the flowing Quantity of a given Fluxion.*

### CONSECTARY V.

5°. For instance, if the Right Line $AO = c$ be divided into an infinite Number of $\dot{x}$, the Sum of all the Rectangles contain'd under any Power of the Abscissa $x$, and all the $\dot{x}$ respectively, that is, the Sum of all the $x^{\mp\mu}\dot{x}$, or the *Flowing Quantity*, whereof $x^{\mp\mu}\dot{x}$ is the Fluxion, is equal to $\frac{c^{1\mp\mu}}{1\mp\mu} = \frac{x^{\mp\mu+1}}{\mp\mu+1} =$ to the Power of $x$ increased by Unity, and divided by the new Exponent. And seeing the Thread of my Discourse has led me on to this Head, I shall insist more at large on the same in the next.

## PROP. I.

*To find the flowing Quantity of any Fluxion.*

The summing up of Infinites, or finding the Sum of all the Fluxions of an unknown Quantity, or the finding the Flowing Quantity from its Fluxion given, is not less difficult in many Cases, than the Reverse is easy. I shall begin with the easiest Examples, and proceed gradually to those that are more intricate and difficult.

*Example* I.

Let it be required to find the flowing Quantity of this Fluxion $a\,a\dot{x}$, or $a\,a\,x^0\dot{x}$; to the Index of the flowing Quantity add 1, and then we have $a\,a\,x^{0+1}\dot{x}$; divide this by the fluxionary Letter $\dot{x}$, and by the new Index $0+1$, or 1, the Quotient $a\,a\,x$ is the flowing Quantity of the given Fluxion.

*Example* II.

Let it be required to find the flowing Quantity of $a\,y\dot{x} + a\,x\dot{y}$; the flowing Quantity of the first Member $a\,y\dot{x}$ is $= a\,x\,y$; and that of the second Member $a\,x\dot{y}$ is $= a\,x\,y$: Whence it is plain, that the flowing Quantity of $a\,y\dot{x} + a\,x\dot{y}$ is $= a\,x\,y$.

*Example* III.

Let it be required to find the flowing Quantity of $3\,x\,x\,\dot{x}$; increase the Index of the flowing Quantity $x$ by 1, and then we have $3\,x^3\dot{x}$, which divide by the new Index 3, and by the fluxionary Letter $\dot{x}$, then the Quotient $= \frac{3\,x^3\dot{x}}{3\times\dot{x}} = x^3$ is the flowing Quantity of the given Fluxion.

And Universally;

If it be requir'd to find the flowing Quantity of $m\,x^{m-1}\dot{x}$, increase the *Index* of the flowing Quantity $x$ by 1, and then we have $m\,x^m\dot{x}$, which divide by the new *Index* $m$, and by the fluxionary Letter $\dot{x}$, and there will arise $x^m$ for the flowing Quantity requir'd.

*Example* IV.

Let it be required to find the flowing Quantity of $\frac{a\dot{x}}{x\,x}$; the Fluxion (*Hayes, Art. 16.*) express'd by the other way of Notation, is $a\,x^{-2}\dot{x}$, and the flowing Quantity thereof is $-a\,x^{-1} = \frac{-a}{x}$. Thus the Flowing Quantity of $\frac{a\,x\,\dot{x}}{x^{\frac{3}{2}}} = \frac{a\,\dot{x}}{x^{\frac{1}{2}}} = a\,x^{-\frac{1}{2}}\dot{x}$ is $= 2\,a\,x^{\frac{1}{2}}$.

*Example* V.

Let it be required to find the flowing Quantity of $\frac{-3\dot{x}}{x^4} = -3\,x^{-4}\dot{x}$. To the *Index* of the Power of the flowing Quantity add 1, and divide by the new Exponent, and by $\dot{x}$, the Quotient is $= x^{-3} = \frac{1}{x^3} =$ the flowing Quantity required.

*Example* VI.

Let it be required to find the flowing Quantity of $\frac{x^r\dot{x}}{\sqrt{r\,x}}$; this Fluxion may be express'd thus,

thus, $r^{-\frac{1}{2}} \times x^{\frac{2}{2}} \dot{x}$, and then the flowing Quantity thereof is $\frac{2}{5} r^{-\frac{1}{2}} x^{\frac{5}{2}} = \frac{2\sqrt[2]{x^5}}{5\sqrt{r}}$.

*Example* VII.

The flowing Quantity of $\dot{x}\sqrt{2rx}$, or $\dot{x} \times \overline{2r}^{\frac{1}{2}}$ is $\frac{2}{3} \times \overline{2r|}^{\frac{1}{2}} x^{\frac{3}{2}} = \frac{2}{3}\sqrt[2]{2rxxx}$, and the flowing Quantity of $\dot{x}\sqrt{2rx - xx}$ is found by reducing $\overline{2rx - xx|}^{\frac{1}{2}}$ to an infinite Series, and multiplying the ſame by $\dot{x}$, and then finding the flowing Quantity of every Term.

*Example* VIII.

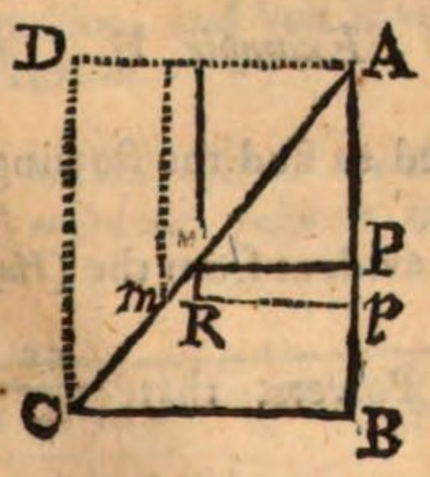
To find the Fluent of $a\dot{x}\sqrt{ax - aa}$. In ſuch Caſes where the Fluxion is affected with a *Vinculum*, we muſt conſider whether the fluxional Quantity, ſtanding before the Radical Sign, be the Fluxion of the ſimple or compound Quantity under the ——— *Vinculum*, for in ſuch Caſes the Fluent may be found by the General Rule.

Thus in this Example I obſerve, that $a\dot{x}$ is the Fluxion of $\overline{ax - aa}$, and therefore the Fluent of $a\dot{x}\sqrt{\overline{ax - aa|}}$ or $a\dot{x} \times \overline{ax - aa|}^{\frac{1}{2}}$ is $\frac{2}{3} \times \overline{ax - aa|}^{\frac{3}{2}} = \frac{2ax - 2aa}{3}\sqrt{\overline{ax - aa}}$.

In like manner the Fluent of $\frac{r\dot{x} - x\dot{x}}{\overline{2rx - xx}^{\frac{1}{2}}}$, or $\overline{r\dot{x} - x\dot{x}} \times \overline{2rx - xx|}^{-\frac{1}{2}}$ or $\overline{2r\dot{x} - 2x\dot{x}} \times \overline{2rx - xx|}^{\frac{1}{2}}$ will be found (if to the Exponent $-\frac{1}{2}$ we add 1, and divide by the new Exponent $\frac{1}{2}$, and by the fluxionary Quantity $2r\dot{x} - 2x\dot{x}$) to be $\sqrt{2rx - xx}$.

*Theſe Rules may be demonſtrated by Induction alſo; and becauſe that Method, by particular Inſtances, may ſerve to give the Reader a clearer Notion of* Summatory Arithmetick, *I ſhall explain the ſame in the following Examples.*

1. In the Rectangular Triangle $ABC$: Suppoſe $AB = a$, $BC = b$, $AP = x$, $Pp = \dot{x}$, $PM = y$; then the Equation of the Triangle is




$y = \frac{bx}{a}$, and the infinitely little Parallelogram $Mp$ = to the Fluxion of the Triangle, is $= y\dot{x}$ $= (\text{by Subſtitution}) \frac{b\dot{x}x}{a}$: And the flowing Quantity is $\frac{bxx}{2a} = \left(\text{putting } y = \frac{bx}{a}\right) \frac{xy}{2}$. it remains to be proved that the Sum of all the $y\dot{x}$ is $= \frac{xy}{2}$.

Compleat the Parallelogram $ABCD$, then it is evident that the Triangle $ABC$ is equal to the Sum of all the $y\dot{x}$, and the Triangle $ADC$ is equal to the Sum of all the $x\dot{y}$. But both theſe Triangles are equal to the Parallelogram, and each is equal to $\frac{1}{2}$ the Parallelogram, and the Parallelogram is equal to $xy$; therefore all the $y\dot{x} = \frac{xy}{2} =$ Triangle $ABC$.

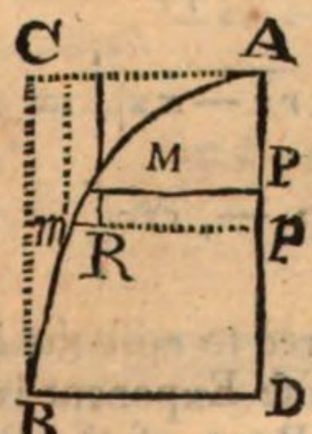
2. Let $AMB$ be a Parabola, $AP = x$, $PM = y$, the Parameter $= 1$, then the Equation of the Curve is $x^{\frac{1}{m}} = y$, and the Fluxion of the Parabolick Space, *viz.* $Mp = y\dot{x} = x^{\frac{1}{m}}\dot{x}$. Now it is evident, that the Sum of all thoſe Parallelograms is equal to the Parabolick Space $AMBD$. And the flowing Quantity of $x^{\frac{1}{m}}\dot{x}$ is $\frac{m}{m+1} x^{\frac{1}{m}+1} = \left(\text{putting } y \text{ for } x^{\frac{1}{m}}\right) \frac{m}{m+1} xy$, which we muſt prove to be equal to the Sum of all the $y\dot{x}$.

Compleat the Parallelogram $ADBC$, then it is manifeſt that the Space $AMBD$ is equal to all the $y\dot{x}$, and the Space $A.MBC$ is equal to all the $x\dot{y}$. But by the Method of Tangents it is $\dot{y} : \dot{x} :: y : t$, and $t\dot{y} = y\dot{x}$, and in the Parabola $t = mx$; *ergo* $y\dot{x} = mx\dot{y}$.

$$\text{Whence } 1 = \frac{mx\dot{y}}{y\dot{x}},$$

$$\text{And } \frac{1}{m} = \frac{x\dot{y}}{y\dot{x}},$$

$$\text{Adding 1 to each Side of the Equation } \left\} \quad \frac{1}{m} + 1 = \frac{x\dot{y}}{y\dot{x}} + 1;\right.$$




$$\text{That is } \frac{m+1}{m} = \frac{x\dot{y} + y\dot{x}}{y\dot{x}};$$

Whence

Whence

$$m : m+1 :: \dot{y}\dot{x} : x\dot{y} + y\dot{x};$$

And consequently,

$$m : m+1 :: S : \dot{y}\dot{x} : S : x\dot{y} + S : y\dot{x};$$

But

$$S : x\dot{y} + S : y\dot{x} = xy.$$

Therefore

$$m : m+1 :: S : \dot{y}\dot{x} : xy;$$

And consequently

$$\frac{m}{m+1} \times xy = S : \dot{y}\dot{x}. \quad \text{Q. E. D.}$$

*And besides the Examples I have produced, there are others which occur, to which these Rules cannot be immediately applied; and that the Reader may not be at too great a Loss in such Cases, I shall endeavour to assist him in that Particular. But first, It will be necessary to premise this.*

## *LEMMA.*

If a Binomial be to be rais'd to any Power, g. v. $m$, (which represents any Number, whole or broken, positive or negative) then the *Unciæ* or Numbers prefix'd to the several Terms are,

$$1 \times \frac{m-0}{1} \cdot 1 \times \frac{m-0}{1} \cdot \times \frac{m-1}{2} \cdot 1 \times \frac{m-0}{1} \cdot \times \frac{m-1}{2} \times \frac{m-2}{3} \times, \&c.$$ respectively.

And if $P + PQ$ represent the Quantity to be raised to the given Power; $P$ the first Term, and $Q$ the rest, divided by that first Term, and $\frac{m}{n}$ the Exponent of that Root or Dimension,

Then

$$\overline{P+PQ}|^{\frac{m}{n}} = \overset{A}{P^{\frac{m}{n}}} + \overset{B}{\frac{m}{n}AQ} + \overset{C}{\frac{m-n}{2n}BQ} + \overset{D}{\frac{m-2n}{3n}CQ}, \&c.$$

For Instance, if it be required to extract the square Root of $rr - xx$; that is, to raise (the Word *raise* being used indifferently for involving or evolving any *Binomial*) the Binomial $rr - xx$ to the Power or Dimension, whose Exponent is $\frac{1}{2}$, then $P = rr$, $Q = \frac{-xx}{rr}$, $m = 1$, and $n = 2$; and consequently, $\overline{rr-xx}|^{\frac{1}{2}} = r - \frac{xx}{2r} - \frac{x^4}{8r^3} - \frac{x^6}{16r^5} - \frac{5x^8}{128r^7} -, \&c.$

Let it be required to raise the Binomial $a + x$ to the Power whose Exponent is $m$, or let $m$ be the Index of the Root of the Binomial, which is to be extracted. Then, $P = a$, $Q = \frac{x}{a}$, and $\frac{m}{n} =$ ($n$ in this Case being $= 1$) $m$; therefore $\overline{a+x}|^m$ is $= a^m + ma^{m-1}x + m \times \frac{m-1}{2} \times a^{m-2}x^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times a^{m-3}x^3 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times a^{m-4}x^4$, &c.

By the same Method any *Trinomial*, *Quadrinomial*, &c. or *Infinito-nomial* may be raised to any given Power, v. g. To raise the *Infinito-nomial* $a + bz + cz^2 + dz^3 +$, &c. to the Power, whose Exponent is $m$: In the preceding *Binomial* Theorem,

Instead of $x$ put $\overline{bz + cz^2 + dz^3, \&c.}|^1$, and instead of $x^2$ substitute $\overline{bz + cz^2 + dz^3, \&c.}|^2$ Then it is manifest that $\overline{a + bz + cz^2 + dz^3, \&c.}|^m$ is $= a^m + ma^{m-1} \times \overline{bz + cz^2 + dz^3, \&c.}|^1 + m \times \frac{m-1}{2} a^{m-2} \times \overline{bz + cz^2 + dz^3, \&c.}|^2 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times a^{m-3} \times \overline{bz + cz^2 + dz^3, \&c.}|^3 + m \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times a^{m-4} \times \overline{bz + cz^2 + dz^3, \&c.}|^4 +$, &c.

## *Example* I.

Let it be required to find the flowing Quantity of this Fluxion $\dot{x}\sqrt{rr - xx}$. Reduce $\sqrt{rr - xx}$ to an (*Hayes*'s *Art.* 93.) Infinite Series, and then $\overline{rr - xx}|^{\frac{1}{2}}$ is $= r - \frac{xx}{2r} - \frac{x^4}{8r^3} - \frac{x^6}{16r^5} - \frac{5x^8}{128r^7} -, \&c.$ And consequently, $\dot{x}\sqrt{rr - xx}$ is $= r\dot{x} - \frac{x^2\dot{x}}{2r} - \frac{x^4\dot{x}}{8r^3} - \frac{x^6\dot{x}}{16r^5} - \frac{5x^8\dot{x}}{128r^7} -, \&c.$ And finding the flowing Quantity of every Term of this Series, then the Sum of all the $\dot{x}\sqrt{rr - xx}$ is $= rx - \frac{x^3}{6r} - \frac{x^5}{40r^3} - \frac{x^7}{112r^5} - \frac{5x^9}{1152r^7} -, \&c.$ Q. E. I.

## *Example* II.

It is required to find the flowing Quantity of $\frac{rr\dot{x}}{r+x}$. It is evident from the (*Hayes*'s *Art.* 16.) Notation of Powers, that $\frac{rr}{r+x}$ is $= rr \times \overline{r+x}|^{-1}$. But $\overline{r+x}|^{-1}$ is $=$ (*Hayes*'s *Art.* 93.) $r^{-1} - \frac{x}{rr} + \frac{xx}{r^3} - \frac{x^3}{r^4} +$, &c. And consequently

consequently $\frac{rr}{r+x}$ or $rr \times \overline{r+x}|^{-1}$ is $= r - x + \frac{xx}{r} - \frac{x^3}{r^2} +$, &c. and $\frac{rr\dot{x}}{r+x}$ is $= r\dot{x} - x\dot{x} + \frac{x^2\dot{x}}{r} - \frac{x^3\dot{x}}{r^2} +$, &c. and the flowing Quantity of $\frac{rr\dot{x}}{r+x}$ is $= rx - \frac{xx}{2} + \frac{x^3}{3r} - \frac{x^4}{4r^2} +$, &c. *Q. E. I.*

*SCHOLIUM.*

And if we divide the Series (*Examp.* 1.) by $\overline{rr-xx}|^{\frac{1}{2}}$ reduced to an infinite Series, and multiply the Diviſor by the Quotient, we ſhall have $rx - \frac{x^3}{6r} - \frac{x^5}{40r^3} - \frac{x^7}{112r^5} - \frac{5x^9}{1152r^7} -$ &c. $= x + \frac{2x^3}{6r^2} + \frac{32x^5}{123r^4}$, &c. $\overline{rr-xx}|^{\frac{1}{2}}$

And in general, If the given Fluxion conſiſts of Univerſal Exponents and Coefficients, reduce the Part under the *Vinculum* to an infinite Series, which multiply by the Part before the *Vinculum*, and find the flowing Quantity of every Term; Laſtly, divide this laſt Series or the Fluent by the Part under the radical Sign affected, with any the moſt convenient Exponent, and multiply the ſaid Part under the ſaid Exponent by the ſaid Quotient; ſo ſhall you have a Series expreſſing the Fluent of the given Fluxion, and readily ſhewing when and whether the Series conſiſts of a finite Number of Terms or not.

*The Fluent of a Fluxion involving ſurd Quantities, may be inveſtigated after another manner, which is ſometimes preferable by much to the former: The Principles of this Method are,*

1. Reduce the given Fluxion to its ſimpleſt Terms.

2. Aſſume a new Equation adfected with indetermined Coefficients; ſo that reducing the ſame to Fluxions, the Terms of this may be compared with thoſe of the given Fluxion, in order to determine the unknown Coefficients.

3. Having determined the aſſumed Coefficients, ſubſtitute their reſpective Values in the aſſumed Equation, and you have the Fluent of the given Fluxion.

*Since this Method deſerves the Reader's Conſideration, I ſhall endeavour fully to explain the ſame; and that I may not be miſunderſtood, I ſhall begin with ſome eaſy* Examples.

*Example* I.

Let it be required to find the Fluent of $a\dot{x}\sqrt{ax-aa}$, the Fluxion reduced to its ſimpleſt Terms is $a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. Now ſuppoſe the Fluent of this Fluxion to be $A \times \overline{xa-aa}|^{\frac{3}{2}}$, then it is evident, that the Fluxion of this Fluent muſt be equal to the given Fluxion, *i. e.* $\frac{3}{2}A \times a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$ is $= a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. Therefore (dividing by $\overline{ax-aa}|^{\frac{1}{2}}$) $\frac{3}{2}A \times a\dot{x} = a\dot{x}$, and $A = \frac{2}{3}$. Having thus found the true Value of the indeterminate Coefficient $A$ (*viz.* $\frac{2}{3}$) in the aſſum'd Equation, ſubſtitute the ſame in place of $A$, and then we have $\frac{2}{3} \times \overline{ax-aa}|^{\frac{1}{2}}$ or $\frac{2ax-2aa}{3}\sqrt{ax-aa}$ equal to the Fluent of the given Fluxion.

*Example* II.

To find the Fluent of $\frac{r\dot{x}-x\dot{x}}{\sqrt{2rx-xx}}$, this Fluxion is expreſſed thus, $\overline{r\dot{x}-x\dot{x}} \times \overline{2rx-xx}|^{-\frac{1}{2}}$. Suppoſe the Fluent thereof to be $A \times \overline{2rx-xx}|^{\frac{1}{2}}$. Then the Fluxion of this Quantity is $\frac{1}{2}A \times \overline{2r\dot{x}-2x\dot{x}} \times \overline{2rx-xx}|^{-\frac{1}{2}} = \overline{r\dot{x}-x\dot{x}} \times \overline{2rx-xx}|^{\frac{1}{2}}$: Therefore $\frac{1}{2}A \times 2r\dot{x} - 2x\dot{x} = r\dot{x} - x\dot{x}$, and $A = 1$; and conſequently, the Fluent of the given Fluxion is equal to $\overline{2rx-xx}|^{\frac{1}{2}}$.

*Example* III.

To find the Fluent of $dx^r\dot{x} \times \overline{e+fx^n}|^m$. Aſſume an Equation with indeterminate Coefficients, ſo that reducing the ſame to Fluxions, the Terms thereof may be compared with thoſe of the given Fluxion. Let the ſaid Equation be $Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}$, &c. $\times \overline{e+fx^n}|^{m+1} = S : dx^r\dot{x} \times \overline{e+fx^n}|^m$

Then,

$\overline{r-n+1} \times Adx^{r-n}\dot{x} + \overline{r-2n+1} \times Bdx^{r-2n}\dot{x} + \overline{r-3n+1} \times Cdx^{r-3n}\dot{x}$, &c. $\times \overline{e+fx^n}|^{m+1} + \overline{m+1} \times \overline{e+fx^n}|^m \times nfx^{n-1}\dot{x} \times \overline{Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}}$, &c. $= dx^r\dot{x} \times \overline{e+fx^n}|^m$.

Whence

Whence, supposing $\frac{1}{p} = m + 1$, and putting $\dot{x} = 1$.

$$\overline{r-n+1} \times A dx^{r-n} + \overline{r-2n+1} \times B dx^{r-2n} + \overline{r-3n+1} \times C dx^{r-3n}, \&c.$$

$$\times \overline{e+fx^n}|^{\frac{1}{p}} + \frac{1}{p} \times n \times Adf \times x^r + \frac{1}{p} \times n \times Bdf x^{r-n} + \frac{1}{p} \times n \times Cdf x^{r-2n}, \&c.$$

$$\times \overline{e+fx^n}|^{\frac{1-p}{p}} = dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}}.$$

And multiplying each Side of the Equation by $p \times \overline{e+fx^n}|^{\frac{p-1}{p}}$ we have $p \times \overline{\overline{r-n+1}$

$$\times Adx^{r-n} + p \times \overline{r-2n+1} \times Bdx^{r-2n} + p \times \overline{r-3n+1} \times Cdx^{r-3n}, \&c. \times \overline{e+fx^n}|$$

$$+ n \times Adf \times x^r + n \times Bdf x^{r-n} + n \times Cdf x^{r-2n}, \&c. = dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}} \times p \times$$

$$\overline{e+fx^n}|^{\frac{p-1}{p}}.$$

Which being order'd, we have

$$p \times \overline{r-n+1} \times Adf \left\{ \begin{matrix} \\ n \times Adf \end{matrix} \right\} x^r + p \times \overline{r-n+1} \times Ade \left\{ \begin{matrix} \\ + p \times \overline{r-2n+1} \times Bdf \\ n \times Bdf \end{matrix} \right\} x^{r-n} + p \times \overline{r-2n+1} \times Bde \left\{ \begin{matrix} \\ + p \times \overline{r-3n+1} \times Cdf \\ n \times Cdf \end{matrix} \right\} x^{r-2n}, \&c.$$

$$= dx^r \times \overline{e+fx^n}|^{\frac{1-p}{p}} \times p \times \overline{e+fx^n}|^{\frac{p-1}{p}} = p \times dx^r.$$

From which Equation the unknown Coefficient $A$, $B$, $C$, &c. may be determined in this manner;

$$p \times \overline{r-n+1} \times Adf + n \times Adf = pd$$

And dividing by $pd$,

$$\overline{r-n+1} \times Af + \frac{1}{p} \times n \times Af = 1,$$

Substituting $m + 1$ for $\frac{1}{p}$,

$$\overline{r-n+1} \times Af + \overline{m+1} \times n \times Af = 1.$$

Whence $A = \frac{1}{\overline{\overline{r-n+1} \times f + \overline{mn+n} \times f}} = \frac{1}{\overline{mn+r+1} \times f}$.

Secondly,

$$p \times \overline{r-n+1} \times Ade + p \times \overline{r-2n+1} \times Bdf + n \times Bdf = 0.$$

And by Transposition, Division and Restitution.

$$\overline{r-2n+1} \times Bf + \overline{mn+n} \times Bf = \overline{n-r-1} \times Ae.$$

Whence $B = \frac{\overline{n-r-1} \times Ae}{\overline{\overline{r-2n+1} \times f + \overline{mn+n} \times f}} = \frac{\overline{n-r-1} \times Ae}{\overline{mn+r-n+1} \times f}$.

In like manner,

$$C = \frac{\overline{2n-r-1} \times Be}{\overline{mn+r-2n1} \times f},$$

Whence it is evident that $Adx^{r-n+1} + Bdx^{r-2n+1} + Cdx^{r-3n+1}$, &c.

$$\times \overline{e+fx^n}|^{m+1} \text{ is} = \frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} + \frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times e}{\overline{mn+r-n+1} \times f}$$

$$\times x$$

$$\times x^{r-2n+1} + \frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times$$

$$\frac{\overline{2n-r-1} \times de}{\overline{mn+r-2n+1} \times f} \times x^{r-3n+1}, \&c. \times \overline{e+fx^n}|^{m+1} = \dot{S} : dr\dot{x} \times \overline{e+fx^n}|^{m}, \text{ Q. E. I.}$$

In which it may be obſerved, That the Exponents of the Terms of the Indeterminate Series before the Radical Sign may be taken different from thoſe above, provided that the Exponent of the firſt Term be not leſs than $r-n+1$, and that the following Exponents proceed regularly: That the Exponents of the Terms before the Radical Sign may be continually increaſed or decreaſed by $n$; for in either Caſe the Terms of the Fluxion of this aſſumed Equation will become homologous to thoſe of the given Fluxion: That when the Exponents increaſe regularly by $n$, the Fluent will conſiſt of a finite Number of Terms, when $\frac{r+1+mn}{-n}$ is equal to a poſitive whole Number: And that when the Exponents decreaſe regularly by $n$, the Fluent will conſiſt of a finite Number of Terms, when $\frac{r+1}{n}$ is equal to a poſitive whole Number.

This General *Theorem* may eaſily be applied to find the Fluent of any given Fluxion included in the General one $dx^r\dot{x} \times \overline{e+fx^n}|^{m}$. *V. G.*

To find the Fluent of $a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}$. I put the ſame equal to the General Fluxion, *viz.*

$$dx^r\dot{x} \times \overline{e+fx^n}|^{m} = a\dot{x} \times \overline{ax-aa}|^{\frac{1}{2}}.$$

Then $d=a$, $f=0$, $f=a$, $n=1$, $m=\frac{1}{2}$, $e=-aa$; and if we ſubſtitute the ſaid particular Values of $d$, $r$, $f$, $n$, $m$, $e$ in the General Fluent, we ſhall have

$$\frac{d}{\overline{mn+r+1} \times f} \times x^{r-n+1} + \frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times x^{r-2n+1} +$$

$$\frac{d}{\overline{mn+r+1} \times f} \times \frac{\overline{n-r-1} \times de}{\overline{mn+r-n+1} \times f} \times \frac{\overline{2n-r-1} \times de}{\overline{mn+r-2n+1} \times f} \times x^{r-3+1} +, \&c. \times$$

$$\overline{e+fx^n}|^{m+1} = \frac{a}{\frac{1}{2}+1 \times a} \times x^{0-1+1} \times \overline{ax-aa}|^{\frac{1}{2}+1} = \tfrac{2}{3} \times \overline{ax-aa}|^{\frac{3}{2}} = \dot{S} : a\dot{x}\sqrt{ax-aa}.$$

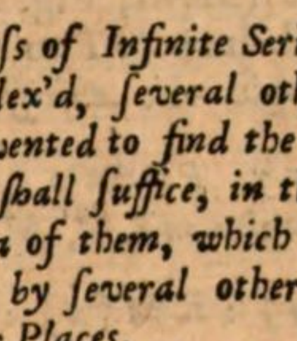
Q. E. I.

*I have hitherto explained the General Methods of finding the Fluent of any Fluxion by help of Series's, and therefore ſhall not farther inſiſt on theſe or other Methods invented for the ſame Purpoſe, but refer the Reader (who deſires to have a fuller Account of them) to a late Learned Treatiſe, writ by that excellent Analyſt* G. Cheyne, *M. D. and entitled* Fluxionum Methodus Inverſa.

*Since the Buſineſs of Infinite Series is ſometimes tedious and too perplex'd, ſeveral other particular Methods have been invented to find the flowing Quantity of a Fluxion. It ſhall ſuffice, in this Place, to give the Reader an Idea of them, which will become more plain and familiar by ſeveral other Examples, to be ſeen in their proper Places.*

### *Example* I.

Let it be required to find the Flowing Quantity of $\dot{x}\sqrt{2rx-xx}$. On the Center $C$, with




the Radius $CB=r$, deſcribe the Semi-circle $AMB$, and ſuppoſe $AP=x$; then is $PB=2r-x$, and $MP=\sqrt{2rx-xx}$, and $Pp=\dot{x}$; therefore the Fluxion of the *Area*, *viz.* the Parallelogram $Mp$ is $=\dot{x}\sqrt{2rx-xx}$, and conſequently the Sum of all the $\dot{x}\sqrt{2rx-xx}$, that is, the Flowing Quantity of the given Fluxion is equal to the Semi-ſegment $AMP$.

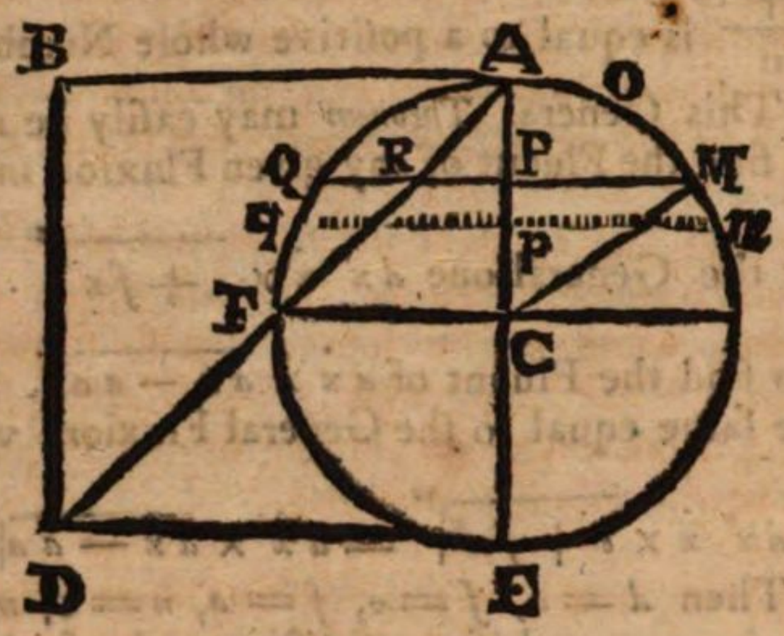
### *Example* II.

Let it be required to find the Flowing Quantity of $\frac{r\dot{x}x}{2\sqrt{2rx-xx}}$. Draw the Lines $AM$, $Am$, infinitely near each other, $MP$, $mp$, perpendicular to the Diameter $AB$, and $MR$ perpendicular to $Am$; then by the Property of the Circle $AM=\sqrt{2rx}$, and $Rm$ the Fluxion thereof is $\frac{r\dot{x}}{\sqrt{2rx}}$. Now becauſe the Triangles $APM$, $MRm$, are (the Angles $AMP$ and $MmR$ ſtanding on equal Arches of the Circle) ſimilar, it is $PM(\sqrt{2rx-xx}) : AP(x) :: Rm\left(\frac{r\dot{x}}{\sqrt{2rx}}\right) : MR = \frac{rx\dot{x}}{\sqrt{2rx} \times \sqrt{2rx-xx}}$; and conſequently the infinitely little Sector $MAR = \frac{1}{2}AR \times MR$ is $= \frac{rx\dot{x}}{2\sqrt{2rx-xx}} =$ to the given Fluxion: Whence it is evident that the Segment

Segment $AOMA$ is the flowing Quantity of the given Fluxion.

*Example* III.

Let it be required to find the flowing Quantity of this Fluxion $\dot{x}\dot{x} \times 2\sqrt{2rx - xx}$. On




the Center $C$, with the Radius $CA = r$, describe the Circle $AFEM$; and suppose $= x$, $Pp = \dot{x}$, $PE = 2r - x$, the Circumference $AFEM = c$; then, I say, that the Sum of all the $\dot{x}\dot{x} \times 2\sqrt{2rx - xx}$ is $= \frac{crr}{2}$.

*Demonstration.*

Let the Circle $AFEM$ be the Base of an upright Cylinder, and the Parallelogram $ABDE$ the Section of the Cylinder thro' its Axis, $AB$ the Height of the Cylinder is equal to $AE$ the Diameter of the Base. Draw the Diagonal $AD$, then a Plane passing thro' $AD$, and perpendicular to the Plane $BE$, will divide the Cylinder in two equal Parts, and cut off the Semi-quadrantal *Ungula* $ADE$. Now the Fluxion of this *Ungula* is equal to the Parallelogram $Qm$, multiplied into its Height $PR$ or $AP$ (because the Angle $RAP$ is equal to 45°.) $= \dot{x}\dot{x} \times 2\sqrt{2rx - xx}$; and consequently the Sum of all the $\dot{x}\dot{x} \times 2\sqrt{2rx - xx}$ is (when $AP$ becomes equal to $AE$, or $x = 2r$) equal to the Semi-quadrantal *Ungula* $ADE = \frac{rrc}{2}$. *Q. E. I.*

*And thus innumerable Instances might be assign'd, to assist us in finding the flowing Quantity of any Fluxion, without having immediate Recourse to an Infinite Series.*

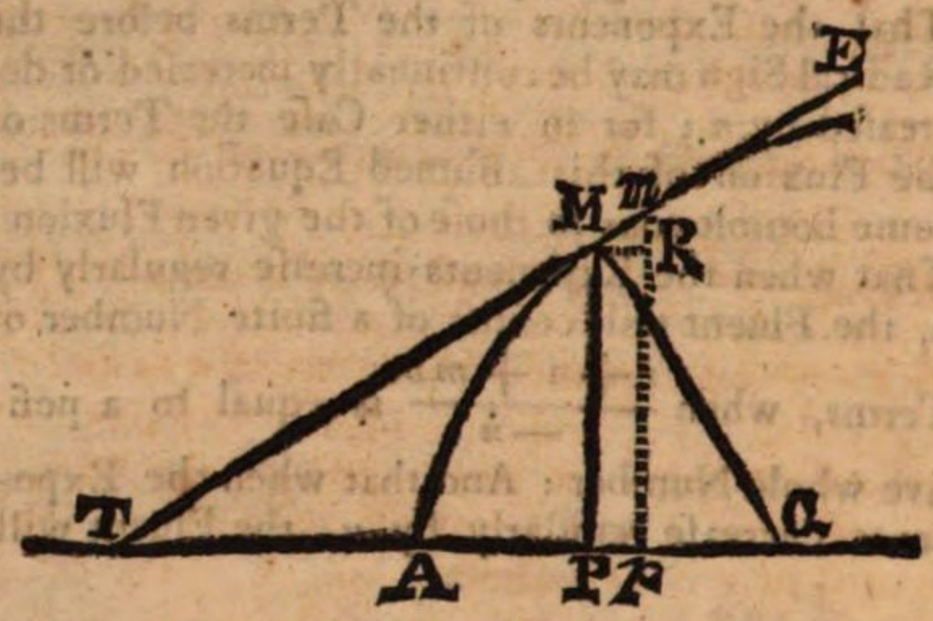
INVERSE *Method of Tangents*, is the Method of finding an Equation to express the Nature of a Curve in an Equation, express'd in the *neareſt Terms*. This depends on the Problem of finding the *fluent* or *flowing Quantity*, by having the Fluxion given (of which see the *Inverse Method of Fluxions* above given.) And the Art of doing it Mr. *Hayes* (in *Fluxions*, p. 48.) shews after this manner.

At Page 33. he had shewn how to deduce Universal Rules for *drawing Tangents to all sorts of Geometrical Curves, when the given Equation expresses the Relation between the Ordinate and the intercepted Diameter*. And therefore he states his 16th *Proposition* thus:

*An Equation expressing the Value of the Subtangent of any Curve, in the neareſt Terms being given: 'Tis requir'd to find the Equation expressing the Nature of the Curve.*

1. What I mean by the neareſt Terms will be best explain'd by an *Example*.

Suppose $PT = t$, $AP = x$, $PM = y$, $MT = s$; and let the Equation expressing the Nature of




the Curve be $y^3 + ayy = x^3 + bxx$; Then the Sub-tangent $TP$ will be $t = ($*Hayes*, Sect. 10. Art. 61.$) \frac{3y^3 + 2ayy}{3xx + 2bx}$. Now I call these *Terms*, expressing the Value of the Sub-tangent, the *neareſt*, because they immediately flow from the Equation of the Curve: But if this Value of the Sub-tangent be changed, by applying the Equation of the Curve; *v.g.* If we put $3y^3 = 3x^3 + 3bxx - 3ayy$; and consequently $t = \frac{3x^3 + 3bx\dot{x} - ayy}{3xx + 2bx}$, such I call *Remote Terms*.

Now if the Value of the Sub-tangent be express'd in the neareſt Terms, the Equation of the Curve may be inveſtigated in this manner.

Let the Curve (*Hayes*, Fig. Art. 77.) $AMm$ be described, and draw $MT$ to touch the Curve in $M$; then suppose the *Abscissa* $AP = x$; the Ordinate $PM = y$, $Pp = \dot{x}$, $Rm = \dot{y}$; then because the Triangles $mRM$, $MPT$ are similar; therefore $mR\ (\dot{y}) : RM\ (\dot{x}) :: PM\ (y) : PT = \frac{y\dot{x}}{\dot{y}}$. Put this Value of the Sub-tangent equal to its Value given in the neareſt Terms; clear the Equation of the Fractions, and find the flowing Quantity of each Term; so have you the Equation of the Curve.

*Example* I.

Let it be required to find the Equation of the Curve $AMm$, the Value of the Sub-tangent $PT$ being $= \frac{2y^3}{3rr}$. The Sub-tangent $PT$ is $= \frac{y\dot{x}}{\dot{y}} = (ex\ Hyp.)\ \frac{2y^3}{3rr}$; therefore $3rry\dot{x} = 2y^3\dot{y}$, and $3rr\dot{x} = 2y^2\dot{y}$: And substituting $x$ for $\dot{x}$,

and

and $y$ for $\dot{y}$: $3rr\dot{x} \square 2y^3$, and (dividing $3rr\dot{x}$ by 1 the Exponent of $x$, and dividing $2y^3$ by 3 the Exponent of $y$) $3rr\dot{x} = \frac{3}{1}y^3$, and $9rr\dot{x} = 2y^3$, which divided by 2, we have $\frac{9}{2}rr\dot{x} = y^3$, the Equation expreſſing the Nature of the Curve $AMm$.

*Example* II.

Let it be required to find the Property of the Curve $AMm$, the Sub-tangent $PT$ being $= \frac{2yy}{r}$.

The Sub tangent $PT$ is $= \frac{y\dot{x}}{\dot{y}} =$ (by Supposition) $\frac{2yy}{r}$; and therefore $ry\dot{x} = 2yy\dot{y}$, and $rx = 2yy$, and (ſubſtituting $x$ for $x$, and $y$ for $y$) $rx \square 2yy$, and conſequently (dividing $rx$ by the Exponent of $x$, and $2yy$ by 2 the Exponent of $y$) $rx = yy$, which ſhews that the Curve $AMm$ is a Parabola.

*Example* III.

Let it be required to find the Property of the Curve $AMm$, the Value of the Sub-tangent $PT$ being $= \frac{3y^3 + 2byy}{3xx + 2ax}$.

The Sub-tangent $PT$ is $= \frac{y\dot{x}}{\dot{y}} = \frac{3y^3 + 2byy}{3xx + 2ax}$.

Therefore $3xx\dot{x} + 2ax\dot{x} = 3y^2\dot{y} + 2byy$ and (putting $x$ for $\dot{x}$, and $y$ for $\dot{y}$) $3x^3 + 2ax^2 \square 3y^3 + 2by^2$, and (dividing every Term by the Exponent of the Flowing Quantity therein) $x^3 + axx = y^3 + byy$; which Equation expreſſes the Nature of the Curve $AMm$.

But becauſe this Method depends on that *Problem*, to find the Flowing Quantity of any Fluxions, with which the Reader is yet ſuppoſed to be unacquainted, I ſhall deſiſt from proſecuting the ſame any further at preſent, and content my ſelf to deduce the Solution of the preſent *Propoſition* from the (*Hayes*, Art. 61.) ſixth preceding; this being nothing elſe but the *Reverſe* of that.

That we may be able to proceed with the greater Certainty in this Enquiry, it will be neceſſary to obſerve from the forecited Place:

1°. The Sub-tangent $s$ is always of one Dimenſion, and is expreſs'd by a Fraction.

2°. When the Value of the Sub-tangent is expreſſed in the neareſt Terms, then the Numerator of the Fraction conſiſts only of thoſe Terms wherein the Ordinate $y$, (or the Tangent $s$) is found.

3°. And if all the Terms of the Equation of the Curve be ſimple Terms, then the intercepted Diameter $x$ never occurs in the Numerator; nor the Ordinate $y$, Tangent $s$, or Curve $z$, in the Denominator.

4°. But if the Equation of the Curve contain mix'd Terms, then both $x$, $z$, $s$ and $y$ may be found in both parts of the Fraction; but with this Condition, That the Fraction being reduced to an Equation, and all the Terms of the Equation being brought over to one ſide, and every $r$ changed into $x$, and every $s$ into $z$, every mix'd Term will be found as often as there are variable Quantities in the ſame. And the Coefficients, or prefixed Numbers, will be equal or proportional to the reſpective Exponents of the Powers of the variable Quantities.

5°. Whence it follows, that the Signs of the Terms, wherein the ſame variable Quantities occur, are the ſame, after a due Diviſion by the prefix'd Numbers (or rather by the Exponents of the variable Quantities.)

Hence to reſolve the *Problem* concerning the

*Inverſe Method of Tangents.*

1°. Change every $r$ into $x$, and every $s$ into $z$ (denoting the Curve) and tranſpoſe all the Terms to one ſide of the Equation, and diligently obſerve whether all the Terms are Simple, or ſome Simple and others Mixt.

2°. If all the Terms be Simple, divide every Term by the Exponent of the Intermediate or Flowing Quantity in the ſame; ſo have you the Equation expreſſing the Nature of the Curve.

3°. And if there be any mixt Terms, then obſerve (*Hayes*, Sect. 4, 5. Art. 78.) and let every Term containing the ſame variable Quantities be divided by the Exponent of the Power to which the reſpective Flowing Quantities are advanced, ſo that the ſame Term reſult from every ſuch Diviſion, and be as often found in the Equation as it has Flowing Quantities.

4°. Retain only one of thoſe mixt Terms which occur more than once in the Equation, and manage the other ſimple Terms according to *Hayes*, Sect. 2. and there will ariſe an Equation expreſſing the Nature of the Curve.

*Example* I.

Suppoſe $t = \frac{y^3 + ayy - bby}{xx + ax + bb}$; then (by *Rule* 1.) changing $t$ into $x$, and tranſpoſing all the Terms to one ſide of the Equation, we have $x^3 + axx + bbx - y^3 - ayy + bby$; and becauſe all the Terms are ſimple Terms, therefore (2.) $\frac{1}{3}x + \frac{1}{2}axx + bbx - \frac{1}{3}y^3 - \frac{1}{2}ayy + bby = 0$, which is an Equation expreſſing the Nature of the Curve, as was required.

*Example* II.

Let the Value of the Sub-tangent be $t = \frac{3y^3 + 2ayy - 2xyy - xxy}{3xx + 2xy + yy}$, then we have (by 1.) $3x^3 + 2yxx + yyx - 3y^3 - 2ayy + 2xyy + xxy$, and becauſe we have the

mixt Terms $2yxx$ and $yxx$, alſo $yyx$, and $2yyx$, each repeated twice, according to the Number of the flowing Quantities; therefore if one of them be divided by the Exponent of $x$, and the other by the Exponent of $y$, (3.) there will ariſe $yxx + yyx$ (by 4.) and dividing the ſimple Terms by the Exponents of the flowing Quantities in each reſpectively, the Equation expreſſing the Nature of the Curve will be $x^3 + yxx + yyx - y^3 - ayy = 0$.

*Example* III.

And the Method is the ſame if the Curve $z$ enter into the Value of the Sub-tangent, *v.g.* ſuppoſe $t = \frac{6ay^3zz + 4ay^3zs + aay^4 - yxxz^3 - 2yxxzzs}{2yxz^3}$ change every $t$ into $x$, and every $s$ into $z$; and tranſpoſe all the Terms over to the ſame Side of the Equation, and then we have $2yz^3xx + yxxz^3 + 3yxxz^3 - 6ay^3zz - 4ay^3zz - aay^4$.

Wherein the Term $yxxz^3$, containing three flowing Quantities, is found thrice, and the Term $ay^3zz$, containing two, is found twice: And becauſe thoſe mixt Terms being divided by the reſpective Exponents of the Powers of the flowing Quantities, the ſame Quotient always reſults; it is plain, that the Value of the Sub-tangent is given in the neareſt Terms; and therefore the Equation expreſſing the Nature of the Curve will be $yz^3x^2 - 2ay^3zz - \frac{1}{4}aay^4 = 0$: Or adding any determinate Quantity $bb$; $yz^3x^2 - 2ay^3zz - \frac{1}{4}aay^4 + bb = 0$.

Hence it appears that a determinate Quantity may be added to the Equation of the Curve; which is plain from the direct Method of Tangents; becauſe then when we inveſtigate the Value of the Sub-tangent, all the Terms conſiſting of invariable Quantities are rejected and vaniſh: And this is ſometimes abſolutely neceſſary, *v.g.* Suppoſe $t = \frac{-xy}{2x+y}$: then we have $2xx + yx + xy$; and conſequently $xx + xy = 0$: And becauſe this Equation has no true Root, therefore we muſt add a determinate Quantity, and then the Equation of the Curve may be $xx + xy = bb$.

*COROLLARY.*

Hence, if the Value of the Subnormal (Fig. *Hayes*, Art. 82.) $PQ$ be given, the Property of the Curve may be found. For the Triangles $QMP$, $MTP$ are ſimilar; therefore $QP : PM :: PM : PT$; and if $PQ$ be $= q$, then $t = \frac{yy}{q}$. Whence the Equation of the Curve may eaſily be (*Hayes*, Art. 78, 79.) found.

The Property of the Curve may be inveſtigated otherwiſe, thus: The Triangles $mRM$, $QPM$, are ſimilar; therefore $MR\ (\dot{x}) : Rm\ (y) :: PM\ (y) : PQ = \frac{y\dot{y}}{\dot{x}}$, and putting this equal to the Value of the Subnormal given, the Property of the Curve may be (*Hayes*, Art. 77.) found.

*Example.*

Suppoſe $PQ = \frac{aax}{2yy}$; then is $\frac{y\dot{y}}{\dot{x}} = \frac{aax}{2yy}$, and $aaxx = 2y^3\dot{y}$; and (ſubſtituting $x$ for $x$, and $y$ for $\dot{y}$) $aaxx \square 2y^4$; therefore (dividing the Terms by the Exponents of $x$ and $y$ reſpectively) $\frac{1}{2}aaxx = \frac{1}{2}y^4$. Whence $ax = y^2$, which ſhews that the Curve $AMm$ is a *Parabola*.

INVEST. To *Inveſt*, in the Law, ſignifies to give Poſſeſſion: And the Action of doing this, which is attended in different Places with different Ceremonies, Forms and Cuſtoms, is called INVESTITURE.

INVOYCE, 12 *Car.* 2. c. 34. is a Particular of the Value, Cuſtom and Charges of any Goods ſent by a Merchant in another Man's Ship, and conſign'd to a Factor or Correſpondent in another Country.

JOBENT *Nails*, are a ſmaller ſort, commonly uſed to nail thin Plates of Iron to Wood.

JOINT-*Tenants*, are ſuch as come to, and hold Lands or Tenements by one Title *pro Indiviſo*, or without Partition.

Theſe are diſtinguiſh'd from *Sole*, or *Several Tenants*; from *Parceners*, and from *Tenants* in *Common*: And anciently they were called *Participes*, and not *Hæredes*: And theſe muſt *jointly implead*, and *jointly be impleaded*; which Property is common to them and to *Coparceners*. But *Joint-Tenants* have a *ſole Property* of Survivorſhip, which *Coparceners* have not: For if there be two or three *Joint-Tenants*, and one hath Iſſue and dies, then he, or thoſe *Joint-Tenants* that ſurvive, ſhall have the whole by Survivorſhip.

JOISTS, in Architecture, are ſuch Pieces of Timber as are framed into the Girders and Summers, and on which the Boards of the Floor are laid.

JOYNDER, in Law, is the coupling or joining of two Perſons in one Action or Suit againſt another.

JOYSTS. See JOISTS.

IRON. In the Foreſt of *Dean* in *Glouceſterſhire*, the beſt *Iron* Ore is of a bluiſh Colour, and is called *Bruſh Ore*: But this being melted alone produces a Metal very ſhort and brittle: To remedy which Inconvenience they make uſe of *Cynder*, which is found in great Quantity where any old Works have been in that County: For in former Times, their Bellows being moved only by Hand, their Furnaces produced a Fire much leſs intenſe, than thoſe they now employ: So that formerly they melted down only the principal Part of the Ore, rejecting the reſt as uſeleſs. This Refuſe is the *Cynder*; which being mingled with the Ore in a due Quantity, gives it that excellent Temper of Toughneſs, for which this Iron is preferred before any brought from abroad.

The Ore is firſt calcined in Kilns, like ordinary Lime-Kilns, which they fill up to the Top with Coal and Ore, *S. S. S.* Then putting Fire to the Bottom, they let it burn till the Coal be waſted. This is done without *Fuſion* of the Metal, and ſerves to conſume the more droſſy Part of the Ore, and to make it friable. From hence they carry it to the Furnaces, which are built of Brick or Stone, about 24 Foot ſquare on the Outſide,

Outside, and near 30 Foot in Height. Within they are not above 8 or 10 Foot over in the middle, and the Top and Bottom have a yet narrower Compass; so they are almost of the Shape of an Egg. Behind the Furnace are placed two very large Pair of Bellows, whose Noses meet at a little Hole near the Bottom. These are compressed together by certain *Buttons* placed on the Axis of a very large *Overshot Wheel*.

The Furnaces are at first filled with Ore and Cynder, intermix'd with Fuel, which in these Works is always of Charcoal, laying them hollow at the Bottom, that they may the more easily take Fire. But after they are once kindled, the Materials run together into a hard Cake or Lump, which is sustain'd by the Fashion of the Furnace; and through this the Metal, as it melts, trickles down into the *Receivers*, where there is a Passage open, by which they clear away the Scum and Dross. Before this lies a great Bed of Sand, wherein they make Furrows of what Fashion they please, into which they let their Metal; which is made so very fluent by the Violence of the Fire, that it continues boiling for a good while. The Furnaces are kept at work Day and Night for many Months, still supplying the Waste of the *Fuel* and other Materials with fresh, pour'd in at the Top.

From these Furnaces they bring their *Sows* and *Pigs* of *Irons* (as they call them) to their *Forges*. These *Forges* are of two sorts, tho' standing together under the same Roof: And one they call *Finery*, the other their *Chafery*. Both of them are on Hearths, on which they place great Heaps of *Sea-Coal*, and behind them Bellows, like the former, but not near so large. Into their *Finery* they first put the *Pigs* of *Iron*, placing three or four of them together behind the Fire, with a little of one End thrust into it; where softning by Degrees, they stir and work them with long Bars of *Iron*, till the Metal runs together into a round Mass or Lump, which they call an *Half Bloom*: This they take out, and giving it a few Strokes with their *Sledges*, they carry it to a great weighty *Hammer*, raised by the Motion of a Water-Wheel; where applying it dextrously to the Blows, they presently beat it out into a thick short Square: This they put into the *Finery* again; and heating it red hot, they work it out under the same Hammer, till it comes to be in the Shape of a Bar in the middle, but with two square Knobs on the Ends. Last of all, they give it other Heats in the *Chafery*, and more Workings under the Hammer, till they have brought their *Iron* into Bars of several Shapes and Sizes. If they omit any one Process, it will be sure to want something of its *Toughness*, which they esteem its Perfection.

For the Backs of Chimneys, Hearths of Ovens, or the like, they take the melted Metal out of the Receivers in great Ladles, and pour it into Moulds of fine Sand. *Philos. Transf.* N° 137.

At *Milthorpe* in *Lancashire* they have several Sorts of *Iron-Stone*, some of it making *Coldshire-Iron*; that is, such as is brittle when it is cold. Another sort makes *Redshire*, which is such as is apt to break if it be hammer'd when 'tis of a dark red Heat; and therefore they are never melted down but in Mixture, and so they yield an indifferent good sort of *Iron*. They have of late made it much better than before, by melting the *Sow-Metal* over again, as likewise by using Turf and Charcoal; whereas formerly the Fuel was only Charcoal.

They first burn the *Iron-Stone*, and then for every seventeen Baskets of this burnt Stone they put in one of Lime-Stone, *unburnt*, to make it melt freely and cast the Cynder, which they always take off from the melted *Iron*, before they let it run.

The Bottom of the Furnace is about two Yards square, and so rises perpendicularly for a Yard or more, which is also lined within with a Wall of the best Fire-stone, to keep off the Force of the Fire from the Walls of the Furnace. The Bellows, which are very large, and moved by Water, enter about the middle of the *Focus*: The rest of the Furnace is raised above this six or seven Yards *square-wise*, but *tapering*; so that the top Hole, where they throw in the Mine and Fuel, is but half a Yard square. When they find it to have subsided about a Yard and Quarter, they fill the Furnace again.

Their *Forge* is much like that of a common Blacksmith's, about one Yard and half over, and of the same Height. The *Hearth* is all of *Sow-Iron*, much of the Shape of a Broad-brim'd Hat, with the Crown downwards. The hollow Place they fill and heap up with Charcoal, and lay the Ore (first broken into Pieces as big as a Pigeon's Egg) all round about the Charcoal on the flat Hearth, to bake it as it were, or neal it; thrusting it by little and little into the Hollow, and keep blowing for twelve Hours. Then they pull out a Stopple at the Bottom of the Wall, and out comes all the *Glassy Cynder*, being very liquid, leaving the *Iron*, which is never in a perfect Fusion, in a Lump at the Bottom: This they take out with great Tongs, and turn it under heavy Hammers moved by Water, which at the same time beat off, or rather squeeze out the fluid *Scoriæ* or Dross, and after several Heats form it into Bars. They use no Lime-Stone, or any thing else, to promote the Flux. They get about 100 Pound Weight of Metal at one *Melting*, out of about three times as much Ore.

The *Iron* Mine in *Sussex* lies from four Foot deep to forty and upwards. There are several sorts of Mine, some hard, some gentle, some rich, some poor, some fine, some coarser. The *Iron* Masters mix different sorts of Mine together, otherwise it will not melt to so good an Advantage.

When the Mine is brought in, they take Small-coal, and lay a Row of that and a Row of Mine alternately, *S. S. S.* one above another; and setting the Coals on Fire, therewith burn the Ore. This is done to mollify it, that so it may be broken in small Pieces, otherwise it would not melt in the Furnace, but come away whole: Nor must it be over-burnt; for then it will *loop*, as they call it, that is, run together in a Mass.

After 'tis burnt, 'tis beat into small Pieces with an *Iron* Sledge, and then put into the Furnace, which is before charged with Coals, on the Top of which it is cast, where it melts and falls down into the *Hearth* in about twelve Hours more or less, and then 'tis run into a *Sow*.

This *Hearth* is made of Sand-Stone, as also its Sides round to the Height of about a Yard; and then the rest of the Furnace is lined up to the Top with Brick.

When they begin upon a new Furnace, they put Fire for a Day or two before they begin to blow: Then they blow gently, and increase by Degrees, till they come to the Height in ten Weeks or more.

Every

Every ſix Days they call a *Founday*, in which time they make 8 Ton of *Iron*; that is, if you divide the whole Sum of *Iron* they make by the *Founday*; or at firſt they make leſs in a *Founday*, at laſt more.

The Hearth, by the Force of the Fire continually blown, grows wider and wider; ſo that if at firſt it contains ſo much as will make a *Sow* of 600 or 700 Pound Weight, at laſt it will contain ſo much as will make a *Sow* of 2000 Pound. The leſſer Pieces of 1000 Pound, and under, they call *Pigs*.

Of twenty four Load of Coals, they expect eight Ton of *Sows*. To every Load of Coals, which conſiſts of eleven Quarters, they put a Load of Mine, containing eighteen Buſhels.

A *Hearth*, if made of good Stone, will ordinarily laſt forty *Foundays* or Weeks; during which time the Fire is never let go out. They never blow twice on one *Hearth*, tho' they go upon it but five or ſix *Foundays*. The Cynder, like Scum, ſwims upon the melted Metal in the *Hearth*, and is let out once or twice before a *Sow* is caſt.

*The Manner of Working Iron at the Forge or Hammer.*

In every Forge there are two Fires at leaſt, which, as before is obſerved, are called, one the *Finery*, and the other the *Chafery*.

At the *Finery*, by the Working of the Hammer, they bring it into *Blooms* and *Anconies*, thus: They roll the *Sow* at firſt into the Fire, and then melt off a Piece of about ¼ of a hundred Pound Weight; which, as ſoon as 'tis broken off, they call a *Loop*. This *Loop* they take out with their *Shingling-Tongs*, and beat it with *Iron* Sledges on an *Iron* Plate near the Fire, that ſo it may not fall in Pieces, but be in a Capacity to be carried under the Hammer; where it is beat very gently at firſt, only to draw Cynders and Droſs out of the Matter: But afterwards they let out or draw more Water, and ſo by degrees beat it thicker and ſtronger, till they bring it to a *Bloom*; which is a four-ſquare Maſs, about two Foot long. This Operation they call *Shingling the Loop*. This done, they immediately return it to the *Finery* again; and after two or three Heats, and Working, they bring it to an *Ancony*, whoſe Figure is in the middle a Bar of about three Foot long, and of the Shape they intend the whole Bar ſhall be made of; but at both Ends is a ſquare Piece left rough, to be wrought at the *Chafery*.

*Note*, At the *Finery* three Load of the biggeſt Coals go to the making of one Tun of *Iron*.

At the *Chafery* they only draw out the two Ends ſuitable to what was drawn out at the *Finery* in the middle, and ſo finiſh the Bar.

*Note*, One Load of ſmaller Coals draws out a Tun of *Iron* at the *Chafery*.

At the *Finery*, they expect that one Man and a Boy ſhould make two Tun of *Iron* in a Week; and at the *Chafery*, that two Men ſhould *take up*, that is, make or work five or ſix Tun in a Week.

One thing is remarkable here: They ſay, That if into the *Hearth* where they work the *Iron Sows* (whether the *Finery* or the *Chafery*) you caſt on the *Iron* a piece of Braſs, it will hinder the Metal from Working, cauſing it to ſpatter about ſo, that it cannot be wrought into a ſolid Piece. *Ray's Collect. of Engliſh Words*, at the End.

IRREGULARITY, in the Canon-Law, ſignifies an Impediment, which will hinder a Perſon's going into Holy Orders, as being a *Baſtard*, *Maimed*, *Conſenting to a Murder*, &c.

IRREPLEVIABLE, in the Common-Law, ſignifies what may not be *Replevied*, or ſet at large, upon *Sureties*.

ISOCHRONAL-LINE, is that in which a heavy Body is ſuppoſed to deſcend without any Acceleration. And the Excellent *G. G. Leibnitz*, in the *Act. Erud. Lipſ.* for *Febr.* 1689. hath a Diſcourſe on this Subject; in which he ſhews, That an heavy Body, with a Degree of Velocity acquired by the Deſcent from any Height, may deſcend from the ſame Point, by an infinite Number of *Iſochronal-Curves*, and which are all of the ſame *Species*, differing from one another only in the Magnitude of their *Parameters*; ſuch as are all the *Quadrato-Cubical Paraboloids*, and conſequently ſimilar to one another.

He ſhews alſo there how to find a Line, in which a heavy Body deſcending ſhall recede uniformly from a given Point, or approach uniformly to it.

ISTHMUS, in Anatomy, is a Paſſage in that part of the *Medulla Oblongata* of the Brain, which lies between the *Cerebrum* and *Cerebellum*, and which reaches from the place called the *Anus* to the fourth Ventricle. The Upper Part or Cover of this Conduit or Paſſage, which is betwixt the *Teſtes* and the foremoſt Vermicular Proceſs of the *Cerebellum*, and to which two it is tied at its two Ends, and to the Proceſſes that come from the *Cerebellum* to the *Teſtes*, at its Sides, is called *Valenta Major*: It is of a Medullary Subſtance; and its Uſe is to keep the *Lympha* from falling out above the Nerves in the *Baſis* of the Skull.

ITALIAN *Hours*, are the 24 Hours of the Natural-Day, accounted on from the Sun-ſetting of one Day, to the ſame time again the next Day, as 'tis the Cuſtom in *Italy* to do at this day, and as the *Jews* did of old.

ITINERANT *Judges* or *Juſtices*, are ſuch as were formerly ſent with Commiſſion into divers Countries, to hear chiefly ſuch Cauſes as were called *Pleas of the Crown*, the ſame with *Juſtices in Eyre*; which ſee.

JUBILEE, is a ſolemn Time of Feſtivity at *Rome*, in which the Pope pretends to give Pardons, Indulgencies, and Bleſſings, to ſuch rich credulous Perſons as have as much *Money* as *Faith*, and who have leiſure enough to go thither to fetch them. The firſt Jubilee is ſaid to have been Inſtituted by Pope *Boniface* VIII. *A. D.* 1300. to return every Hundred Years. But Pope *Clement* VI. thought ſuch a *Fair* of Indulgencies ſhould be kept oftner; and ſo he order'd that the *Jubilee* ſhould return again every Fifty Years; which was decreed *A. D.* 1350.

In Imitation of this profitable Pardon-Market at *Rome*, the Monks of *Chriſt*'s-Church in *Canterbury* ſet up a *Jubilee* of their own every Fiftieth Year alſo, to get a Concourſe of Fools to the Shrine of that inſolent Prelate *Thomas Becket*.

Our King *Edward* II. kept a kind of *Civil Jubilee* at his Court in the Fiftieth Year of his own Age, which was in 1362, granting Pardons, Privileges, and other Civil Indulgencies.

JUDICIUM *Dei*. Our Anceſtors uſed to call thoſe now prohibited Trials of guilty Perſons by *Ordeal*, *Judicium Dei*, the Judgment of God: See *Ordeal* in this Volume.

JUGUM *Terræ*, is half an Arpent or fifty Perches, mention'd in *Domeſday-Book*, and interpreted there to contain half a Plough-land.

JUPITER. The Calculation of the Eclipſes of *Jupiter*'s Satellites, being a thing of great Uſe for determining the Longitude of Places on the Earth, I judg'd it neceſſary to inſert the Manner and Method of it here, from Mr. *Whiſton*'s *Prælectiones Aſtronomicæ*, p. 219.

He takes for an Example an Eclipſe of the firſt Satellite; becauſe, both thoſe Excellent Aſtronomers, *Caſſini* and *Halley*, have ſhewn how to calculate that by proper Tables; and that the ſame Method will ſerve to find the Eclipſes of the other Satellites of this Planet.

And he obſerves that theſe *Caſſinian Tables* are formed after a new and accurate Method, and will give the Moment of the Eclipſes in as new and accurate a Way.

It is ſuppoſed there, That the Periodick Time of this firſt Satellite is preciſely *one* 2448th Part of the Periodick Time of *Jupiter* from one Aphelion to another. Whence the Equations of the Jovial Orbit being turn'd in Minutes of Time, and adapted to thoſe particular Revolutions of the Satellites, will make good the principal Parts of the Equation of theſe Eclipſes. 'Tis to be obſerved alſo, that theſe Tables ſuppoſe the Aphelion of *Jupiter* to be in the Beginning of the 9th Degree of *Libra*; and that the Orbit of the Satellite is ſo little diſtant from the Plane of the Orbit of *Jupiter*, or alſo of the Ecliptick, that the Differences thence ariſing may uſually not be taken notice of. Note alſo, That in the accurate Calculation of theſe Eclipſes, there is need of another Equation, according to the various Poſition of the Earth to *Jupiter*. Which Reſtitution of the *Poſition*, ſuppoſe the Oppoſition of the *Sun* and *Jupiter*, contains $225\frac{1}{8}$ Periods of this Satellite.

The firſt Obſerver of this Equation, Mr. *Römer*, aſſerts, That 'tis in its greateſt Quantity 22 Minutes of Time; but *Caſſini* ſaith it don't exceed 14 Minutes and 10 Seconds. The Cauſe of this Equation is the ſucceſſive Propagation or Motion of Light; which is by no means inſtantaneous. And from this Fountain the Equations of the $225\frac{1}{8}$ Revolutions of the ſecond Satellite, being reſpectively adapted, do compleat the ſecond Parts of theſe Eclipſes. But a little Table may alſo be added, ſhewing the *Half-Stay* of the Satellite in the Shadow of *Jupiter*, accommodated to the former Periods of 2448. For as *Jupiter* accedes to the Sun, the Shadow increaſes; and as he recedes from the Sun, it decreaſes. But this Equation is ſo inconſiderable, that it may moſt ſafely be omitted. There is added alſo, as there ought, a Tablet, ſhewing the *Half Duration* of the Satellite in the Shadow of *Jupiter*, according to the different Poſition of the Satellite with reſpect to the *Nodes* and *Limits*: For tho', as was ſaid above, the Angle of the Inclination of the Plane of the Satellite's Orbit be not great, 'tis yet ſomething: And therefore about the *Nodes* of the Orbit, the Immerſion will be more direct and deep in the Shadow, than about the *Limits*: And theſe Tables, together with the common one of the Equation of Time, and no other, according to Mr. *Halley*'s Judgment, are to be uſed in the Calculation of the Eclipſes of this Satellite.

In order to Calculation then,

1. From the Table of the *Epochæ* of the Revolutions of the firſt Satellite to the Shadow of *Jupiter* (which you will find amongſt the Aſtronomical Tables, under thoſe Words in this Vol. 2.) find firſt the *Year* in the left Hand Column, and then write down the Numbers that ſtand againſt it, expreſſing the Days, Hours, Minutes, and Seconds of the Revolution; and alſo thoſe in the other two Columns, N° 1, N° 2. Under theſe Numbers place alſo in their proper Order (from the next Table) thoſe which belong to the Month and Day aſſign'd, with thoſe alſo in the little Columns, N° 1, N° 2. And then add them all ſeverally, as they ſtand in order, into one Sum. Then will the firſt of thoſe Sums ſhew the middle Moment of the middle of the Eclipſe: The ſecond ſerves for the firſt Equation: The third finds the ſecond Equation; that is, if you write down alſo in every *Leap-Year*, and in the Months of *January* and *February*, the Day next after the given one, inſtead of the given Day, with its Equations: For the Table accommodated, as it ſhould be, to the greater Part of the *Leap-Year*, can't ſerve without Correction for the former Part of the *Year*, before the interpoſed *Leap-Year Day*.

2. If the Number placed in the former Column, and appointed for the former Equation, be leſs than 1224 (the half of the greateſt 2448) that greateſt Number itſelf alſo, if it be needful, being, as the entire Circle, firſt omitted, go to the next following Table agreeing to that Equation, and add the Equation there placed to the middle Time of the Eclipſe before found. If the Sum exceed the half of the greateſt Number, ſubtract the Equation correſponding to it from the middle Time of the Eclipſe: Then will the *Sum* in the former Caſe, and the *Difference* in the latter, give you the Time of the middle of the Eclipſe equated the firſt Time.

3. If the Number placed in the latter Column, and either increaſed by the eleventh Part of the former Equation, where the firſt Equation was found by Subtraction; or leſſen'd by it, where it was gain'd by Addition; be leſs than 113, the half of the greateſt Number 225.4 (that greateſt alſo itſelf, where 'tis neceſſary, being quite rejected); Then take that very Number, or if it be greater than the ſame half, its Compliment to the greateſt Number, and apply it to find the ſecond Equation; and add the proper correſponding Numbers, taken out of the Table, to the *firſt Equated* Time of the middle of the Eclipſe. So ſhall the Sum of both be the true Moment of the middle of the Eclipſe. From which Moment of Time, if you ſubtract the *Half Duration* of the ſame Eclipſe (taken eaſily out of the next following Table) you will have the Moment of the *Immerſion*; if you add it to that Time, you will have the Moment of the *Emerſion*, and both duly accommodated to the mean Time of the Eclipſe.

And theſe few Rules and Operations are fully ſufficient for the Calculation of theſe Eclipſes; only I ſhall add an Example to make all plain and clear.

The

| | D. | H. | ′ | ″ | Numb. 1. | Numb. 2. |
|---|---|---|---|---|---|---|
| The Year 1702. | 1 | 14 | 50 | 36 | 2292 | 78.9 |
| The Day *November* | 23 | 10 | 11 | 00 | 0185 | 184.0 |
| *November* | 25 | 01 | 01 | 36 | 2477 | 262.9 |
| Equation 1 + | 00 | 00 | 03 | 06 | 2448 | .3 |
| Time firſt Equated | 25 | 01 | 04 | 42 | 29 | 262.6 |
| Equation (2) + | 00 | 00 | 03 | 29 | | 225.4 |
| The Half Stay + | 00 | 01 | 04 | 39 | | 37.2 |
| The equal Time of the Emerſion | 25 | 02 | 12 | 50 | ″ ″<br>11) 3,1 (.3 | |
| The Equation of Time + | 00 | 00 | 08 | 25 | ⊙ in ♐ 14 | |
| The apparent Time of the Emerſion | 25 | 02 | 21 | 15 | p. m. | |

But ſince this Eclipſe happens in the Day-time, *viz. Nov.* 25. at 2 Hours, 25 Minutes, and 15 Seconds paſt Noon; a Period or two muſt be added, to find when one will happen in the Night-time.

| | *D.* | *H.* | ′ | ″ |
|---|---|---|---|---|
| The *Radix* is - - - | 25 | 02 | 21 | 15 p. m. |
| Add one Revolution | 1 | 18 | 28 | 36 |
| The Sum will be | 26 | 20 | 49 | 51 p. m. for the Time of the next *Emerſion*. |

Which Eclipſe being alſo inviſible, add to the laſt Sum another Revolution.

| *D.* | *H.* | ′ | ″ | |
|---|---|---|---|---|
| 26 | 20 | 49 | 51 | |
| 1 | 18 | 28 | 36 | |
| 28 | 15 | 18 | 27 | p. m. which will be the Time of the next viſible *Emerſion* of the Satellite in the Meridian of *London*. |

And thus may the Times of the Eclipſes of the Satellites of *Jupiter* be calculated with great Exactneſs for the Meridian of any particular Place, and Tables made of them for any Time to come. And wherever, under any other Meridian, the exact Moment of the Eclipſe of a Satellite can, by a good Teleſcope, be obſerv'd; the Time of its happening ſooner or later than the Tables ſhew it will do, at *London* (ſuppoſe, or for any other Meridian) will ſhew how much the Meridian of the Obſerver is diſtant either Eaſt or Weſt from the Meridian of *London*: That is, the Difference of the Longitude between theſe two Places will be known.

JURIDICAL *Days*, the ſame with *Court-Days*.

JURISDICTION, is a Dignity which a Man has conferr'd on him to do Juſtice in Caſes of Complaint made before him. Of this there are two Kinds; one, which a Man hath by reaſon of his *Fee*, of doing Right in all Plaints relating to his *Fee*, by Vertue thereof. The other is collated by a Prince to a *Bailiff*; which in a large Senſe may ſignify all ſuch as have Commiſſion from the Prince to give Judgment in any Caſe.

JUS *Honorarium*, or the *Edicts of the Prætors*, was a Part of the written *Roman* Laws, and was what the *Prætors*, and ſuch kind of Magiſtrates, did propoſe by the Conſent of the People.

JUS *Retractus ſive Retrovendendi*, in the Civil Law, is an Agreement between Buyer and Seller, that the latter and his Heirs may buy back the Goods or Wares again before any other.

JUSTICE. The Virtue of *Juſtice* is either *Univerſal* or *Particular*. *General* or *Univerſal Juſtice* is a conſtant giving to every one his Due; and this hath for its Object all Laws, both Divine and Humane. *Particular Juſtice*, is a conſtant Will and Deſire of giving every one his Due, according to *particular Agreement*, or the Laws of *Civil Society*. *Particular Juſtice*, as 'tis exerciſed in *Commerce*, is uſually called *Commutative*, and ſometimes *Expletory Juſtice*, being directed without any Regard to the different Conditions of Men, but obſerves the ſimple Proportion, and is wholly bent on the Value or Price of Things, or what is really and juſtly due. But if you conſider *Particular Juſtice*, as it is exerciſed in *Governing*, or in *Beneficence*, it is called *Diſtributive* or *Attributive Juſtice*; and is concern'd in the appointing of Rewards and Puniſhments, according to the ſeveral Conditions, Stations and Qualities of Men, according as they are more or leſs good or bad, uſeful or prejudicial, worthy or unworthy. And when there are many Claimers for Rewards, it obſerves a *Comparative Proportion*.

JUSTICE *of the Hundred*, was formerly the ſame with the *Dominus Hundredi*; called alſo *Centurio*, *Centenarius*, and *Aldermannus*.

JUSTICES *of Labourers*, were *Juſtices* heretofore appointed to redreſs the *Frowardneſs* of Labourers, that would either be *Idle*, or have *unreaſonable Wages*.

JUSTICES *of the Pavillion*, are certain *Judges* of a *Pie-Powder Court*, of a moſt tranſcendent Juriſdiction; anciently authorized by the Biſhop of *Wincheſter*, at a Fair held on St. *Giles*'s *Hill*, near that City, by Virtue of Letters-Patents granted from King *Edw.* IV. See the Patents at large in *Prynn*'s *Animadv.* on 4 *Inſtit.* fol. 191.

JUSTICES *of the Peace*, are they that are appointed by the King's Commiſſion to preſerve the Peace of the Country where they dwell. Of theſe ſome are made of the *Quorum*; becauſe ſome Buſineſs of Importance cannot be diſpatch'd (ſee *Quorum*) without the Preſence or Aſſent of them, or one of them.

The Office and Power of the Juſtices of the Peace is very large and various, being founded on ſeveral Statutes; of which, ſee *Fitzherbert*, *Lambert*, *Crompton*, and in *Smith de Repub. Aulor.* lib. 2. cap. 9. They were called *Guar-*

*Guardians of the Peace* till the 36 *Edw.* 3. cap. 12. where they are ſtiled *Juſtices*. Thoſe that live in, and are Members of Towns, Corporations, &c. are called *Juſtices within Liberties*.

JUSTICE SEAT, is the higheſt Court that is held in a Foreſt, and before the Lord Chief Juſtice in Eyre of the Foreſt, upon Warning given forty Days before; and then the Judgments are always given, and the Fines ſet for Offences, that were preſented at the Courts of *Attachments*, and the Offenders indicted at the *Swain-Motes*: See *Manwood's Foreſt Law*, c. 24.

JUSTICES *of Traile Baſton*, were a kind of Juſtices appointed by *Edward* the firſt, on great Diſorders ariſing in the Kingdom, while he was abſent in the *Scotch* and *French* Wars. Their Office was to make Inquiſition throughout the Realm, by the Verdict of ſubſtantial Juries, upon all Officers, as Mayors, Sheriffs, Bailiffs, &c. for their Breach or Neglect of Duty, in not puniſhing Bribery, Extortion, &c. 'Tis moſt likely they received their Name from *a Baſton*, or Staff, that was the Badge of their Office, as it is of a Mareſchal of *France*: And whoever was brought before them was *Traile à Baſton, traditus ad Baculum*, brought to the Staff of Juſtice.



KALENDÆ, were formerly Rural Chapters, or Conventions of the Rural Dean and Parochial Clergy; ſo called, becauſe they were held on the Kalends, or firſt Days of every Month; as at firſt every three Weeks: At laſt theſe Conventions came to be held only once a Quarter; and by Degrees have been wholly intermitted, to the great Decay of good Diſcipline. *Parochial Antiquities*, p. 640.

KALENDAR *Month*, is mentioned in 16 *Car.* 2. cap. 7. and conſiſts of 30, or 31 Days (except *February*, which never hath more than 28 Days, excepting *Leap-Year*, and then has 29) twelve of which being thoſe mentioned in the *Kalendar*, make a *Year*; which hence is vulgarly expreſs'd in the Singular Number, and called a *Twelve Month*: But when in the Plural Number we ſay *Twelve Months*, then it ſhall be accounted a *Month of Weeks*, which is but 28 Days.

KALENDAR. There is in Uſe ſtill in *Staffordſhire*, among the common People, a very peculiar Kind of perpetual *Kalendar* or Almanack, which Dr. *Plott*, in his *Natural Hiſtory* of that County, deſcribes very accurately, and proves to be of *Daniſh* Invention, and no doubt brought in when the *Danes* had the Government of this Kingdom.

It is called there the *Clogg*, I ſuppoſe from its Form and Matter, being uſually made of a Piece of Wood, ſquared into four plane Sides, and with a Ring on the upper End of it, to hang it on a Nail ſomewhere in the Houſe.

There is ſome Diverſity in the Form of them, ſome being more perfect than others. The following Figure, which I borrow from Dr. *Plott*, repreſents the Common or Family Clogg, where each Angle of the *Square Stick*, with one half of each of the flat Sides belonging to it, is expreſs'd; and this is the moſt clear and intelligible Form it can well appear in, upon a Flat.

On each of the four Sides are three Months, the Number of the Days being repreſented by the Notches; That which begins every Month having a patulous Stroke turn'd up from it: Every ſeventh Notch, being alſo of a larger Size, ſtands for *Sunday*, which ſeems to ſhew that the Cycle of the Sun or Dominical Letters, are here committed to Memory; the *Sundays* and other Days here being fix'd.

Over againſt many of the Notches, whether great or ſmall, there are placed on the left Hand ſeveral Marks or Symbols, denoting the *Golden Number*, or Cycle of the Moon; which Number, if under 5, is repreſented by ſo many Points; but if it be 5, then a Line is drawn from the *Notch*, or Day to which it belongs, with a *Hook* returned back againſt the Courſe of the Line; which ſeems to be deſign'd to repreſent V the *Roman* Letter for 5.

If the *Golden Number* be above 5 and under 10, then 'tis mark'd out by the former hooked Line for 5; and with the Addition of as many Points as make up the Number deſign'd; As if it be 8, there are three Points added to the hooked Line, &c.

When the *Golden Number* is 10, there is a Croſs on the Notch to repreſent X; And if it be above, and under 15, 'tis expreſs'd by Points as before; And if above 15, by the croſs Stroke, Points, and a hook Line for V: When 'tis 19, the Line iſſuing from the Notch for the Day, hath two patulous Croſſes, or Strokes, as is plain from the following Figure.

And theſe Numbers are not ſet ſo wildly and confuſedly againſt the Days of the Month, as at firſt Sight may appear, but in a Method and Order; whether you conſider them as they immediately *precede* and *follow* one another, or the *Diſtance interceding* each Figure, or the *Value*, or Denomination; for every following Number is made by adding 8 to the preceding; and every preceding one, by adding 11 to the following one; ſtill caſting away 19, the whole Cycle, when the Addition ſhall exceed it. Thus to 3, which ſtands againſt *January* 1, add 8, it makes 11; which ſtands againſt the third Day of the Month; to which add 8 again, and it makes 19; whence 8 itſelf comes to be the *following* Figure, and 16 the next: On the contrary, if to 16 you add 11, it makes 27; whence deducting 19, there remains 8, the Number above it; and ſo on, &c.

And for the *Diſtances* of the Numbers of the ſame Denomination, 'tis to be noted that they ſtand aſunder either 30 or 29 Days, interchangeably. Thus after 3, which ſtands overagainſt the 1ſt of *January*, at 30 Days Diſtance you will find 3 again at the 30th of the ſame Month; and from thence, at 29 Days Diſtance, you will have 3 again ſet to the 1ſt of *March*; and at the laſt of *March*, at 30 Days Diſtance, 3 again, &c.

*Note*, 3 ſtands againſt the 1ſt of *January*, becauſe 3 was the *Golden Number*, when the Fathers of the *Nicene Council* ſettled the Time for the Obſervation of *Eaſter*. See *Plot*, *in Loc. cit.*

On the Right Hand, and iſſuing from the Notches, are ſeveral *Inſcriptions* and Figures, Hieroglyphically repreſenting the *Feſtival* Days, by ſome Actions, Offices, or Endowments of the Saints; or elſe the *Work* or *Sport* in faſhion at the Time of the Year.

Thus from the Notch of *January* 13. being St. *Hillary*'s Day, iſſues a *Croſs*, the Badge of a Biſhop. From the 1ſt of *March* an *Harp* for St. *David*. Againſt *June* 29. St. *Peter*'s Day, you have his *Keys*: And againſt St. *Criſpin*'s Day a Pair of *Shoes*. Againſt *Jan.* 25. St. *Paul*'s Day there is an *Ax*: And againſt *June* 24. a *Sword* for St. *John Baptiſt*. On *Aug.* 10th a *Gridiron* for St. *Lawrence*. So a *Wheel* for St. *Katherine*, a *Star* for *Epiphany*, a *True-Lover's-Knot* for St. *Valentine*'s Day, *&c.* And againſt *Chriſtmas*-Day is the old *Waſſhailling*, or *Carouſing-Horn*, that the Danes uſed to make merry withal at that Time.

The Uſe of this Clogg is chiefly to find by the *Prime* or *Golden Number* the *Eccleſiaſtical New Moons*, and the *Moveable Feaſts*; and the *Immoveable Feaſts* by the Symbols on the Right Hand.

KANT-

KANT-*Rref*, was uſed anciently in *Wales* for the Government of an Hundred Towns; under which were ſo many *Commots*, which the *Welch* call *Cwmmwd*, and ſignifies *Provincia* or *Regio*, and conſiſted of twelve Manors or Circuits, and two Townſhips.

KARITE, or *Carite*, was the Word uſed formerly by the *Religious* for their beſt *Conventual Drink*, or Strong Beer; becauſe in this they drank their *Poculum Caritatis*, or Grace Cup: Which Grace-Cup itſelf was ſometimes called by the Name of *Karite* or *Carite*.

KEELS or *Keyles*, were a kind of Long-Boats, of great Antiquity, and mentioned 23 *H.* 8. 18. *Spelman* ſaith they were thoſe in which the *Saxons* invaded *England*.

KELP, what it is, and how made, ſee under *Allum Works* in this Vol.

KERF, is the Notch or Slit that is made by the Saw between two Pieces of Wood, when they are ſawing aſunder.

KERNELLATUS, anciently ſignified *Embattelled* or *Crenelled*, i. e. *Fortified*: And

KERNELLARE *Domum*, was to build a Houſe with ſuch Walls and Towers; which to be allow'd to do, was a Favour commonly granted by our Kings after the Demoliſhments of the Caſtles.

KEYSTONE in an Arch, is placed at the Top or Vertex of Elliptical or ſuch-like flat Arches, to bind the Sweeps of the Arch together.

KIDNEYS. The Kidneys in Man are always two in Number, one on each Side, being nearly of the Figure of the *French* or *Kidney*-Beans; which latter Name they take from being like the Kidneys.

The Length of the human Kidney is between four and five Fingers Breadth. They are about two Fingers Breadth in Thickneſs, and three over. The Right Kidney is ſituated under the Liver; the left under the Spleen.

In a Fœtus their external Subſtance is divided into ſeveral Lobes join'd together, which in adult Perſons become more cloſe; wherefore in ſuch their Surface is equal and ſmooth. They have two Membranes; one *Common* from the *Peritonæum*, the other *Proper*. Uſually they are cover'd with a good deal of Fat; their Colour is of a dark Red.

There are ſeveral *Lymphatic Veſſels* obſerved in the Kidneys, which diſcharge themſelves into *Pecquet*'s Repoſitory: The *Veins* go into the *Vena Cava*: The Arteries come from the *Aorta*.

Thoſe Veins and Arteries are called Emulgents: They come out from the Kidneys in their hollow Sides (which lie neareſt to the *Cava* and *Aorta*) included in one common *Capſula*, and are divided into ſeveral Branches, which ſurround the *Pelvis*. Theſe Branches are again ſub-divided into an Infinity of other leſſer ones, which go to the external Parts of the Kidneys, where they inoſculate, and form a kind of *Net*; from which their Extremities coming, terminate alſo in Infinity of Glands, which are all very ſmall.

Theſe Glands are in Figure roundiſh, and they compoſe the outer Subſtance of the Kidneys, which is half a Finger thick. From each of them there goes a long ſmall Tube; and the Collection of theſe Tubes compoſe the innermoſt Subſtance of the Kidneys.

As theſe *Tubules* approach the *Pelvis*, they gather together in little Bundles; whoſe Extremities piercing the Membrane of the *Pelvis*, form thoſe little Protuberances on the Inſide of the *Pelvis*, or Cavity in the middle of the Kidney, which are called the *Papillæ*.

This Cavity, or *Pelvis*, is form'd by the Dilatation of the *Ureters*: It ſends out ſeveral Ramifications, which divide the Urinary Tubes into Bundles, and which make a ſort of *Capſula* to the Blood Veſſels.

The Uſe of the Kidneys is to ſeparate the Urine from the Blood; which by the Motion of the Heart and Arteries is thruſt into the Emulgent Branches, which carry it to the little Glands; by whoſe Means the Seroſity being ſeparated, is received by the Orifice of the little Tubes, which go from thoſe Glands to the *Pelvis*; from whence it runs by the Ureters into the Bladder.

The Blood which was carried into the Glands, its Particles being too groſs to enter into the ſmall excretory Tubes, is brought back from the Kidneys by the Emulgent Veins, to be mingled with the other Venal Blood in the *Cava*.

The Deſcription of the *Ureters*, *Veſica Urinaria*, *Glandulæ Renales*, *&c.* you will find in their proper Places.

Dr. *Keil*, in his *Animal Secretion*, pag. 33. judges that the *Kidneys* are placed ſo near the Heart as they are, becauſe Salts are Corpuſcles, which are ſtrongly attracted, and have a moſt cloſe Union with the Fluid of Water: For tho' the Lungs may divide the Particles of Salt one from another, yet ſtill they firmly adhere to the aqueous Humour in which they ſwim; and therefore they may likewiſe at firſt be drawn off: And he thinks that the *Kidneys* could not well have been placed at a greater Diſtance, to have ſeparated ſuch a Quantity of Urine as they now do; and that not only on the account of the great Quantities of Blood they receive where they are; but likewiſe, if they had a more diſtant Situation, other Particles muſt have united with the Salts and aqueous Particles (as even in their preſent Station *ſome* terreſtrial Particles do) and conſequently the Urine could not have been diſtilled ſuch as it is now, or at leaſt but in a ſmall Quantity.

KING-PIECE in any Building, is a Piece of Timber ſtanding upright in the middle between two principal Rafters, and having Strutts or Braces going from it to the middle of each Rafter.

KINGS *at Arms*: See *Heralds* in this Vol.

KING-SILVER, is properly that Money due to the King or Queen in the Court of Common-Pleas *pro Licentia concordandi*, in reſpect of a Licence then granted to any Man for paſſing a Fine.

KINTAL, is a Weight in Merchandiſe, uſually of about an hundred Pounds, but ſomething more or leſs, according to the different Cuſtoms of different Nations.

KNAVE, is an old *Saxon* Word for a Man-Servant, and is ſo uſed in 14 *E.* 3. *Stat.* 1. *c.* 3. and *Verſtegan* thinks it comes from the *Dutch Cnapa*, which ſignifies the ſame Thing. *Cnapa* in *Saxon* alſo is a Male-Child or Boy; and in this Senſe a *Knave-Child* hath been frequently uſed formerly in Contradiſtinction to a *Girl*; and in this Senſe *Wickliff* uſes the Word in his Tranſlation of *Exod.* 1.16. and other Places of the Bible.

KNEVELS, the same with *Kevels*.

KNIGHT, *Miles*, from the *Saxon Cnite*, signifies with us a Person that beareth Arms, and who for Valour and Martial Conduct is by the Sovereign, or his Authority, singled from the ordinary sort of Gentlemen, and raised to a higher Step or Dignity. This among almost all Nations takes his Name from the *Horse*, because they used to serve in War on Horseback. Thus the *Romans* called them *Equites*; the *Italian* Word is *Cavallieri*; the *French*, *Chevaliers*; the *Germans*, *Reyters*; the *Spaniards*, *Gavallares*, *&c.* It appears by the *Stat.* 1 *E.* 2. c. 1. That formerly a Gentleman having a full Knights-Fee, and holding his Land by Knight-Service, might be urged by Distress to procure himself to be made *Knight* when he came to full Age: But by 17 *Car.* 1. 20. no Man can be compelled to take that Order on him. The Manner of making *Knights*, *Cambden*, in his *Britannia*, shortly expresses in these Words: *Nostris vero Temporibus qui Equestrem Dignitatem suscipit, flexis genibus educto Gladio leviter in humero percutitur; Princeps his Verbis Gallicè effatur: Sois Chevalier au nom de Dieu.*

KNIGHTS *Bannerets*: See *Bannerets* in this Vol.

KNIGHTS *of the Bath*, are an Order of *Knights* made within the Lists of the *Bath*, and girded with a Sword in the Ceremony of their Creation. They are spoken of in 8 *Edw.* 4. c. 2. For their Antiquity and Manner of Creation, see *Dugdale*'s Description of *Worcestershire*. They take Place of *Knights Batchelors*, and come after *Baronets*.

KNIGHTS-FEE, is so much Inheritance as is sufficient yearly to maintain a *Knight* with convenient Revenue; which in *H.* IIId's Time was 15 Pounds, *Cambd. Brit.* p. 111. But Sir *Tho. Smith*, in his *Repub. Anglor.* lib. 1. c. 18. rateth it at 40 Pounds. And in 1 *E.* 2. c. 1. it appears that such as had 20 Pound in Fee, or for Term of Life, might be compelled to be *Knights*; but this is now repealed by 17 *Car.* 1. *Stow* in his *Annals* saith, "There were in *England* at the "Time of the Conquest 60211 (others say 60215) "*Knights-Fees*; whereof the Religious Houses, "before their Suppression, were possess'd of "28015." Some say a *Knight's-Fee* contained 8, others 12 *Plough-lands*, or 600 Acres.

KNIGHTS *of the Garter*, are an Order first created by King *Edw.* III. after the Acquisition of many great and glorious Victories. He fought out of his own Kingdom, and all over Christendom, for a Number of most excellent and noble Persons, to each of which he gave a blue Garter deck'd with Gold, Pearls, and precious Stones, with a Buckle of Gold, to be worn only on the left Leg; a Kirtle, Crown, Cloak, Chaperon, a Collar, and other stately and magnificent Apparel. The Number was 26, of which the King and his Successors were ordain'd *Sovereigns*, and the others *Companions*, or Brethren of the most Noble Order of the *Garter*.

This most Honourable Society is now a College or Corporation; having a Common Seal belonging to it; having, besides the *Sovereign*, which is Guardian of the Order, and who governs it by himself, or Deputy; and besides the 25 *Companions*, or *Knights of the Garter*, 14 Secular Canons, that are Priests, or must be within a Year after their Admission; 13 Vicars, which must also be Priests; and 26 poor Knights, that have no other Subsistence or Means of Living but the Allowance of this Order. The Bishop of *Winton*, for the Time being, is called *Prelate of the Garter*; the Bishop of *Sarum*, *Chancellor of the Garter*; the Dean of *Windsor*, *Register of the Garter*. The Principal King at Arms is called *Garter*, who is to manage and marshal their Solemnities at all Installations and annual Feasts. The *Usher of the Garter* is also *Usher of the Black-Rod*. By Order of King *Charles* I. all the Companions of the *Garter* are to wear on the left Side of their upper Garment the Cross of *England*, encircled with the *Garter* and *Motto*, and with Rays of Silver issuing from thence every way like a Star; whence 'tis usually called the *Star and Garter*.

KNIGHT-*Marshal*, is an Officer in the King's House, having Jurisdiction and Cognizance of any Transgression within the King's House and Verge; as also of Contracts made there, whereof one of the House is Party.

KNIGHTEN *Gyld*, was anciently a *Guild* in *London*, consisting of nineteen Knights, founded by King *Edgar*; who gave then a Portion of waste Ground, lying without the Walls of the City, which is now called *Port-Soken-Ward*. *Stow*'s *Annals*, p. 151.

KNOCKING-*Mill*, is the same with a Stamping-Mill, which see, and also the Word *Tin*.

LABEL, in the Law, is a narrow Slip of Paper or Parchment affixed to a Deed or Writing, in order to hold the appending Seal: So alſo any Paper, annex'd by way of Addition or Explication to any Will or Teſtament, is called a *Label* or *Codicil*.

LACERTA, is a Word uſed in *Doomſday-Book*, and ſignifies a *Fathom*.

LACHES, in the Law-ſenſe, ſeems to ſignify *Slackneſs* or *Negligence*, as appears from *Littleton*, *Fol.* 403 and 726, where *Laches* of Entry is nothing elſe but a Neglect of the Heir to enter; and ſo perhaps comes from our *Engliſh* Word to *Lack*; unleſs from the French *Laſcher* or *Laſche*.

LACHRYMATORIES, were ſmall Earthen Veſſels, wherein the Tears of the weeping Friends that ſurvived, were repoſited and buried with the Aſhes and Urns of the Dead.

LADA, is a *Lade* or *Lath*, from the Saxon *Lathian*, ſignifies an Aſſembly or Court of Juſtice; and from hence the annual Court at *Dym-Church*, by *Romney-Marſh* in *Kent*, for the Election of a Bailiff and other Officers, is call'd *Dym-Church-Lath* to this Day.

LADA, from the Saxon *Ladian*, alſo ſignifies a Purgation by Trial; and in the Laws of King *Ethelred* there is frequent Mention of the *Lada Simplex*, *Triplex*, and *Plena*.

LAFORDSWICK, in the old Saxon, is the betraying of, or Infidelity to a Lord and Maſter. 'Tis mentioned in the Laws of *Canutus*, c. 61. and thoſe of *Henry* I. c. 13.

LAGA, is a Word uſed for Law in *Magna Charta*: And hence comes *Dane Lage*, *Saxon Lage*, *Mercen Lage*, &c. as alſo

LAGEDAYUM or *Lagh-day*, that is, a Law-day, or Day of open Court: Hence alſo a *Lages-Man* is *Homo Legalis*; and this Word *Lage-Man* is frequently uſed in *Doomſday-Book*, and in the Laws of *Edward* the Confeſſor.

LAGEN, *Lagena*, in ancient Times was a Meaſure containing ſix *Sextarii*. Vid. *Fleta*, l. 2. c. 8, 9. and *Charta Ed.* 3. *m.* 25. *n.* 82.

LAGON or *Lagan*, is a parcel of Goods thrown out of a Ship in a Storm, &c. and becauſe they would elſe ſink, they are faſtened to a Buoy or Cork, in order to be found again. If the Ship be wreck'd, the Goods are called *Lagan* or *Ligan*, *quaſi à Ligando*: and ſo long as they continue in the Sea they belong to the Admiral; but when caſt aſhore they become a *Wreck*, and belong to him that hath the *Wreck*, as appears in *Co. l.* 5. *fo.* 106.

LAHSLITE, *Lagſlite*, *Laghſlite*, is uſed in the Laws of *Hen.* I. c. 13. for a Tranſgreſſion of the Law; and ſometimes for the Puniſhment thereunto belonging.

LAMMAS-DAY, quaſi *Lamb-mas*, is our firſt of *Auguſt*; and on this Day the Tenants which formerly held Lands of the Cathedral Church in *York*, were bound by their Tenure to bring a *Lamb* alive into the Church at High-maſs.

LAND-BOC, was anciently a Charter or Deed, whereby Lands or Tenements were given or held.

LAND-CHEAP, was an old cuſtomary Fine paid either in Cattle or Money at every Alienation of Land, lying in ſome peculiar Manor, or Liberty of ſome Burgh. This Cuſtom yet remains in *Malden* in *Eſſex*.

LAND GABLE or *Gavel*, was anciently a Tax or Rent iſſuing out of Land: 'Tis called in *Doomſday Cenſus Prædialis*; and *Spelman* ſaith, it was a Penny for every Houſe, being, as we now ſpeak, a kind of Quit-Rent or Ground-Rent.

LANDIRECTA, in the *Saxons* Time, were ſuch Services and Duties as were laid on thoſe that held Land. Theſe were three Obligations, which from their Number were called *Trinoda Neceſſitas*, and were *Expedition*, *Burgh-bote*, and *Brig-bote*. Theſe were not called *Servitia*, becauſe not Feodal Services ariſing from the Condition of the Owners; but by this Name *Landirecta*, Rights that charged the *very Land*, whether poſſeſt by Churchman or Layman.

LAND-TENANT, in the Law, is he that actually poſſeſſes the Land, and who hath it in his manual Occupation. The ſame with *Terre-Tenant*.

LANO-NIGER, was a kind of baſe Coin in Uſe about the Time of *Edw.* I.

LAPSE, is the Omiſſion of a Patron to preſent to a Church within ſix Months after voidable; on which Neglect, Title is given to the Ordinary to *Collate* to the ſaid Church.

LASHITE, was a common Forfeiture in the time of the *Danes*; it was 12 *Ores*, each *Ore* was about 6 *d.* Sterling. *Vid. Selden Hiſt. Tythes.* Tho' ſome ſay, the *Ore* was in Value about 16 Pence, and that 15 of them made the *Libra* or Pound.

LAST, in general ſignifies a Burden, and particularly a certain Weight or Meaſure: As a Laſt of Pitch, Tar, or Aſhes, is 14 Barrels; a Laſt of Hides or Skins is 12 Dozen; a Laſt of Codfiſh is 12 Barrels; a Laſt of Herrings is 20 *Cades*, or ten Thouſand; a Laſt of Corn is 10 Quarters; a Laſt of Wool is 12 Sacks; a Laſt of Leather is 20 Dickers, and every Dicker is 10 Skins; a Laſt of unpack'd Herrings is 18 Barrels.

LAST, in the Marſhes of the *Eaſt* of *Kent*, alſo is a Court held by 24 Jurats, and ſummoned by the two Bailiffs thereof, wherein they make Orders, lay and levy Taxes, &c. for the Preſervation of the Marſhes.

LASTAGE or *Leſtage*, is a Cuſtom exacted in ſome Fairs and Markets, to carry Things where one will, ſaith *Raſtall*; but ſometimes 'tis taken alſo for the Balaſt of a Ship; and, as ſome ſay, 'tis properly a Cuſtom paid for Wares ſold by the *Laſt*.

LAST-HEYRE, is he to whom the Land comes by *Eſcheat*, for want of lawful Heirs; which is ſometimes the Lord of whom the Land is held; and ſometimes the King.

LATCHES, in a Ship, are the ſame with *Laskets*.

LATHE (*Læſtium*) is a great part of a County or Shire, containing three or four Hundreds, as in *Kent* and *Suſſex*. Whence the

LATHE REEVE, or *Leid-grede*, or *Tything-Reeve*, was an Officer in the *Saxon* Government, who had Authority over the third Part of the Country,

Country, or over three or more Hundreds or Wapentakes; whoſe *Territory* was called a *Tithing*, or a *Leid* or *Leithen*. Perhaps the *Ridings* in *Yorkſhire* are ſo called corruptly from *Tithings* or *Tridings*, as 'tis ſometimes written. Matters that could not be determined in the Hundred Court, were brought to the *Trithing*, where the principal Men of three or more Hundreds, being aſſembled by the Authority of the *Lath Reeve* or *Trithing Reeve*, did decide and determine it; but if they did not, it went further to the County Court.

LATITUDE *of a Place*, is found at Sea by having the Sun's or any Star's Declination (by the Tables) and his Meridian Altitude; and that is found by a Quadrant or Aſtrolabe. Now from the Horizon to the Zenith being 90°; if from 90° you take the Sun's Meridian Altitude, the Remainder will be the *Sun's Diſtance from the Zenith*. When therefore by Obſervation the Sun's Meridian Altitude is found, you are to conſider whether the Sun hath any Declination or not: If he hath none, but moves in the Equinoctial that Day, then the Elevation of the Equator will be equal to his Meridian Altitude; and conſequently his Meridian Altitude is the Co-Latitude: Subduct therefore that from 90, the Remainder is the Latitude of the Place, which will be *North*, if the Sun be on the South Part of the Meridian, and South when the Sun comes to the North of the Meridian. 'Tis the ſame thing with any Star in the Equator. When the Sun or Star hath any Declination, the Zenith Diſtance with that will give the Latitude; for if the Meridian Altitude and Declination be both the ſame way, *i. e.* both North or both South, the Difference between them will be the Latitude of the Place, or the Pole's Height: Only obſerve, that if the Zenith Diſtance exceed the Declination, the contrary Pole will be elevated. *V. gr.* If the Declination be 23°. 30′. *N.* and the Zenith Diſtance 8°. 30′. *N.* the Latitude will be 15°. *N.* But if the Zenith Diſtance be 71°. 30′. *S.* and the Declination 20°. *S.* the Difference will be 51°. 30′ = to the Latitude, as before; only it will be *North*, becauſe the Zenith Diſtance exceeds the Declination. If the Declination be *North*, and the Meridian Altitude *South*, or *vice verſa*, *i. e.* one contrary to the other, then the *Sum* of the Declination and the Zenith Diſtance is the Latitude of the Place. Indeed ſometimes the Sun or Star may have two Meridian Altitudes; as when the Altitude and Declination being the ſame way, the latter exceeds the former; and then the Sum of the Co-declination and the Meridian Altitude is the Height of the Pole towards which the Declination is. And you muſt obſerve, that whether the Meridian Altitude be North or South, if *that* and the Co-declination together be leſs than 180°. the Sun or Star will have two Meridian Altitudes in 24 Hours.

LATROCINIUM, in ſome old Charters, is uſed for the Liberty of *Infang-thief*, or the Privilege of adjudging and executing Thieves.

LATTA, is a *Lathe* or *Tithing*.

LAUDIMIUM, in the Civil Law, is the 50th Part of the Value of Land or Houſes paid by the Proprietor to the new Tenant, by way of *Emphyteuſis*, as an Acknowledgment upon *Inveſtitures*, or for being put into Poſſeſſion.

LAUDUM, was formerly uſed for an Arbitration or deciſive Sentence of any choſen Judge or Arbitrator.

LAUNDER, is a Trench cut in the Floor 8 Foot long and 10 Foot over, with a Turf for a Stopper at one End, to let the Water (which comes along with the bruiſed Ore from the Coffer of a ſtamping Mill in the Tin-works) run away while the Ore ſinks to the bottom. See *Tin*.

LAURETS, were pieces of Gold coined in the Year 1619, with the King's Head laureated on them. There was a 20*s.* Piece marked with xx; one of 10*s.* marked x, and one of 5*s.* marked v.

LAW. In *England* our Laws have been variable. (1.) We had the Laws of *Molmutius*, which were tranſlated out of *Britiſh* into *Engliſh* by *Gildas*; of which there ſome remain in our preſent Laws. *Vid. Mag. Chart.* c. 1. *and* 14.

(2.) There was the *Merchen Lage*, mentioned in *Cambden's Brit.* and *Polyd. Hiſt. Angliæ, lib.* 5.

(3.) *Weſt-Saxon-Lage.*

(4.) *Dane-Lage*; all which were reduced into one Body by *Edward the Confeſſor*.

At preſent the Law of *England* is divided into three Parts.

(1.) The *Common Law*, which is the moſt ancient and general.

(2.) *Statutes*, or *Acts of Parliament*.

(3.) Particular Cuſtoms. *C. on L.* fol. 15.

LAW hath alſo a ſpecial Signification, ſometimes implying that which is *Lawful* with us, and not elſewhere, as *Tenant by Courteſy of* England, 13 *E.* I. 3.

To *Wage Law* (*Vadiare Legem*) is to put in Security: To *make Law* (*facere Legem*) at a Day aſſigned: And to *make Law*, is to make Oath that he owes not the Debt challenged at his Hands; as alſo to bring with him ſo many Men as the Court ſhall aſſign, to avow upon their Oath, that they believe in their Conſciences he hath ſworn truly.

And this *Law* is uſed in Actions of Debt without Specialty; as alſo, where a Man coming to the Court after ſuch a Time, that his Tenements have been ſeized for Default, ſhall deny himſelf to have been ſummoned.

LAW *of Arms*, *Jus Militare*, is the allowed Rules and Precepts concerning War; to make and obſerve Leagues and Truces, to puniſh Offenders in Camps, &c.

LAW *of Merchants*, *Lex Mercatoria*, is a Privilege or ſpecial Law, differing from the Common Law of *England*, proper to Merchants, and ſummary in Proceedings. *Vid.* 27 *E.* 3. *Stat.* 8, 9, 19, 20. 13 *E.* 1. *Stat* 3. *Cook on Littleton*, fol. 182.

LAW *Spiritual*, is the Eccleſiaſtical Law, allowed by the Laws of this Realm, ſo far as it is not contrary to the Common-Law, nor the Statutes and Cuſtoms of the Realm. According to this the Ordinary or other Eccleſiaſtic Judges do proceed in Cauſes within their Cognizance. *Cook on Littleton*, fol. 344.

This was called the *Law Chriſtian*, and the Court the *Court Chriſtian*; and the Rural Dean, who was Judge or Preſident of the Court within his own Diſtrict, was called hence *Decanus Chriſtianitatis*; and in Contradiſtinction to this, the Common-Law was by ſome called *Lex Mundana*, *Terrena*, &c.

LAW *of the Staple*, is the ſame with the *Law of Merchants*.

LAW *of Marque*, (ſee *Repriſals*.) This Word is uſed 27 *E.* 3. *Stat.* 2. c. 22. and comes from the *German* Word *March*, which is a *Bound* or *Limit*; and thoſe who are driven to Repriſals, are forced to take the Ship and Goods of the Injurer, ſince they

they cannot meet him at Home to have ordinary Justice.

LAW-*day*, is otherwise called the *View of Frank Pledge* or *Court-Leet*; and is used for the County Court, 1 *E.* 4. c. 2. and indeed the *Lage-day* or *Law Day*, formerly was any Day of open Court; and was commonly used for the more solemn Courts of a County or Hundred.

LAW-*less Court*. On *King's Hill* at *Rochford* in *Essex* on *Wednesday* Morning next after *Michaelmas-day*, at Cock-crowing, is held a Court so called, because 'tis held at a lawless or unlawful Hour: They whisper, and have no Candle, nor any Pen and Ink, but only a Coal: And he that owes Suit or Service and appears not, forfeits double every Hour he is missing. This Court belongs to the Honor of *Raleigh*, and to the Earl of *Warwick*.

LAWES, are round Heaps of Stone, being a kind of rude Monument for the Dead. They are so called on the Borders between *England* and *Scotland*.

LAYMAN, among the Painters, is a Statue of Wood, whose Joints are so made, that it may be put into any Posture; and its chiefest Use is for the *casting* and *adjusting* of *Draperies* for the cloathing of Figures.

LEA *of Yarn*. By *Stat.* 22, 23 *Car.* 2, c. — a Lea of Yarn at *Kidderminster* is appointed to contain 200 Threads, on a Reel which is four Yards about.

LEAD. The Lead Mines in *Somersetshire* are at *Mendip*, which is a Place all mountainous, but the Hills are of unequal Heights; 'tis barren and cold, and in some Places rocky: the Ridges of the Hills run confusedly, but most *East* and *West*, and not many parallel one with another. The Surface is heathy, ferny and furzy; it feeds Sheep all the Year, and young Beasts, Horses and Colts at Spring and Fall. The Soil is red and stony, but no way *Claiey*, *Marley* or *Chalkey*. The Stones are either of the Nature of Fire-stones or Lime-stones. The Trees have their Tops burnt, and their Leaves and their Outsides discoloured and scorched with the Wind; and they grow to no considerable Bigness. The Stones which are wash'd out by the Brooks and Springs are reddish and ponderous. The Country is more troubled with Thunder and Lightning, Storms, nocturnal Lights and fiery Meteors, than other Parts of the County.

When they have gotten the Ore, they *beat* it small, then *wash* it clean in a running Stream, and then sift it in Iron *Rudders*, after which they make an *Hearth* or *Furnace* either of Clay or Fire-stone, which they set in the Ground, and upon it build their Fire which is lighted with Charcoal, and continued with young oaken Gadds: 'Tis blown with Bellows by Men's treading upon them, and after the Fire is lighted, and the Fire-place hot, they throw their Lead Ore upon the Wood which melts down into the Furnace; and then with an Iron Ladle, they take it out, and on Sand cast it into what Form they please. *Phil. Trans.* N° 28.

In *Phil. Trans.* N° 39, you have this further Account.

The Veins of Lead have been found to run up into the Roots of Trees without apparently altering them. White, yellow, and mix'd Earth, are *Leaders* to the *Country* or Place where the Ore lies; and changeable Colours do always encourage their Hopes. Sometimes they dig 12 Fathom deep before they meet with any Stones; other while when a *stony Reak* is at top, they meet Ore just under the *Swerd* or Surface of the Grass: which Ore hath gone down 40 Fathom. A *black Stone* is an ill Sign, and leads to *Jam*, as they call it, that is, a thick Bed of Stone that hinders their Work; a grey, clear, and dry one they account the best, They seldom meet with any *Damps*. If in sinking they come to wet moorish Earth, they expect a *Jam*, and to be closed up with Rocks. Their Nearness to the Ore they guess by short brittle Clay; for they don't think or find a tough Clay to be *leading*, as they call it; that is, directing towards Ore.

Sometimes the Ore lies *Shale* or shallow, and then it is 14 or 20 Fathom, more or less, before they hit it. They follow a Vein inclining to some Depth, when it runs away in little flat *Binns*.

When the Stones part it, then they find a Vein again. Their Draughts are 14 or 16 Fathom, till they come to a Stone, where they cast a Side-Draught, called a *Cut*. Then they sink *plumb* again 4 or 5 *Cuts* one under another; They find Ore at 50 Fathom. Their best *Reaks* are North and South; East and West are good, tho' not so deep. The *Groove* is 4 Foot long and 2½ Foot broad, till they meet with Stone, and then they carry it as they can. The *Groove* is supported by Timber; a Piece as big as one's Arm will support 10 Tun of Earth. The Timber there lasts long; they have known it lie 200 Years, and after that it will serve in new Works; it is tough and black, and being exposed a few Days to the Sun and Wind grows so hard that an Ax will scarce cut it.

For the supply of Air, they have Boxes of *Elm*, exactly closed, of about 6 Inches in the Clear, by which they carry it down 20 Fathom and more; but when they come at Ore, and need an *Air-shaft*, they sink it 4 or 5 Fathom distant, of the same Fashion with a *Groove*, to draw as well Ore as Air.

They make use of *leathern Bags*, holding 8 or 9 Gallons a piece, to free them from Water, which are drawn up with Ropes. If they find a *Swallet*, they drive an *Adit* upon a level till it is dry. If they cannot cut the Rock, they use Fire to *anneal* it, laying on Wood and Coal, and contriving the Fire so that they can leave the Mine before Operation begins; and they find it dangerous to enter again before it be quite cleared of the Smoak, which hath killed some.

Their Beetles, Axes, and Wedges, *&c.* unless so hardened as to make a deep Impression on the Head of an Anvil, are not fit for their Use; and yet they sometimes break them in an Hour; others last three or four Days, as it happens. They work in Frocks and Wastcoats, by Candle-light (of Tallow) 14 or 15 to the Pound, each of which lasts three Hours, if they have Air enough. A Vein being lost, they drive two or three Fathom in the *Breast*, as the Nature of the Earth directs them. They hand out their Materials in *Elm Buckets* drawn by Ropes; the Buckets hold about a Gallon. Their Ladders are of Ropes.

The Ore sometimes runs in a Vein, and sometimes is dispersed in *Banks*; it lies often between Rocks: Some of it is hard, some milder. Many times they have *branched Ore* in the *Spar*. About the Ore there is a Spar and Chalk, and another Substance which they call *Crootes*, which is a mealy white Stone matted with Ore, and soft. The Spar is white, transparent and brittle like Glass. The Chalk white, and heavier than any Stone.

Stone. The Vein lies between the Coats and is of different Breadths; it breaks off ſometimes abruptly in the Earth, which they call a *deading Bed*; and after a Fathom or two may come again to keep the ſame Point. It terminates ſometimes in a Rock called a *Fire-ſtone*, and ſometimes in a dead Earth, Clayie without either *Croote* or *Spar*. The cleareſt and hardeſt Ore is the beſt, of which 36 hundred Weight makes about a Tun of Lead.

The Hearth for melting the Ore is about 5 Foot high, ſet on Timber, to be turned about as a Wind-mill, to avoid the Smoak on a ſhifting Wind; it holds half a Buſhel of Ore and Coal: There is a Sink on the ſide of the Hearth into which the Lead runs, and it holds about 1½ Hundred. They have a Bar to ſtir the Fire, a Shovel to throw it up, and a Ladle heated red hot to caſt out the melted Metal. Once melting is enough, and the beſt, which is the heavieſt, melts firſt. There is a *Flight* (as they call it) or Steam in the Smoak, which falliing on the Graſs, poiſons thoſe Cattle that eat of it. The Workmen find the Taſte of it (when the Smoak flies in their Faces) to be ſweet upon their Lips; brought home and laid in their Houſes it kills Rats and Mice. What of this *Flight* falls upon the *Sand*, they gather up to melt on a *Flag-Hearth*, and make *Shot* and *Sheet Lead* of it.

LEAD, at Sea, ſignifies a Plummet of that Metal of about a Foot long, and ſix or ſeven pound Weight, which is hung at the End of a long String to ſound the Depth of the Sea withal: Therefore their Word is, *Heave the Lead*, that is, ſound the Depth of the Water, to know whether it be ſafe for the Ship to venture in any further or not.

LEAD-NAILS, are ſuch as are commonly uſed to nail down Lead, Leather, or Canvas to hard Wood.

LEDGERS, are long Pieces of Timber faſtened horizontally to the Poles in the Scaffolds belonging to any Wall or Building, on which the outermoſt Ends of the Putlogs do reſt.

LEE-WAY, of a Ship at Sea, is the Angle made by the Line on which the Ship ſhould run, according to her Courſe or the Point of the Compaſs ſteered upon, and the real Line of the Ship's Way; for all Ships are apt to fall a little to *Leeward* or to make ſome *Lee-way*. Wherefore in caſting up the Log board, ſomething muſt always be allowed for *Lee-way*; and they give ſuch Rules as theſe, 1. If the Ship be *upon a Wind* you muſt allow one Point for *Lee-way*. 2. If the Wind blow hard, ſo that you are forced to take in one Top-ſail, allow two Points for the *Lee-way*. 3. If it blow ſo hard that both Top-ſails muſt be taken in, and the Sea runs high, then allow three Points for the *Lee-way*. 4. If her Fore-ſail being furled, ſhe *Try* under a Main-ſail and Mizzen, ſhe will make her Way four Points before the Beam. 5. If ſhe *Try* with a Main-ſail only, ſhe will make her Way near three Points before the Beam. But, 6. If under a Mizzen only, ſhe will make her Way about two Points before the Beam.

LEGACY, *Legatum*, is uſually any particular Thing given in a laſt Will and Teſtament; for if the whole Eſtate be ſo given, 'tis *Hæreditas*. But in the Eccleſiaſtical Senſe it was formerly a *Soul-Seat*, or a Legacy given to the *Church*, or accuſtomed Mortuary.

LEGION. In the time of the *Romans* firſt War in *Sicily*, *Polybius*, *lib.* 1. ſaith, that the *Roman* Legion conſiſted of 4000 Foot and 300 Horſe; afterward *L. Æmylius* and *C. Atilius Coſſ.* their Legion (in the great Preparations they made againſt the *Gauls*) conſiſted of 5200 Foot and 300 Horſe.

After this, ſome Time before the Battel at *Cannæ*, the *Roman* Legion had in it 5000 Foot and 300 Horſe, to which was added an equal Number of Latin Auxiliary Foot, and for the moſt part thrice the Number of Horſe. *Polyb. lib.* 3.

LEVANT, in Geography, is properly the Eaſtern Side of any Continent or Country, or that on which the Sun riſes. But now with our Seamen it ſignifies the Mediterranean Sea, and eſpecially the Eaſtern Part of it; and our Trade thither is called the *Levant Trade*; and a Wind that blows from thence out of the *Streights Mouth* is called a *Levant Wind*.

LEVEL: In *Phil. Tranſact.* N° 141. there is an Account of a new Level by Mr. *Butterfield*, which he ſaith is done by a Tube with Glaſſes, and a Thread hanging between four Points, with a Weight in a Box; ſo contrived, that as ſoon as the Inſtrument is ſet down, you have the *Point* of Horizon with a great deal of Exactneſs; and he ſaid he was then making another which plaid on the Point of a Diamond. But I have never heard any thing of this ſince, and Mr. *Butterfield*, Inſtrument-Maker to the *French* King is now dead.

In *Phil. Tranſ.* N° 74. *p.* 2217, is an Account of a Book, then publiſhing, about *the Art of Levelling* by Mr. *Mariotte*; but whether it was ever actually publiſhed, I know not. Capt. *Halley*, Geometry Profeſſor at *Oxford*, from his Obſervations of the Height of the Mercury in the Barometer, at the Top and Bottom of *Snowdon Hill* in *Wales* (where at the Top it ſunk three Inches eight Tenths lower than its Height at the Foot of the Hill) concludes, that one of our new portable Barometers, would be accurate enough to take the Levels for bringing Water from diſtant Places, and would be much leſs ſubject to Error than the common Levels, there being $\frac{1}{10}$ of an Inch for every 30 Yards; which may be divided into many Parts evidently. See *Phil. Tranſact.* N° 229. And Mr. *Derham*, by Obſervations of this nature made at the Foot and Top of the Monument, allows $\frac{1}{10}$ of an Inch to 82 Foot of perpendicular Aſcent, when the Mercury ſtandeth at 30 Inches.

There is a Book written on the Subject of Levelling by Mr. *De la Hire*, but I have not ſeen it. And there is a Deſcription of a new levelling Inſtrument, by Mr. *Couplet*, in the *French* Memoirs for 1699.

LEVELLING, is the Art of finding a true horizontal Line, or the Difference of Aſcent or Deſcent between any two Places, in order to drain Moors, Marſhes, and Moraſſes, &c. or to convey Water from Place to Place. The Inſtruments made Uſe of you will find under the Word *Level* in Vol. I. and *Pendulous Level* in Vol II.

The Method of proceeding in the Art of Levelling is, or may be much the ſame, let the Inſtrument be the common Water Level, that of *Spirit of Wine*, or the *new Pendulous one*. The moſt commodious and expeditious Way is to provide two Station Staves of ſquare Deal, like Rulers, about 8 or 10 Foot in Length. Let every Foot be divided into 10 Parts, and each of thoſe into 10 more; ſo each ſmall Diviſion will be the 100th part of a Foot. On each of theſe Staves there muſt be a Vane to ſlide up and down, and with a Screw in the back Part to faſten it to any Height on the

Staff

Staff. The fore-side of the Vane or Sight should be painted white, or covered with white Paper, with a *black* Line drawn across it lengthways. Having then two Assistants to hold these Staves upright, and to slide the Sights up and down, supposing you were to find the Difference of the Heights of any two Places, as of *A* and *B*: If one Station will do, place the Level in the middle between the Places, and having by the Bubble or otherwise set it truly Horizontal, look back to the first place, till your Assistant sliding the Vane up and down for you there on the Staff, you can see the black Line thereon cut or covered by the cross Hair in the Telescope; and then let him mark the Height of that black Line above the Ground on the Divisions on the Staff. Then turn the Telescope about and look towards your other Assistant at *B*, till you can see the Black Line on the Vane or Sight on his Staff coinciding with the cross Hair in the Telescope; and let him also note how high his Black Line is above the Ground: If his Number be the same with the former, the Places are on a level, or of the same Height; otherwise that where the greatest Number is, is the highest; and the Difference between the Numbers shews how much.

But if the Places are so far asunder, or have Obstacles interposing, that you can't do it at one Station, as is usually the Case; then you must do it at as few more than one as you can; and you must keep an Account of the Numbers on the Staves at all your Stations, putting the Back Station in one Column, and the Fore Station in another, with a Column for the Number of their Stations in the middle; in this, or such like Form.

| Back$^{d}$. | St. | Forw$^{d}$. |
|---|---|---|
| 029 | 1 | 132 |
| 178 | 2 | 201 |
| 199 | 3 | 295 |
| 221 | 4 | 256 |
| 6.27 | | 8.84 |
| | | 627 |
| | | 2.57 |

Where all the Back Stations make together 6.27. or six Foot and .27 of a Foot, and all the Fore Stations make 8.84. or 8 Feet and .84 of a Foot; and the Difference between those two Numbers being 2.77. or 2 Feet .77 of a Foot, is the Excess in height of the last place above the first.

*N. B.* In levelling of Rivers, you must set the Black Line of the Sight in the first Backward, and in their last Fore Station, just to the Edge of the Water: And then you may take the Intermediate Stations, any where, a Mile off from the River, *&c.* in the Meadow adjoining, for it will all come right at last.

LEVITATION, is a Word I've met with no where but in Dr. *Hook*'s *Opera Posthuma*; and he means by it a Property directly contrary to that of Gravitation towards the Sun: And in his Discourse of Comets, *p.* 168, he saith he hath by many Observations discovered, that tho' there be a Descent of the Steams from the *Nucleus* of the Comet towards the Sun, yet they also quickly returned and went contrary and opposite to the Sun, and that sometimes to a prodigious Extent. And perhaps where the Power or Force of Gravitation ceases, some such *contrary Force* may begin: Of which there seem to be many Instances in the Gravitations or Attractions of the Particles of Matter toward one another. (See *Attraction*.) This Force in such Cases Sir *Is. Newton* calls *Vis Repellens*; and it appears plainly to be one of the Laws of Nature, or a Branch of the Will of our Creator in the Material World; and without it I think there can be no possible Account of Rarefaction, and some other *Phænomena* of Nature. Dr. *Hook*, *p.* 170. takes notice also, that there is as *vast an Acceleration* in the Motion of *Levitating Bodies*, as there is in *Gravitating* ones.

LIBERA, anciently signified a *Livery* or Delivery of so much Grass or Corn to a Customary Tenant, who cuts down or prepares the said Grass or Corn, and receives some Part or small Portion of it as a Reward or Gratuity.

LIBERTAS *Ecclesiastica*, was the usual Phrase in our old Writings to express Church Liberty and Ecclesiastical Immunities. At first this was only the *Right of Investiture*; but afterwards it grew very great, extending so far under some weak Governments as to a Pretence of Exemption of the Persons and Possessions of the Clergy from the Civil Power and Jurisdiction.

LIBERTINE, in the Civil Law, is a Person who is manumised, and made free from Bondage, to which he was born.

LIBRA. See *Pound*.

LIBRA, a Mechanick Power. See *Balance* in Vol. I.

LIBRATA *Terra*, was anciently a Quantity of Land containing 4 Ox-gangs, and every Ox-gang 15 Acres.

LICENTIA *Transfretandi*, is a Writ or Warrant directed to the Keepers of the Ports, willing them to let some pass quietly beyond Sea, who have formerly obtained the King's Licence thereunto.

LIGHT. In the *French* Memoirs of the Academy of Sciences, *A. D.* 1699, there are some Reflections about the Nature of Light and Colours; and of the Generation of Fire, by Mr. *Malebranche*; in which he endeavours to support his Notion before communicated in his *Recherches de la Verité*, and in his *Metaphysicks*, *viz.* That Light and Colours do consist only in the various *Pulses* or Vibrations of the Ethereal or Subtile Matter.

Dr. *Hook*, in his *Op. Posthuma*, p. 54. considering the exceeding Hardness of a Diamond, and its wonderful Property of emitting Light or shining in the Dark, upon being *rubbed* or *struck*, thinks that there is this one Essential Property necessary only to the Existence of Light, *viz. a very quick vibrative Motion*; for in this Experiment there is neither Combustion nor Flame, as in Fire; nor Moisture and Putrefaction, as in Fish, Flesh of Veal, rotten Wood, *&c.* nor a Motion of the Animal Spirits, (which some think to be the Cause of the Light in Glo-worms, the Eyes of Cats, *&c.*) essentially necessary to the Production of this Quality.

The same Author thinks that *Aristotle*'s Definition of Light, φῶς ἐστὶν ἡ ἐνεργεία τῦ Διαφανῦς, That it is the inworking of the Diaphanous Body, or of the *Medium*, or the Internal Action of the Pellucid or Transparent Body, is the Light of which we are sensible, or which moves our Eye: So that he makes Light in the Luminous Body to be a peculiar Motion of it, which the Lucid Body can communicate to the Transparent *Medium*, or to such a Body as is fit to propagate it. And Light in the Eye is this Motion impressed on it; by which the Soul becomes sensible of it.

*P.* 114. The Doctor aſſerts, That the Power or Force of Light decreaſes in a quadruplicate Ratio of the Diſtances reciprocally taken, or as the ſquared Squares of the Diſtances reciprocally; and conſequently the Effect of Light, or the Motion it cauſes in other Bodies, will be in ſubduplicate Proportion of the Powers; and therefore only in duplicate Proportion of the Diſtances reciprocally taken.

*P.* 118. The Length of the Strokes of the Pulſes of Light are in duplicate Proportion of the Diſtances reciprocally. *P.* 121. Suppoſe then that the Length of the Pulſe from the Centre outwards at the Body of the Sun ſhould be one Inch, the Length of the Pulſe of Light here with us would not be the 1000000th part of the thickneſs of a Hair: and yet is that amazing Organ, the Eye, ſo wiſely contrived, as that the Strength of the Pulſe, which was deſtroyed by ſo vaſt a Diſtance, is reſtored again to a good part of its firſt Power; for as in diverging Rays, the Length of the Pulſe decreaſes in a duplicate Ratio of the Diſtance; ſo in converging Rays, it increaſes in that Ratio, and in a contrary Order.

I had before, in *Vol.* I. ſhewn from Sir *Iſ. Newton*, that Light is propagated in Time; and he then ſuppoſed about 10 Minutes were taken up in its Paſſage from the Sun to us: But in his Opticks he determines this Matter more accurately. *Romer* firſt, and after him others, had obſerved that the Eclipſes of *Jupiter*'s Satellites happen about 7 or 8 Minutes ſooner than they ought to do by the Tables, when the Earth is interpoſed between the Sun and that Planet; but as much later, when the Earth is beyond the Sun in reſpect of *Jupiter*: the Reaſon of which is, that the Light of the Satellites hath farther to go in the latter Caſe, than in the former, by the Diameter of the Earth's Orbit. Some Inequalities of Time indeed may ariſe from the Eccentricities of the Orbits of the Satellites; but theſe can't anſwer in all the Satellites, and at all times, to the Poſition and Diſtance of the Earth from the Sun. The mean Motion of *Jupiter*'s Satellites is alſo ſwifter in his Deſcent from his *Aphelium* to his *Peribelium*, than in his Aſcent in the other half of his Orb. But this Inequality hath no reſpect to the Poſition of the Earth, and in the three Interior *Satellites* is inſenſible; as he found by Computation from the Theory of their Gravity.

After this Sir *Iſaac* advances this Propoſition, which is the 12th of Part 3. of the 2d Book of his Opticks, *viz.*

*Every Ray of Light in its Paſſage thro' any refracting Subſtance is put into a certain Tranſient Conſtitution or State, which in the Progreſs of the Ray returns at equal Intervals, and diſpoſes the Ray at every Return to be eaſily tranſmitted thro' the next refracting Surface, and between the Returns to be eaſily reflected by it.* This is manifeſt from his 5, 9, 12 and 15th Obſervations. Whence it appears, that one and the ſame ſort of Rays, at equal Angles of Incidence on any thin tranſparent Plate, *is alternately reflected and tranſmitted* for many Succeſſions, according as the Thickneſs of the Plate increaſes in Arithmetical Progreſſion of the Numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, &c. (See Colours.) And this alternate Reflection and Tranſmiſſion, he found by his 24th Obſervation, continues for above 100 Viciſſitudes; nay, as he proves afterwards, to many thouſands; being propagated from one Surface of a Glaſs Plate to another, tho' the Thickneſs of the Plate be $\frac{1}{4}$ of an Inch and more. So that this Alternation ſeems to be propagated from every refracting Surface to all Diſtances without End or Limitation. He ſhews alſo, that this alternate Reflection and Refraction depends on *both* the Surfaces of every thin Plate, becauſe it depends on their Diſtance; but that it is performed at the ſecond Surface. It is alſo influenced by ſome Action or Diſpoſition propagated from the firſt to the ſecond; becauſe otherwiſe at the ſecond it would not depend on the firſt: And this Action or Diſpoſition, in its Propagation, intermits and returns by equal Intervals. What kind of Action or Diſpoſition this is; whether it conſiſt in a vibrating or a circulating Motion of the Ray, or of the *Medium*, or ſomething elſe, the Author does not inquire: But he allows thoſe, that are averſe to all new Diſcoveries which they can't explain by Hypotheſes, at preſent to ſuppoſe, That as Stones by falling upon Water put it into an undulating Motion, and all Bodies by Percuſſion excite Vibrations in the Air; ſo the Rays of Light, by impinging on any refracting or reflecting Surface, excite Vibrations in the refracting or reflecting *Medium*; and by ſo doing do agitate the ſolid Parts of the refracting or reflecting Body, and by that Agitation cauſe the Body to grow warm or hot: That the Vibrations thus excited are propagated in the refracting or reflecting *Medium* or Subſtance, much after the manner that Vibrations are propagated in the Air for cauſing Sound; and that they move faſter than the Rays, ſo as to overtake them; and that when any Ray is in that part of the Vibration which conſpires with its Motion, it eaſily breaks thro' a refracting Subſtance; but when it is in a contrary part of the Vibration, which impedes its Motion, it is eaſily reflected; and conſequently, that every Ray is ſucceſſively diſpoſed to be eaſily reflected or tranſmitted by every Vibration which overtakes it. Whether this Hypotheſis be true or falſe he doth not conſider at preſent, contenting himſelf with the Certainty of the Fact, That he hath diſcovered the Rays of Light by ſome Cauſe or other to be thus alternately diſpoſed to be reflected or refracted for many Viciſſitudes. The Returns of this Diſpoſition of any Ray to be reflected, he calls *Fits of eaſy Reflection*; and thoſe of its Diſpoſition to be tranſmitted, he calls *Fits of eaſy Tranſmiſſion*; and the Space it puts between every Return and the next Return, he calls the *Intervals of its Fits*. Then at *Prop.* 13. he ſhews, that the Reaſon why the Surface of all thick tranſparent Bodies reflect part of the Light incident on them, and refract the reſt, is that ſome Rays at their Incidence are in Fits of eaſy Reflection, and others in Fits of eaſy Tranſmiſſion. This appears from his 24th Obſervation; where the Light reflected by thin Plates of Glaſs and Air, which to the naked Eye appeared evenly white all over, did thro' a Priſm appear waved with many Succeſſions of Light and Darkneſs, made by alternate Fits of eaſy Reflection and eaſy Tranſmiſſion; the Priſm ſevering and diſtinguiſhing the Waves of which the white Light was compoſed.

And hence 'tis plain, Light is in its Fits of eaſy Reflection and eaſy Tranſmiſſion *before* its Incidence on any tranſparent Body: And probably it is put into ſuch Fits *at its firſt Emiſſion* from Luminous Bodies, and *continues* in them during all its Progreſs. For theſe Fits are of a laſting Nature; as appears by what he proves elſewhere.

He

He ſuppoſes here the Tranſparent Bodies to be thick; becauſe if the Thickneſs of the Body be much leſs than the Interval of the Fits of eaſy Reflection and eaſy Tranſmiſſion of the Rays, the Body loſeth its reflecting Power. For if the Rays, which at their entring into the Body are put into Fits of eaſy Tranſmiſſion, arrive at the fartheſt Surface of the Body, before they be out of thoſe Fits, they muſt be tranſmitted. And this is the Reaſon why Bubbles of Water loſe their reflecting Power when they grow very thin, and why all Opake Bodies, when reduced into very ſmall Parts, become Tranſparent.

He ſhews alſo, that thoſe Surfaces of Tranſparent Bodies, which, if the Rays be in a Fit of Refraction, do refract it moſt ſtrongly, if the Ray be in a Fit of Reflection, do reflect it moſt eaſily.

After this he gives ſeveral other curious Propoſitions; from whence he ſhews, that 'tis eaſy to collect the Intervals of the Fits of eaſy Reflection and eaſy Tranſmiſſion of any ſorts of Rays refracted in any Angle into any Medium, and thence to know, whether the Rays ſhall be reflected or tranſmitted at their ſubſequent Incidence on any Pellucid Medium.

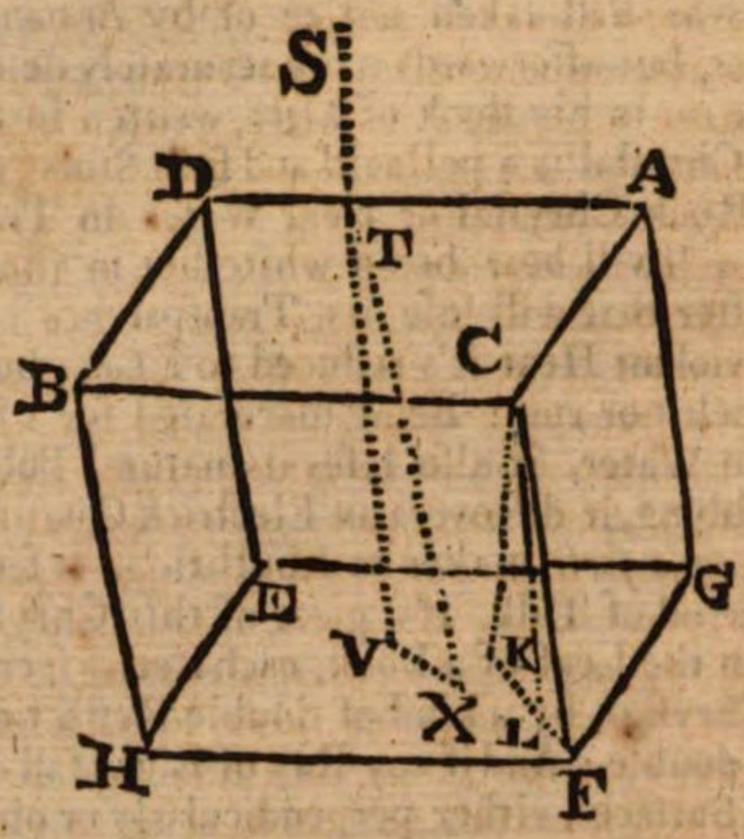
By the Experiments and Obſervation about the *Inflection* of the Rays of Light (See *Inflection*) he makes it plain, that *Bodies act on Light at a diſtance*, and by that Action *bend* the Rays of it; and that this Action is ſtrongeſt at the leaſt diſtance. He ſhews alſo, that Rays which differ in *Refrangibility* differ alſo in *Flexibility*; and by their different Inflections it is that they are *ſeparated* one from another, ſo far as after Separation to make the three Fringes of Colours mentioned in thoſe Experiments: And 'tis probable the Rays of Light, in paſſing by the Edges and Sides of Bodies, are bent ſeveral times backwards and forwards with a Motion like that of an Eel; and that the ſaid coloured Fringes of Light ariſe from three ſuch Bendings. 'Tis probable alſo that the Rays of Light which fall upon Bodies, and by that means are reflected or refracted, *begin to bend before* they arrive at the Bodies; and that Light is reflected, refracted and inflected, by one and the ſame Principle acting variouſly in various Circumſtances.

'Tis probable alſo, that Bodies and Light act mutually on one another: Bodies upon Light, in emitting, reflecting, refracting and inflecting it; and Light on Bodies, by *heating* them, and putting their Parts into a *vibrating Motion*, wherein Heat conſiſts.

All *fix'd Bodies*, when heated beyond a certain degree, do emit *Light* and *ſhine*; and this *Shining* and Emiſſion of Light is probably cauſed by the *vibrating* Motions of the Parts; and all Bodies abounding with Earthy Particles, and eſpecially when they are ſulphureous, when their Parts are ſufficiently agitated, do emit Light; whether this Agitation be cauſed by *Attrition*, by Percuſſion, by Putrefaction, or a vital Motion in an Animal Body, *&c.* or any other way. Thus the Sea-water ſhines in a Storm; *Quickſilver* when *ſhaken in Vacuo*; a Cat's Back, or a Horſe's Neck, rubb'd by the Hand in the dark; Wood, Fleſh and Fiſh, when putrified.

The ſame admirable Author, in the new Queries annexed to the *Latin* Edition of his *Opticks*, thinks it probable, that there are yet ſome other *congenite Properties* of the Rays of Light beſides thoſe above deſcribed; one of which the Refraction of that ſtrange Body *Iſland Chryſtal* acquaints us with. This was firſt taken notice of by *Eraſmus Bartholinus*, but afterwards more accurately deſcribed by *Huygens* in his Book of *Light*, written in *French*. This Chryſtal is a pellucid and fiſſil Stone, equalling Rock Chryſtal or clear Water in Tranſparence; 'twill bear being white hot in the Fire, and after that will loſe its Tranſparence: By a very violent Heat it's reduced to a *Calx*, but will not melt nor run: Being macerated for a Day or two in Water, it alſo loſes its natural Poliure; on rubbing, it diſcovers an Electrick Quality, and with *Aqua fortis* makes an Ebullition. It ſeems to be a kind of Talk. If a piece of this Chryſtal be laid on the Leaf of a Book, each Letter ſeen thro' the Chryſtal, by a kind of double Reflection, appears double: And if any Ray of Light fall on any of its Surfaces, either perpendicularly or obliquely, it is always divided by a double Refraction into two Rays; each of which is of the ſame Colour with the Incident Ray, and they appear equal to one another as to the Quality of Light. One of theſe two Refractions is conformable to the known Laws of Opticks; *viz.* That the Sine of the Incidence out of Air into the Chryſtal is to the Sine of Refraction : : as 5 is to 3. But the other, which may be called the *Unuſual Refraction*, is made thus: Let A D B C be the Surface of the Refracting Chryſtal, C the greateſt ſolid Angle belonging to that Surface: Let G E H F be the oppoſite Surface, to which the Line C K is perpendicular: This Perpendicular with the Line C F repreſenting the extream Edge of the Chryſtal contain an Angle of 19°. 3'. Join K F; in which take K L ſo, that the Angle K C L may be of 6°. 40'. but the Angle L C F of 12°. 23'. This being done, let the Line S T repreſent any Incident Ray of Light in the Point T; let T V be the refracted Ray; and what that is may be found by the given Ratio of the Sines of 5 to 3, according to the common Laws of *Opticks*. Then draw V X parallel and equal to K L, and ſo poſited that it may lie the ſame way towards V, as L doth in reſpect of K. Join T X; and that Line T X ſhall be the *unuſual Refracted Ray*, being carried by the new Refraction from T to X. If then the Incident Ray S T fall alſo perpendicularly on the Refracting Surface, thoſe two Rays T V, and T X, into which by Refraction it is divided, will become parallel to the two Lines C K and C L: and the other Ray will be tranſmitted perpendicularly, according to the common Laws of Opticks; and the other (*viz.* T X) diverging by this unuſual Refraction from the Perpendicular, will make with it the Angle V T X of about 6 degr. as is found by Experience.

And hence the Plane T V X, and ſuch like ſimilar Planes, which are parallel to the Plane C F K, may be called *the Planes of Perpendicular Refraction*; and that Part, Side or Place towards which the Lines K L and V X tend, and which are drawn from the Points K. and V. may be called the *Part*, *Place*, or *Side* of *Unuſual Refraction*.




In like manner *Rock Chryſtal* hath a double Refraction; but the Difference between the two Refractions is leſs and leſs conſpicuous, than in the *Iſland Chryſtal*.

When the Ray ST, which falling on the firſt Surface of the *Iſland Chryſtal*, is divided into the two Rays TV, and TX; and thoſe two Rays come to the latter Surface of the ſaid Chryſtal; then the Ray TX, which in the firſt Superficies is refracted in the *unuſual Ratio*, will be again refracted entire with the ſame *unuſual Ratio*, ſo that theſe two Rays will emerge out of the ſecond Surface in Lines parallel to the firſt incident Ray ST. For the ſame will happen alſo as to the Ray TV, which being refracted in the firſt Surface with the *uſual Ratio*, will alſo be again refracted at the ſecond with the *uſual Ratio*.

And if of two pieces of Iſland Chryſtal, one be ſo placed after another, that all the Surfaces of the latter be reſpectively parallel to thoſe of the former: Now alſo thoſe Rays, which in the firſt Surface of the firſt Chryſtal were refracted with the *uſual Ratio*, ſhall in all the latter Surfaces be refracted with the ſame *uſual Ratio*; and thoſe Rays, which in the firſt Surface of the former Chryſtal were refracted with the *unuſual Ratio*, ſhall in all the latter Surfaces be refracted with the *unuſual Ratio*: And the ſame thing will come to paſs when the Surface of the two Chryſtals are inclined one to another, ſo their *Planes* of *Perpendicular Refraction* be but parallel.

There is therefore ſome *congenite Difference* in the Rays of Light, that occaſions, as in this Experiment, ſome of them to be refracted in the *uſual Ratio* always, and others always in the *unuſual Ratio*; for if it were not *congenite*, but did ariſe from ſome *new Modifications* impreſſed on the Rays in the firſt Refraction, then that would be changed by the ſame kind of new Modifications in the three following Refractions. But no ſuch thing happens: But the Property continues always the ſame, and hath the very ſame Effect in the Rays in all thoſe Refractions: Wherefore this *unuſual Refraction* muſt depend on ſome *congenite Property* in the Rays of Light. And 'tis very well worth while to enquire, whether there may not be *other ſuch*, as yet unobſerved and unknown.

For one would ſuſpect that there are *divers Sides* of the Rays of Light, and thoſe endued with *divers* congenite Properties: For if the *Planes of Perpendicular Refraction* of the ſecond piece of Chryſtal be placed at Right Angles with the *Planes of Perpendicular Refraction* of the firſt Chryſtal; then will the Rays, which in their Projection thro' the firſt Chryſtal were refracted with the *uſual Ratio*, in paſſing thro' the ſecond be refracted with the *unuſual Ratio*; and thoſe Rays, which in paſſing thro' the firſt Chryſtal were refracted with the *unuſual Ratio*, ſhall in paſſing thro' the ſecond be refracted with the *uſual Ratio*. Wherefore there are not two divers kinds of Rays in their own Nature different; of which one ſort are always and in all Poſitions refracted with the *uſual*, and others with the *unuſual Ratio*: But theſe two kinds of Rays, as mentioned in the laſt Experiment, did only differ in this, that the Rays, according to their different Poſition, did with their different Sides reſpect the *Place, Region or Side of unuſual Refraction* in the Chryſtal: For in the preſent Experiment, one and the ſame Ray is refracted one way with the *uſual*, the other way with the *unuſual Ratio*, according to the Poſition of its Sides to thoſe of the Chryſtal. If the ſame *Sides* of any Ray look towards the ſame Parts of each Chryſtal, then will that Ray be refracted with *one* and the *ſame Ratio* in each Chryſtal; but if that Side of the Ray, which is turned towards the *Place of unuſual Refraction* in the former Chryſtal, be diſtant 90°. from that Side of the ſame Ray which looks towards the *Place of unuſual Refraction* of the ſecond Chryſtal (which may be done, by ſo turning the ſecond Chryſtal, that it ſhall look towards the former Chryſtal, and conſequently the Rays of Light themſelves in a different Poſition) that Ray will now be refracted in different Ratio's in the different Chryſtals. So that you may determine, whether the Rays, which fall on the ſecond Chryſtal, will be refracted in the *uſual* or *unuſual Ratio*. And for this there is nothing more required, than that the ſecond Chryſtal be ſo turned about, that its *Place or Region of unuſual Refraction* be accordingly poſited on this or that Side of the Ray.

Wherefore every Ray may be conſidered as having four Sides; two of which being directly oppoſite to one another, cauſe that the Ray be always refracted in the *unuſual Ratio*, whenever either of thoſe Sides is turned towards the Side or Place of *unuſual Refraction* in the Chryſtal: But the other two Sides, as often as either of them is turned towards the Side of *unuſual Refraction* in the Chryſtal, do yet *cauſe* the Ray to be refracted with the *uſual Ratio*. The two former Sides of the Ray therefore may be called the *Sides of unuſual*, the two latter of *uſual Refraction*. And becauſe theſe *Diſpoſitions* were in the Rays before they fell on the 2d, 3d, and 4th Surface of the 2 Chryſtals, nor were they at all changed by the Refraction of the Rays in their Paſſage thro' thoſe Surfaces, but the Rays were refracted by one and the ſame Law in every one of the four Surfaces, it ſeems that theſe *Diſpoſitions* are properly *congenite* to the Rays of Light, and were not at all changed by the firſt Refraction; but that it is on the account of theſe *Diſpoſitions* in the Rays, that they were refracted in their Incidence on the *firſt* Surface of the *firſt* Chryſtal, ſome in the *uſual*, and ſome in the *unuſual Ratio*, according as their *Sides* of *uſual* or *unuſual Refraction* at that time reſpected the Sides or Place of *unuſual Refraction* in that Chryſtal.

All the Rays of Light therefore have two oppoſite Sides, in which the *Property is congenite*, on which the *unuſual Refraction* depends; and the other

other two Sides are *without* any ſuch *Property*. And it requires yet further to be conſidered, whether there be not even *other Properties of Light*, by which the Sides of the Rays *differ*, and are *diſtinguiſhed* from one another.

After this he ſhews, that in an *Oblique* Incidence of the Rays upon the *firſt* Chryſtal, the ſame *Difference* between them appears, as when they fall *perpendicularly* to the former Properties.

From the whole therefore may be very juſtly concluded, That all thoſe *Hypotheſes* are falſe and precarious which have been yet advanced, in order to explain the *Phænomena* of Light by *new Modifications of the Rays*; for they do not depend on any ſuch *Modifications*, but on *congenite* and *immutable* Properties, eſſentially inherent in the Rays.

And equally erroneous alſo are thoſe *Hypotheſes*, which attempt to explain the *Phænomena* of Light by any *Preſſure* or *Pulſe* impreſſed upon the *fluid Medium* by Motion; for theſe at long run depend upon the *new* and *different Modifications* of the Rays, and ſo fall in with the other.

But further, if Light conſiſted only in a *Preſſure* upon the *Medium*, it muſt be either without any *local Motion*; and then 'tis impoſſible to account for the Agitation and Heat produced in Bodies by the Refraction and Reflection of the Rays: Or if it be ſuppoſed to conſiſt in Motion propagated to all Diſtances in an Inſtant, to that muſt be required an *infinite Force* acting every Moment, and in each lucid Particle. But did Light conſiſt in a *Preſſure* or a *Motion* propagated thro' a *fluid Medium*, whether it propagated inſtantaneouſly, or in time, it could not be done in Right Lines, but muſt inflect back upon itſelf in a Shadow; for *Preſſure* or *Motion* in a fluid Medium, whenever it meets with any Obſtacle which may impede Part of its Motion, cannot be propagated in *Right Lines*, but muſt be inflected back towards itſelf, and diſuſed every way throughout the *quieſcent Medium* which lies beyond the Obſtacle.

The Force of Gravity tends downwards; and yet the Preſſure of the Parts of Water, which ariſes only from the Force of Gravity, tends with an equable Force every way, and is propagated with equal Eaſe by crooked Lines as by ſtrait. *Waves*, on the Surface of Water, where they fall on the Surface of any large Obſtacle, inflect back upon themſelves, and are dilated and diffuſed gradually in the quieſcent Water lying beyond that Obſtacle. The Waves, Vibrations, or Pulſes of Air, in which Sounds conſiſt, are manifeſtly inflected, tho' not ſo much as thoſe of Water; for the Sound of a Bell, or of a great Gun, can be heard over a Hill, interpoſed between the Ear and Eye, and ſounding Body: And we find that Sound is propagated as eaſily by crooked as ſtrait Tubes; whereas Light is never obſerved to move in curve Lines, nor to be inflected back ſo as to ſhadow itſelf. Indeed there is a kind of Inflection of the Rays of Light, as hath been before mentioned; but that is not *ad Umbram*, but a contrary way, and is only found in a Ray's paſſing by and very near the extream Edge of ſome Body; and then as ſoon as it is paſt the Body, it goes on *ſtrait* again.

The *Rays of Light* are therefore certainly *little Particles*, actually emitted from the *Lucent Body*, and *refracted* by ſome *Attraction*, by which *Light*, and the *Bodies* on which it falls, do mutually act upon one another; for ſuch Particles or Corpuſcles thro' uniform Mediums will be tranſmitted in right Lines without any Inflection *in Umbram*, as we find the Rays of Light are: They may have alſo *divers Properties*, and which they may preſerve immutable in their own Paſſages thro' divers Mediums; which agrees with the Nature of the Rays of Light. *Pellucid Bodies act* upon the Rays of Light at *ſome Diſtance*, when they refract, reflect and inflect them; and the Rays of Light reciprocally act upon them, at ſome little Diſtance alſo, by agitating and heating their Particles. And this *Action* and *Re-action*, which is performed at *ſome Diſtance*, is mighty like what we call the *Force of Attraction*, or *Gravity*, in other Bodies. And if the Cauſe of *Refraction* be the *Attraction* of the Rays, he ſhews in his admirable *Principia*, that the *Sines of Incidence muſt be to the Sines of Refraction in a given Ratio*; as in Fact we find the thing to be. The Rays of Light, in paſſing out of Glaſs into a *Vacuum*, are *inflected* towards the Glaſs, and, if they fall too obliquely, will revert back again to the Glaſs, and *be totally reflected*. Now the Cauſe of this Reflection cannot be attributed to any Reſiſtance of the *Void* or *Vacuum*, but entirely to ſome *Force* or *Power* in the Glaſs, which attracts or draws back again the Rays as they are paſſing into the *Vacuum*. And this appears from hence, That if you wet the poſterior Surface of the Glaſs with Water, Oil, or liquid and clear Honey, or with a Solution of Quickſilver; then the Rays, which would otherwiſe have been *reflected*, will paſs into and thro' that Liquor. Which plainly ſhews, that the Rays are not reflected till they come to that *poſterior Surface* of the Glaſs, nor till they begin to *go out* of it too. But if at their going out they fall into any of the aforeſaid Liquors, they will then not be *reflected*, but *go on* in their *former Courſe*; the Reaſon of which is, that the *Attraction* of the Glaſs is counter-balanced by the *Attraction* of the Parts of the Liquor which adhere to its Surface. And this appears yet plainer in the Experiment of two Glaſs Priſms, or the Object Glaſſes of two long Teleſcopes, one of which ſhall be plane (on one ſide), the other a little convex, and then compreſſing them ſo that they do neither quite touch one another throughout, and yet have their Surfaces very near; for then that Light which falls on the hinder Surface of the firſt Glaſs, and in that Place where the Glaſſes are not diſtant one from another above $\frac{1}{1000}$ of an Inch, will be totally tranſmitted thro' that Surface and the interjected Air or Vacuity, and will enter into the ſecond Glaſs (as he ſhews in his 1ſt, 4th, and 8th Obſervations of the firſt Part of his 2d Book of his *Opticks*). But if the ſecond Glaſs be moved a little farther off, then the Light, coming out of the hinder Surface of the firſt Glaſs into that Air or *Vacuum*, will be turned back again towards the Glaſs, and reflected. Wherefore 'tis plain, that the Rays are drawn back by ſome *Force* that is inherent in the firſt Glaſs, ſince there is nothing elſe that can occaſion it.

To account alſo for that odd *Phænomenon* of the Rays of Light, which he calls *their Fits of eaſy Tranſmiſſion and Reflection*, he judges that there is nothing more required, than that the Rays ſhould be very ſmall Corpuſcles of Matter, which either by their *Attraction*, *or ſome other Force*, do excite certain *Vibrations* in the Bodies on which they act;

act; which Vibrations, being *ſwifter* than the *Motion of the Rays*, do ſucceſſively outſtrip or get before them, and ſo agitate them as alternately to increaſe or diminiſh their Velocity; and therefore produce thoſe *Fits* in the Rays of Light.

And he thinks it very likely, that the *Unuſual Refraction*, diſcovered to be in the *Iſland Chryſtal* above-mentioned, is cauſed by ſome *Attracting Force*, which is inherent in certain *Sides* of the *Rays* and of the *Particles* of the Chryſtal. For if there were not ſome ſuch *Force* or *Virtue* in ſome Part of the Chryſtal, and not in the others, in order to diſtort and bend the Rays towards the Sides or Parts of *Unuſual Refraction*, it could not be, that the Rays, which fall perpendicularly upon the Chryſtal, ſhould both in their Ingreſs and Egreſs be ſo refracted one way rather than another, as that they ſhould alſo perpendicularly emerge by a now contrary Poſition of the *Place or Region of Unuſual Refraction* in the Surface of the ſecond Chryſtal; the Chryſtal plainly acting upon the Rays *after* they have paſſed thro' it, and are got into the Air, or into a *Vacuum*.

And becauſe the Chryſtal, by that Force, doth not act on the Rays, but when the proper correſponding Sides of the Rays of Light are turned towards the Places or Parts of *Unuſual Refraction* in the Chryſtal, it appears that there is alſo ſome Force or Virtue in the Sides of the Rays themſelves, correſponding to that Force inherent in thoſe Parts of the Chryſtal, almoſt after the ſame manner as the two Poles of the Magnet anſwer to one another. Which Virtue in the Magnet, as it is capable of being increaſed and diminiſhed, and is not any where to be found but in the Magnet and in Iron; ſo this Virtue of the refracting Rays which fall perpendicularly upon it, is greater in the *Iſland* than in the *Rock Chryſtal*, and is as yet found no where elſe.

Not that he thinks this Virtue to be *Magnetical*; for it ſeems to be of a different Nature. But let it be what it will, it can ſcarce be conceived that the Rays of Light, unleſs they be allowed to be really Corpuſcles or Particles of Matter, can have any ſuch permanent *Force* in two of their Sides, and not have any ſuch thing, at the ſame time, in their two other; and this without any regard to the *Poſition* with which they reſpect the Space or *Medium* thro' which they paſs.

And yet tho' Light be certainly a Body, it is almoſt impoſſible to conceive the Smallneſs of its Corpuſcles. But however, that they are exceeding minute, may be gathered from theſe Conſiderations: (1.) That they freely pervade all tranſparent Bodies, ſuch as Chryſtal, Glaſs, ſeveral Pebbles and Gems; and almoſt all Fluids, but Mercury; and paſs where no other Fluid, how thin ſoever, can enter; and yet no Eye hath ever been able to diſcover the conſtituent Particles of the groſſeſt Fluid. (2.) It may be propagated from innumerable different *Luminous Bodies*, without any conſiderable Oppoſition to one another, as Dr. *Cheyne* ſhews by this Experiment: Suppoſe a Plate of Metal, having at the top the ſmalleſt Hole that can be made, were erected *perpendicularly* on an *Horizontal Plane*, and that about it were ſet innumerable *Luminous Objects* of about the ſame Height with the Plate, at an ordinary Diſtance from it; then will the Light, proceeding from every one of theſe Objects, be propagated thro' this ſmall Hole, without interfering. This will appear by applying a dark Object, in a ſtrait Line, againſt the luminous Body; for the Light of this Body will thro' the Hole be received upon the dark Body. Now it is impoſſible that ſo many different *Streams* of Light could be tranſmitted thro' ſo ſmall a Hole, were not the Particles of Light extreamly little. To which may be added, (3.) That if they were not very minute Corpuſcles, their amazing Velocity is ſuch, that they would pierce thro' all Kinds of ſolid Bodies almoſt as eaſily as they do Vacuities; whereas we ſee the Rays of Light to be regularly reflected from ſome Bodies. (4.) We find alſo that innumerable different Spheres of Light may be propagated from their ſeveral luminous Centres within our Horizon, without interfering. How many Millions of Candles and Flambeaus, ſending all out their Tides of Light, is it poſſible for the Eye to ſee together, without their being confounded one with another? Which ſhews both the exceeding Smallneſs of the Particles of Light, and alſo the Largeneſs of the Vacuities between the Particles of Air and other Bodies.

How extreamly ſwift the Particles of Light move, may be gathered from the Experiment of Mr. *Romer*; wherein he finds that the Rays of Light paſs from the Sun to us in about 10 Minutes of Time: And Mr. *Hugens* hath proved in his *Coſmotheoros*, that a Bullet diſcharged from the Mouth of a Cannon, and not abating of its firſt Velocity, would be 25 Years before it reach the Sun. Now the *Via percurſa* being the ſame in both, *the Velocities will be reciprocally as the Times*; that is, the Velocity of Light to that of a Cannon-Bullet, will be to that of a Cannon-Bullet, perſiſting in its greateſt Swiftneſs, as 25 Years to 10 Minutes; or as 1314700 is to one, nearly: So that the Motion of Light is above a Million of times ſwifter than that of a Cannon Ball.

Moreover, the Diſtance between the Sun and Earth is at leaſt 12000 Diameters of the Earth; but ſuppoſe it but 10000, then will Light run 1000 Diameters in a Minute, or 16⅔ Diameters in a Second; that is, at leaſt 130000 Miles in one Second; which is Motion almoſt incredibly and really amazingly ſwift. But the extraordinary Effects of Light and Heat ſeem to require all this; and we ſee how powerfully it acts (being congregated) on the moſt compact ſolid Bodies; and we never find any Abatement of its Force ariſing from a Diminution of its Velocity.

See Mr. *Hauksbee's* Experiments about the Production of Light *in Vacuo* by the Attrition of Bodies, in *Phil. Tranſ.* N° 304, and in N° 307; and by the Effluvia of one Glaſs falling on another in Motion, *Phil. Tranſ.* N° 309, 310.

LIGHTS. Ships of War are in the Night-time very well diſtinguiſhed by the *Lights* that they hang out; for in a Fleet the Admiral carries three Lights on the Poop, and one on the Main-Top; the Vice-Admiral hath two on his Poop, and one on his Main-Top; the Rear-Admiral hath but one on his Poop, and one on his Main-Top; the Vice-Admiral of each particular Squadron hath only two on his Poop, but none on his Main-Top; the Rear-Admiral of each Squadron hath only one on his Poop. But when the whole Fleet carry their Lights, then the Rear-Admiral is diſtinguiſhed by carrying two Lights, the one hoiſted a Yard above the other, on the Enſign-Staff; and in caſe of foul Weather and a dark Night, every Ship muſt carry a Light.

LIGULA,

†

LIGULA, in our *Latin* Law ſignifies a Copy, Exemplification, or Tranſcript of any Court Roll or Deed.

LIMBERS, in *Gunnery*, are a kind of Train joined to the Carriage of a Cannon upon a March. It is compoſed of two Shafts wide enough to receive a Horſe between them (which Horſe is called the *Fillet Horſe*.) Theſe Shafts are joined by two Bars of Wood and a Bolt of Iron at the end, and have a pair of ſmall Wheels: On the Axletree riſes a ſtrong Iron Spike, on which the Train of the Carriage is put upon a March: But when a Gun is on Action, theſe *Limbers* are run out behind her.

LINE of the *True* Place / *Apparent* } of a Planet, is a right Line drawn from { *Earth's Centre*, / *Eye of the Spectator* } thro' the Planet, and continued as far as the fixed Stars.

LINE *of Meaſures*, in the Stereographick Projection of the Sphere in *Plano*, is that Line in which the Plane of a great Circle, perpendicular to the Plane of the Projection and that oblique Circle which is to be projected, interſects the Plane of the Projection. Or it is the common Section of a Plane paſſing thro' the Eye Point, and thro' the Centre of the Primitive, and at right Angles, to any oblique Circle which is to be projected, and in which the Centre and Pole of ſuch Circle will be found.

Line of *Direction*, of the Earth's Axis in the *Pythagorean* Syſtem of Aſtronomy, is the Line connecting the two Poles of the Ecliptick, and of the Equator, when they are projected on the Plane of the former.

LINE *of the Section*, in Perſpective, is the Interſection or Contact of the *Plane to be projected* with the *Glaſs or Diaphanous Plane*.

LINE *of Lines*, on the Sector, is a Scale of equal Parts on each Leg, and running from the Centre. This is divided actually into 100 equal Parts, and ſometimes into more, when the Inſtrument is large. There are only the Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, placed on the Lines; and therefore they ſometimes ſtand for themſelves alone, and ſometimes ſignify ten times, or an hundred, or a thouſand times themſelves, according as the Matter ſhall require.

### The Uſes of the *Line of Lines*.

1. *To increaſe or diminiſh a Line of any given Length, according to any Ratio required.*

Suppoſe the Line were $6_{\frac{5}{8}}$ Inches in length; apply it into the Sector by way of parallel Entrance, ſo that each Foot of the Compaſſes ſtand in $6\frac{1}{2}$ in *Line of Lines*, and then let the Sector be kept at that Angle. Then if you wou'd have it increaſed in the Proportion of $9\frac{1}{4}$ to $6\frac{1}{2}$; or diminiſhed in the Proportion of $2\frac{3}{4}$ to $6\frac{1}{2}$, *&c.* let the Sector lie, and take with the Compaſs the parallel Diſtances between thoſe Points of $9\frac{1}{4}$ and $9\frac{1}{2}$; or of $2\frac{3}{4}$ and $2\frac{1}{2}$, in the *Line of Lines* of each Leg, and that will give you the Length required.

2. *To divide a given Line into any Number of Parts; as ſuppoſe into 9.*

Apply the Line over from 9 to 9 in the *Line of Lines*; and keeping the Sector of that Angle, take the Diſtance between 1 and 1, and that will be $\frac{1}{9}$ Part of the Line.

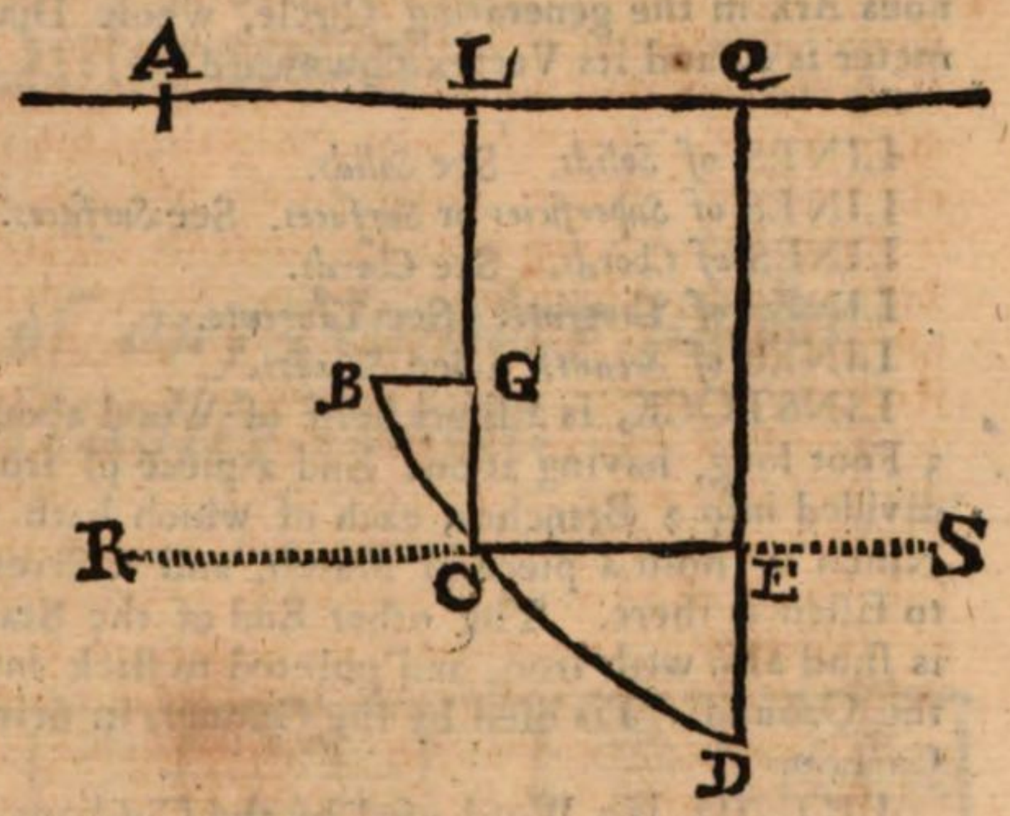
3. *To find what Proportion two or more Lines bear to one another.*

Apply the greater or greateſt over from 10 to 10 at the ends of Lines; and then taking any of the other, and applying it over parallel to the former, it will mark out ſuch Numbers as ſhall expreſs its Proportion to the greateſt Line: as ſuppoſe the Compaſſes pointed to 30 and 30; then will the greateſt Line be to it as 100 is to 30. *&c.*

4. To work Proportions with the Sector, proceed juſt as you do in finding a 3d or 4th Proportional to 2 or 3 Lines given Geometrically. See *Proportion*, Vol. I.

LINEA *Celerrimi Deſcenſus*, is that Curve which a Body would deſcribe in its Deſcent, if it moved the ſwifteſt poſſible: The Inveſtigation of which was firſt, I think, propoſed as a Problem by Mr. *John Bernoulli*, and hath been ſolved by his Brother *James*, and ſeveral others; and very eaſily thus, by Mr. *John Craig*, in *Phil. Tranſ. N.* 268.

Suppoſe B C, C D, two infinitely ſmall Parts of the Curve ſought: Then, ſince the Nature of the Curve is to be ſuch, that the Deſcent of the Body from B to D,




after its Fall from the Horizontal Line A Q, is to be in the leaſt time poſſible; we muſt find in the Line R S (drawn parallel to A Q ſo, that the Differences between any two Ordinates to the Curve, as of G C, D E, may be equal) a Point in which this muſt happen.

Now the Velocity of the Body in the Point C is $= \surd : L C$; and its Velocity in the Point D, as $\surd : Q D$. Wherefore $\left(\frac{BC}{\surd : LC}\right)$ is = to the Time of the Deſcent thro' B C, as $\frac{CD}{\surd : QD}$ = to the Time of the Deſcent thro' C D. by *Prop.* 54. *Newton. Princ.* Wherefore the Point C muſt be ſuch, as that $\frac{BC}{\surd : LC} + \frac{CD}{\surd : QD}$ muſt be a *Minimum*, or the leaſt poſſible. Suppoſe then the Points B and D to be fix'd; let G C (= D E) $= m$: L C $= b$, and Q D $= p$, all invariable Quantities: and let the flowing Quantities B G $= u$: and C E $= z$.

Wherefore $\frac{\surd : \overline{m^2 + u^2}}{\surd : b} + \frac{\surd : \overline{m^2 + z^2}}{\surd : p}$ = to a

*Mini-*

*Minimum.* And consequently $\frac{\dot{u}\,u}{b^{\frac{1}{2}}\sqrt{m^2+u^2}} + \frac{\dot{z}\,z}{p^{\frac{1}{2}}\sqrt{m^2+z^2}} = 0$. But $\dot{u} = -\dot{z}$ (because $u + z =$ to an invariable Quantity.) Wherefore $\frac{u}{b^{\frac{1}{2}}\sqrt{m^2+u^2}} = \frac{z}{p^{\frac{1}{2}}\sqrt{m^2+z^2}}$: Wherefore 'tis plain that $\frac{u}{b^{1}\sqrt{m^2+u^2}} =$ to an invariable Quantity. Let then the *Abscissa* A L $= x$; the Ordinate L C $= y$: And therefore B G $= \dot{x}$. G C $= \dot{y}$. B C $= \sqrt{:\dot{x}\dot{x}}$. and let $a$ be any invariable Line. Then will $\frac{\dot{x}}{y^{\frac{1}{2}}\sqrt{:\dot{x}\dot{x}+\ddot{y}y}} = \frac{1}{\sqrt{:a}}$. Wherefore $\dot{x}\sqrt{a} = y \times \sqrt{\dot{x}\dot{x}+\dot{y}\dot{y}}$. But in every Curve $\dot{x}$ is to $\sqrt{\dot{x}\dot{x}+\dot{y}\dot{y}}$, as the Subtangent to the Tangent: Wherefore the Nature of this Curve is such, that the Subtangent is to the Tangent as $\sqrt{:a}$, is to the $\sqrt{:y}$. which is known to be the Property of the Cycloid; where the Tangent is parallel to the Chord of a Conterminous Ark in the generating Circle, whose Diameter is $a$, and its Vertex downward.

LINES *of Solids.* See *Solids.*

LINES *of Superficies* or *Surfaces.* See *Surfaces.*

LINES *of Chords.* See *Chords.*

LINES *of Tangents.* See *Tangents.*

LINES *of Secants.* See *Secants.*

LINSTOCK, is a short Staff of Wood about 3 Foot long, having at one End a piece of Iron divided into 2 Branches, each of which hath a Notch to hold a piece of Match, and a Screw to fasten it there. The other End of the Staff is shod also with Iron, and pointed to stick into the Ground. 'Tis used by the Gunners in firing Cannon.

LIQUID, is a Word used by the Civilians in this Sense, *for a Thing's being apparently proved,* as they say: A Creditor would be injur'd, should a Debt which is clearly due be stop'd, on the Pretence of another Debt that is not *Liquid,* or apparently proved.

LIQUIDUM *Nervorum,* is that Juice or Fluid which Nerves carry in their Canals, and is usually called the *Nervous Juice.*

LIVER. See *Hepar.*

LOAD, is the Miners Word, especially in the Tin Mines, for a Vein of Ore.

LOCAL *Colours,* in Painting, are such as are natural and proper for each particular Object in a Picture; and they are so called to distinguish them from the *Claro-Obscuro*: Which see.

LOCATIO-*Conductio,* in the Civil Law, is a Contract of the Law of Nations, whereby the Use of a Thing, or the Service and Labour of a Person, is gained for some Time for a certain Reward.

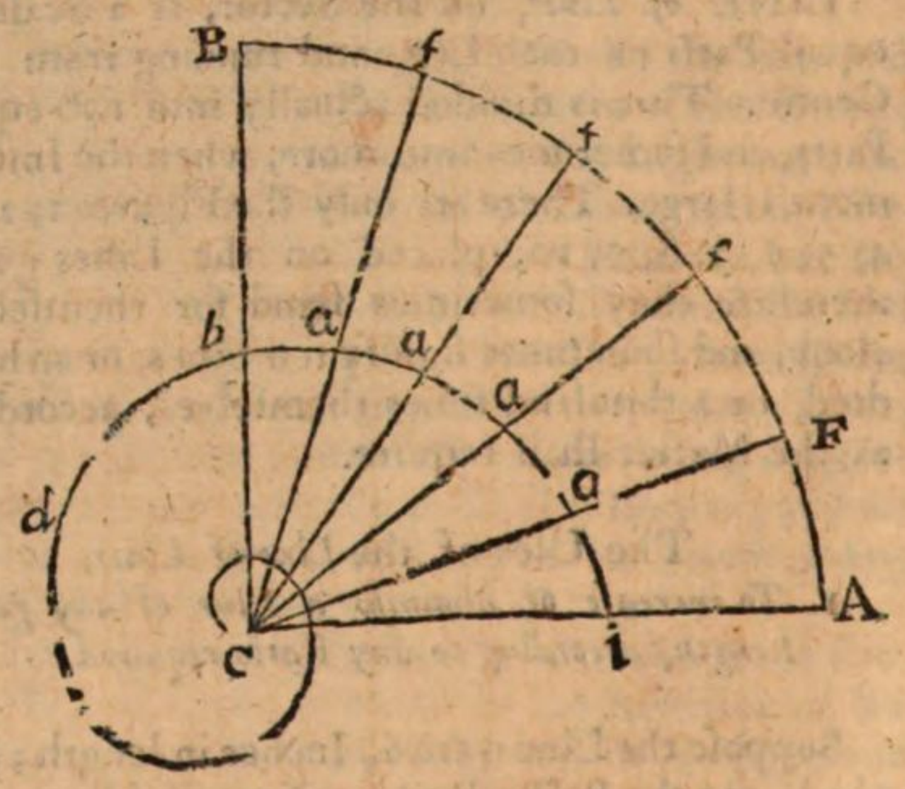
LOCUS *Resolutus,* according to *Pappus*'s Account of it in *Libr.* 7^mo *Mathem. Coll.* is, That it is a proper peculiar Matter, after the common Constitution of the Elements of Geometry, contrived for such Persons as would obtain a ready and easy Method of solving such Problems as shall be proposed to them. (See *Resolution* in Vol. I.) On this Subject *Euclide, Apollonius Pegæus, Eratosthenes* and *Aristæus Senior,* are the only Writers among the ancient Geometers. *Euclide*'s Tracts are *Datorum Liber Unus; Locorum ad Superficiem Duo; Porismatum Tres. Apollonius, de Sectione Rationis* (lately put out at *Oxon* by Mr. *Halley*) *Libri Duo: De Sectione Spatii Libri Duo; Tactionum Libri Duo: Inclinationum Duo; Planorum Locorum Duo: Conicorum Octo.* Of *Aristæus,* there were *Locorum Solidorum Libri Quinque.* And of *Eratosthenes, Duo Libri de Medietatibus.*

There are two Kinds, saith *Pappus,* of this *Resolution*; one, where bare Truth in Theory only is pursued; which therefore he calls the *Contemplative Method or Theoretic*: and the other, where we investigate something which we propose to have done; and this is called the *Problematic Method.* What this *Resolution* or *Analysis* of the Ancients was, you may see in the Learned Mr. *Halley*'s Edition of *Apollonius de Sectione Rationis* abovementioned; and a good Attempt towards its Restitution in a Modern *Spanish* Author, *Hugo de Omerique,* his *Analysis Geometrica,* printed at *Cales* 1698.

LODEMANAGE, was anciently the Term for the Hire of a Pilot, when he conducted a Ship from Place to Place.

LODE-SHIP, was formerly the Name of a small fishing Vessel. *Vid.* 31 *E.* 3. *Stat.* 3. *c.* 2.

LOGARITHMICK-*Spiral,* is a Curve generated by the equable Motion of the Radius of a Circle thro' equal Arks of the Circumference; while at the same time a Point in that Radius is supposed to move from the Ark towards the Centre, with a Retardation of Motion in a Geometric Proportion. As suppose there be a Quadrant of a Circle, as $BCA$, and any equal Divisions in the Ark, as $AF = Ff = ff$, &c. with 5 corresponding Radii, suppose as $CA$, $CF$, $Cf$, &c.




whose Parts or Portions $Ci$, $Ca$, $Ca$, &c. are Geometrically proportional; then if a Line, as 1, $a$, $a$, $b$, $d$, $C$, be drawn thro' those Points, it will be the *Logarithmick-Spiral. Vid. Guido Grand. Theorem. Hugen. Cap.* 1.

LOGARITHMS. The Learned and Ingenious Mr. *Halley,* Savilian Professor of Geometry in *Oxon.* and *F. R. S.* hath in *Phil. Transact.* N° 216. and since that, in *Sherwin*'s *Mathematical Tables,* published a most compendious and easy Method of constructing the *Logarithms*; and this exemplified and demonstrated from the Nature of Numbers, without any regard to the Hyperbola, or any other Curves: Together with a speedy Method of finding the Number answering to any given Logarithm. *See the Preface to* Sherwin's Math. Tables, *p.* 14, &c.

A

# TABLE

OF

# LOGARITHMS

For Numbers increasing orderly from 1 to 10000,
with their Differences.

*Whereby the Logarithm of any Number under* 10000 *may be readily taken.*

| Nu. | Log. | Nu. | Log. | Nu. | Log. | Nu. | Log. |
|---|---|---|---|---|---|---|---|
| 1 | 0.0000000 | 26 | 1.4149733 | 51 | 1.7075702 | 76 | 1.8808136 |
| 2 | 0.3010300 | 27 | 1.4313637 | 52 | 1.7160033 | 77 | 1.8864907 |
| 3 | 0.4771212 | 28 | 1.4471580 | 53 | 1.7242759 | 78 | 1.8920946 |
| 4 | 0.6020600 | 29 | 1.4623980 | 54 | 1.7323937 | 79 | 1.8976271 |
| 5 | 0.6989700 | 30 | 1.4771212 | 55 | 1.7403627 | 80 | 1.9030900 |
| 6 | 0.7781512 | 31 | 1.4913617 | 56 | 1.7481880 | 81 | 1.9084850 |
| 7 | 0.8450980 | 32 | 1.5051500 | 57 | 1.7558748 | 82 | 1.9138138 |
| 8 | 0.9030900 | 33 | 1.5185139 | 58 | 1.7634280 | 83 | 1.9190781 |
| 9 | 0.9542425 | 34 | 1.5314789 | 59 | 1.7708520 | 84 | 1.9242793 |
| 10 | 1.0000000 | 35 | 1.5440680 | 60 | 1.7781512 | 85 | 1.9294189 |
| 11 | 1.0413927 | 36 | 1.5563025 | 61 | 1.7853298 | 86 | 1.9344984 |
| 12 | 1.0791812 | 37 | 1.5682017 | 62 | 1.7923917 | 87 | 1.9395192 |
| 13 | 1.1139433 | 38 | 1.5797836 | 63 | 1.7993405 | 88 | 1.9444827 |
| 14 | 1.1461280 | 39 | 1.5910646 | 64 | 1.8061800 | 89 | 1.9493900 |
| 15 | 1.1760912 | 40 | 1.6020600 | 65 | 1.8129133 | 90 | 1.9542425 |
| 6 | 1.2041200 | 41 | 1.6127838 | 66 | 1.8195439 | 91 | 1.9590414 |
| 7 | 1.2304489 | 42 | 1.6232493 | 67 | 1.8260748 | 92 | 1.9637878 |
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| 9892273 | 9892718 | 9893163 | 9893608 | 9894050 | 445 |
| 9896722 | 9897167 | 9897612 | 9898056 | 9898501 | 445 |
| 9901168 | 9901612 | 9902056 | 9902500 | 9902944 | 444 |
| 9905608 | 9906052 | 9906496 | 9906940 | 9907383 | 444 |
| 9910044 | 9910488 | 9910931 | 9911374 | 9911818 | 443 |
| 9914476 | 9914919 | 9915362 | 9915805 | 9916247 | 443 |
| 9918903 | 9919345 | 9919788 | 9920230 | 9920673 | 442 |
| 9923326 | 9923768 | 9924210 | 9924651 | 9925093 | 442 |
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| 9932157 | 9932598 | 9933039 | 9933480 | 9933921 | 441 |
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| 9945371 | 9945811 | 9946251 | 9946690 | 9947130 | 440 |
| 9949767 | 9950206 | 9950645 | 9951085 | 9951524 | 440 |
| 9954158 | 9954597 | 9955036 | 9955474 | 9955913 | 439 |
| 9958545 | 9958983 | 9959422 | 9959860 | 9960298 | 439 |
| 9962927 | 9963365 | 9963803 | 9964241 | 9964679 | 438 |
| 9967305 | 9967743 | 9968180 | 9968618 | 9969055 | 438 |
| 9971679 | 9972116 | 9972553 | 9972990 | 9973427 | 437 |
| 9976048 | 9976485 | 9976921 | 9977358 | 9977794 | 437 |
| 9980413 | 9980849 | 9981285 | 9981721 | 9982157 | 437 |
| 9984773 | 9985209 | 9985645 | 9986080 | 9986516 | 436 |
| 9989129 | 9989564 | 9990000 | 9990435 | 9990870 | 435 |
| 9993481 | 9993916 | 9994350 | 9994785 | 9995220 | 435 |
| 9997828 | 9998262 | 9998697 | 9999131 | 9999566 | 435 |

# A TABLE OF Proportional Parts.

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 44 | 4 | 9 | 13 | 18 | 22 | 26 | 31 | 35 | 40 |
| 46 | 5 | 9 | 14 | 18 | 23 | 28 | 32 | 37 | 41 |
| 48 | 5 | 10 | 14 | 19 | 24 | 29 | 34 | 38 | 43 |
| 50 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| 52 | 5 | 10 | 16 | 21 | 26 | 31 | 36 | 42 | 47 |
| 54 | 5 | 11 | 16 | 22 | 27 | 32 | 38 | 43 | 49 |
| 56 | 6 | 11 | 17 | 22 | 28 | 34 | 39 | 45 | 50 |
| 58 | 6 | 12 | 17 | 23 | 29 | 35 | 41 | 46 | 52 |
| 60 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 |
| 62 | 6 | 12 | 19 | 25 | 31 | 37 | 43 | 50 | 56 |
| 64 | 6 | 13 | 19 | 26 | 32 | 38 | 45 | 51 | 58 |
| 66 | 7 | 13 | 20 | 26 | 33 | 40 | 46 | 53 | 59 |
| 68 | 7 | 14 | 20 | 27 | 34 | 41 | 48 | 54 | 61 |
| 70 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 57 | 63 |
| 72 | 7 | 14 | 22 | 29 | 36 | 43 | 50 | 58 | 65 |
| 74 | 7 | 15 | 22 | 30 | 37 | 44 | 52 | 59 | 67 |
| 76 | 8 | 15 | 23 | 30 | 38 | 46 | 53 | 61 | 69 |
| 78 | 8 | 16 | 23 | 31 | 39 | 47 | 55 | 62 | 70 |
| 80 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 |
| 82 | 8 | 16 | 25 | 33 | 41 | 49 | 57 | 66 | 74 |
| 84 | 8 | 17 | 25 | 34 | 42 | 50 | 59 | 67 | 76 |
| 86 | 9 | 17 | 26 | 34 | 43 | 52 | 60 | 69 | 77 |
| 88 | 9 | 18 | 26 | 35 | 44 | 53 | 62 | 70 | 79 |
| 90 | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 |
| 92 | 9 | 18 | 28 | 37 | 46 | 55 | 64 | 74 | 83 |
| 94 | 9 | 19 | 28 | 38 | 47 | 56 | 66 | 75 | 85 |
| 96 | 10 | 19 | 29 | 38 | 48 | 58 | 67 | 77 | 86 |
| 98 | 10 | 20 | 29 | 39 | 49 | 59 | 69 | 78 | 88 |
| 100 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| 102 | 10 | 20 | 31 | 41 | 51 | 61 | 71 | 82 | 92 |
| 104 | 10 | 21 | 31 | 42 | 52 | 62 | 73 | 83 | 94 |
| 106 | 11 | 21 | 32 | 42 | 53 | 64 | 74 | 85 | 95 |
| 108 | 11 | 22 | 32 | 43 | 54 | 65 | 76 | 86 | 97 |
| 110 | 11 | 22 | 33 | 44 | 55 | 66 | 77 | 88 | 99 |
| 112 | 11 | 22 | 34 | 45 | 56 | 67 | 78 | 90 | 101 |
| 114 | 11 | 23 | 34 | 46 | 57 | 68 | 80 | 91 | 103 |
| 116 | 12 | 23 | 35 | 46 | 58 | 70 | 81 | 93 | 104 |
| 118 | 12 | 24 | 35 | 47 | 59 | 71 | 83 | 94 | 106 |
| 120 | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 |
| 122 | 12 | 24 | 37 | 49 | 61 | 73 | 85 | 97 | 110 |
| 124 | 12 | 25 | 37 | 50 | 62 | 74 | 87 | 99 | 112 |
| 125 | 13 | 25 | 38 | 50 | 63 | 76 | 88 | 101 | 113 |

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| 130 | 13 | 26 | 39 | 52 | 65 | 78 | 91 | 104 | 117 |
| 132 | 13 | 26 | 40 | 53 | 66 | 79 | 92 | 106 | 119 |
| 134 | 13 | 27 | 40 | 54 | 67 | 80 | 94 | 107 | 121 |
| 136 | 14 | 27 | 41 | 54 | 68 | 82 | 95 | 109 | 122 |
| 138 | 14 | 28 | 41 | 55 | 69 | 83 | 97 | 110 | 124 |
| 140 | 14 | 28 | 42 | 56 | 70 | 84 | 98 | 112 | 126 |
| 142 | 14 | 28 | 43 | 57 | 71 | 85 | 99 | 114 | 128 |
| 144 | 14 | 29 | 43 | 58 | 72 | 86 | 101 | 115 | 130 |
| 146 | 15 | 29 | 44 | 58 | 73 | 88 | 102 | 117 | 131 |
| 148 | 15 | 30 | 44 | 59 | 74 | 89 | 104 | 118 | 133 |
| 150 | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 |
| 152 | 15 | 30 | 46 | 61 | 76 | 91 | 106 | 122 | 137 |
| 154 | 15 | 31 | 46 | 62 | 77 | 92 | 108 | 123 | 139 |
| 156 | 16 | 31 | 47 | 62 | 78 | 94 | 109 | 125 | 140 |
| 158 | 16 | 32 | 47 | 63 | 79 | 95 | 111 | 126 | 142 |
| 160 | 16 | 32 | 48 | 64 | 80 | 96 | 112 | 128 | 144 |
| 162 | 16 | 32 | 49 | 65 | 81 | 97 | 113 | 130 | 146 |
| 164 | 16 | 33 | 49 | 66 | 82 | 98 | 115 | 131 | 148 |
| 166 | 17 | 33 | 50 | 66 | 83 | 100 | 116 | 133 | 149 |
| 168 | 17 | 34 | 50 | 67 | 84 | 101 | 118 | 134 | 151 |
| 170 | 17 | 34 | 51 | 68 | 85 | 102 | 119 | 136 | 153 |
| 172 | 17 | 34 | 52 | 69 | 86 | 103 | 120 | 138 | 155 |
| 174 | 17 | 35 | 52 | 70 | 87 | 104 | 122 | 139 | 157 |
| 176 | 18 | 35 | 53 | 70 | 88 | 106 | 123 | 141 | 158 |
| 178 | 18 | 36 | 53 | 71 | 89 | 107 | 125 | 143 | 160 |
| 180 | 18 | 36 | 54 | 72 | 90 | 108 | 126 | 144 | 162 |
| 182 | 18 | 36 | 55 | 73 | 91 | 109 | 127 | 146 | 164 |
| 184 | 18 | 37 | 55 | 74 | 92 | 110 | 129 | 147 | 166 |
| 186 | 19 | 37 | 56 | 74 | 93 | 112 | 130 | 149 | 167 |
| 188 | 19 | 38 | 56 | 75 | 94 | 113 | 132 | 150 | 169 |
| 190 | 19 | 38 | 57 | 76 | 95 | 114 | 133 | 152 | 171 |
| 192 | 19 | 38 | 58 | 77 | 96 | 115 | 134 | 154 | 173 |
| 194 | 19 | 39 | 58 | 78 | 97 | 116 | 136 | 155 | 175 |
| 196 | 20 | 39 | 59 | 78 | 98 | 118 | 137 | 157 | 176 |
| 198 | 20 | 40 | 59 | 79 | 99 | 119 | 139 | 158 | 178 |
| 200 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
| 202 | 20 | 40 | 61 | 81 | 101 | 121 | 141 | 162 | 182 |
| 204 | 20 | 41 | 61 | 82 | 102 | 122 | 143 | 163 | 184 |
| 206 | 21 | 41 | 62 | 82 | 103 | 124 | 144 | 165 | 185 |
| 208 | 21 | 42 | 62 | 83 | 104 | 125 | 146 | 166 | 187 |
| 210 | 21 | 42 | 63 | 84 | 105 | 126 | 147 | 168 | 189 |
| 212 | 21 | 42 | 64 | 85 | 106 | 127 | 148 | 170 | 191 |
| 214 | 21 | 43 | 64 | 86 | 107 | 128 | 150 | 171 | 193 |
| 216 | 22 | 43 | 65 | 86 | 108 | 130 | 151 | 173 | 194 |
| 218 | 22 | 44 | 65 | 87 | 109 | 131 | 153 | 174 | 196 |
| 220 | 22 | 44 | 66 | 88 | 110 | 132 | 154 | 176 | 198 |
| 222 | 22 | 44 | 67 | 89 | 111 | 133 | 155 | 178 | 200 |
| 224 | 22 | 45 | 67 | 90 | 112 | 134 | 157 | 179 | 202 |
| 226 | 23 | 45 | 68 | 90 | 113 | 136 | 158 | 181 | 203 |
| 228 | 23 | 46 | 68 | 91 | 114 | 137 | 160 | 182 | 205 |
| 230 | 23 | 46 | 69 | 92 | 115 | 138 | 161 | 184 | 207 |
| 232 | 23 | 46 | 70 | 93 | 116 | 139 | 162 | 186 | 209 |
| 234 | 23 | 47 | 70 | 94 | 117 | 140 | 164 | 187 | 211 |
| 236 | 24 | 47 | 71 | 94 | 118 | 142 | 165 | 189 | 212 |
| 238 | 24 | 48 | 71 | 95 | 119 | 143 | 167 | 190 | 214 |
| 240 | 24 | 48 | 72 | 96 | 120 | 144 | 168 | 192 | 216 |
| 242 | 24 | 48 | 73 | 97 | 121 | 145 | 169 | 194 | 218 |
| 244 | 24 | 49 | 73 | 98 | 122 | 146 | 171 | 195 | 220 |
| 246 | 25 | 49 | 74 | 98 | 123 | 148 | 172 | 197 | 221 |
| 248 | 25 | 50 | 74 | 99 | 124 | 149 | 174 | 198 | 223 |
| 250 | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 |
| 252 | 25 | 50 | 76 | 101 | 126 | 151 | 176 | 202 | 227 |
| 254 | 25 | 51 | 76 | 102 | 127 | 152 | 177 | 203 | 229 |
| 256 | 26 | 51 | 77 | 102 | 128 | 154 | 179 | 205 | 230 |
| 258 | 26 | 52 | 77 | 103 | 129 | 155 | 181 | 206 | 232 |

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| 262 | 26 | 52 | 79 | 105 | 131 | 157 | 183 | 210 | 236 |
| 264 | 26 | 53 | 79 | 106 | 132 | 158 | 185 | 211 | 238 |
| 266 | 27 | 53 | 80 | 106 | 133 | 160 | 186 | 213 | 239 |
| 268 | 27 | 54 | 80 | 107 | 134 | 161 | 188 | 214 | 241 |
| 270 | 27 | 54 | 81 | 108 | 135 | 162 | 189 | 216 | 243 |
| 272 | 27 | 54 | 82 | 109 | 136 | 163 | 190 | 218 | 245 |
| 274 | 27 | 55 | 82 | 110 | 137 | 164 | 192 | 219 | 247 |
| 276 | 28 | 55 | 83 | 110 | 138 | 166 | 193 | 221 | 248 |
| 278 | 28 | 56 | 83 | 111 | 139 | 167 | 195 | 222 | 250 |
| 280 | 28 | 56 | 84 | 112 | 140 | 168 | 196 | 224 | 252 |
| 282 | 28 | 56 | 85 | 113 | 141 | 169 | 197 | 226 | 254 |
| 284 | 28 | 57 | 85 | 114 | 142 | 170 | 199 | 227 | 256 |
| 286 | 29 | 57 | 86 | 114 | 143 | 172 | 200 | 229 | 257 |
| 288 | 29 | 58 | 86 | 115 | 144 | 173 | 202 | 230 | 259 |
| 290 | 29 | 58 | 87 | 116 | 145 | 174 | 203 | 232 | 261 |
| 292 | 29 | 58 | 88 | 117 | 146 | 175 | 204 | 234 | 263 |
| 294 | 29 | 59 | 88 | 118 | 147 | 176 | 206 | 235 | 265 |
| 296 | 30 | 59 | 89 | 118 | 148 | 178 | 207 | 237 | 267 |
| 298 | 30 | 60 | 89 | 119 | 149 | 179 | 209 | 238 | 268 |
| 300 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 |
| 302 | 30 | 60 | 91 | 121 | 151 | 181 | 211 | 242 | 272 |
| 304 | 30 | 61 | 91 | 121 | 152 | 182 | 213 | 243 | 274 |
| 306 | 31 | 61 | 92 | 122 | 153 | 184 | 214 | 245 | 275 |
| 308 | 31 | 62 | 92 | 123 | 154 | 185 | 216 | 246 | 277 |
| 310 | 31 | 62 | 93 | 124 | 155 | 186 | 217 | 248 | 279 |
| 312 | 31 | 62 | 94 | 125 | 156 | 187 | 218 | 250 | 281 |
| 314 | 31 | 63 | 94 | 126 | 157 | 188 | 220 | 251 | 283 |
| 316 | 32 | 63 | 95 | 126 | 158 | 190 | 221 | 253 | 284 |
| 318 | 32 | 64 | 95 | 127 | 159 | 191 | 223 | 254 | 286 |
| 320 | 32 | 64 | 96 | 128 | 160 | 192 | 224 | 256 | 288 |
| 322 | 32 | 64 | 97 | 129 | 161 | 193 | 225 | 258 | 290 |
| 324 | 32 | 65 | 97 | 130 | 162 | 194 | 227 | 259 | 292 |
| 326 | 33 | 65 | 98 | 130 | 163 | 196 | 228 | 261 | 293 |
| 328 | 33 | 66 | 98 | 131 | 164 | 197 | 230 | 262 | 295 |
| 330 | 33 | 66 | 99 | 132 | 165 | 198 | 231 | 264 | 297 |
| 332 | 33 | 66 | 100 | 133 | 166 | 199 | 232 | 266 | 299 |
| 334 | 33 | 67 | 100 | 134 | 167 | 200 | 234 | 267 | 301 |
| 336 | 34 | 67 | 101 | 134 | 168 | 202 | 235 | 269 | 302 |
| 338 | 34 | 68 | 101 | 135 | 169 | 203 | 237 | 270 | 304 |
| 340 | 34 | 68 | 102 | 136 | 170 | 204 | 238 | 272 | 306 |
| 342 | 34 | 68 | 103 | 137 | 171 | 205 | 239 | 274 | 308 |
| 344 | 34 | 69 | 103 | 138 | 172 | 206 | 241 | 275 | 310 |
| 346 | 35 | 69 | 104 | 138 | 173 | 208 | 242 | 277 | 311 |
| 348 | 35 | 70 | 104 | 139 | 174 | 209 | 244 | 278 | 313 |
| 350 | 35 | 70 | 105 | 140 | 175 | 210 | 245 | 280 | 315 |
| 352 | 35 | 70 | 106 | 141 | 176 | 211 | 246 | 282 | 317 |
| 354 | 35 | 71 | 106 | 142 | 177 | 212 | 248 | 283 | 319 |
| 356 | 36 | 71 | 107 | 142 | 178 | 214 | 249 | 285 | 320 |
| 358 | 36 | 72 | 107 | 143 | 179 | 215 | 251 | 286 | 322 |
| 360 | 36 | 72 | 108 | 144 | 180 | 216 | 252 | 288 | 324 |
| 362 | 36 | 72 | 109 | 145 | 181 | 217 | 253 | 290 | 326 |
| 364 | 36 | 73 | 109 | 146 | 182 | 218 | 255 | 291 | 328 |
| 366 | 37 | 73 | 110 | 146 | 183 | 220 | 256 | 293 | 329 |
| 368 | 37 | 74 | 110 | 147 | 184 | 221 | 258 | 294 | 331 |
| 370 | 37 | 74 | 111 | 148 | 185 | 222 | 259 | 296 | 333 |
| 372 | 37 | 74 | 112 | 149 | 186 | 223 | 260 | 298 | 335 |
| 374 | 37 | 75 | 112 | 150 | 187 | 224 | 262 | 299 | 337 |
| 376 | 38 | 75 | 113 | 150 | 188 | 226 | 263 | 301 | 338 |
| 378 | 38 | 76 | 113 | 151 | 189 | 227 | 265 | 303 | 339 |
| 380 | 38 | 76 | 114 | 152 | 190 | 228 | 266 | 304 | 342 |
| 382 | 38 | 76 | 115 | 153 | 191 | 229 | 267 | 306 | 344 |
| 384 | 38 | 77 | 115 | 154 | 192 | 230 | 269 | 307 | 346 |
| 386 | 39 | 77 | 116 | 154 | 193 | 232 | 270 | 309 | 347 |
| 388 | 39 | 78 | 116 | 155 | 194 | 233 | 272 | 310 | 349 |
| 390 | 39 | 78 | 117 | 156 | 195 | 234 | 273 | 312 | 351 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
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| 392 | 39 | 78 | 118 | 157 | 196 | 235 | 274 | 314 | 353 |
| 394 | 39 | 79 | 118 | 158 | 197 | 236 | 276 | 315 | 355 |
| 396 | 40 | 79 | 119 | 158 | 198 | 238 | 277 | 317 | 356 |
| 398 | 40 | 80 | 119 | 159 | 199 | 239 | 279 | 318 | 358 |
| 400 | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 360 |
| 402 | 40 | 80 | 121 | 161 | 201 | 241 | 281 | 322 | 362 |
| 404 | 40 | 81 | 121 | 162 | 202 | 242 | 283 | 323 | 364 |
| 406 | 41 | 81 | 122 | 162 | 203 | 244 | 284 | 325 | 365 |
| 408 | 41 | 82 | 122 | 163 | 204 | 245 | 286 | 326 | 367 |
| 410 | 41 | 82 | 123 | 164 | 205 | 246 | 287 | 328 | 369 |
| 412 | 41 | 82 | 124 | 165 | 206 | 247 | 288 | 330 | 371 |
| 414 | 41 | 83 | 124 | 166 | 207 | 248 | 290 | 331 | 373 |
| 416 | 42 | 83 | 125 | 166 | 208 | 250 | 291 | 333 | 374 |
| 418 | 42 | 84 | 125 | 167 | 209 | 251 | 293 | 334 | 376 |
| 420 | 42 | 84 | 126 | 168 | 210 | 252 | 294 | 336 | 378 |
| 422 | 42 | 84 | 127 | 169 | 211 | 253 | 295 | 338 | 380 |
| 424 | 42 | 85 | 127 | 170 | 212 | 254 | 297 | 339 | 382 |
| 426 | 43 | 85 | 128 | 170 | 213 | 256 | 298 | 341 | 383 |
| 428 | 43 | 86 | 128 | 171 | 214 | 257 | 300 | 342 | 385 |
| 430 | 43 | 86 | 129 | 172 | 215 | 258 | 301 | 344 | 387 |
| 432 | 43 | 86 | 130 | 173 | 216 | 259 | 302 | 346 | 389 |
| 434 | 43 | 87 | 130 | 174 | 217 | 260 | 304 | 347 | 391 |
| 436 | 44 | 87 | 131 | 174 | 218 | 262 | 305 | 349 | 392 |
| 438 | 44 | 88 | 131 | 175 | 219 | 263 | 307 | 350 | 394 |
| 440 | 44 | 88 | 132 | 176 | 220 | 264 | 308 | 352 | 396 |
| 442 | 44 | 88 | 133 | 177 | 221 | 265 | 309 | 354 | 398 |
| 444 | 44 | 89 | 133 | 178 | 222 | 266 | 311 | 355 | 400 |
| 446 | 45 | 89 | 134 | 178 | 223 | 268 | 312 | 357 | 401 |
| 448 | 45 | 90 | 134 | 179 | 224 | 269 | 314 | 358 | 403 |
| 450 | 45 | 90 | 135 | 180 | 225 | 270 | 315 | 360 | 405 |
| 452 | 45 | 90 | 136 | 181 | 226 | 271 | 316 | 362 | 407 |
| 454 | 45 | 91 | 136 | 182 | 227 | 272 | 318 | 363 | 409 |
| 456 | 46 | 91 | 137 | 182 | 228 | 274 | 319 | 365 | 410 |
| 458 | 46 | 92 | 137 | 183 | 229 | 275 | 321 | 366 | 412 |
| 460 | 46 | 92 | 138 | 184 | 230 | 276 | 322 | 368 | 414 |
| 462 | 46 | 92 | 139 | 185 | 231 | 277 | 323 | 370 | 416 |
| 464 | 46 | 93 | 139 | 186 | 232 | 278 | 325 | 371 | 418 |
| 466 | 47 | 93 | 140 | 186 | 233 | 280 | 326 | 373 | 419 |
| 468 | 47 | 94 | 140 | 187 | 234 | 281 | 328 | 374 | 421 |
| 470 | 47 | 94 | 141 | 188 | 235 | 282 | 329 | 376 | 423 |
| 472 | 47 | 94 | 142 | 189 | 236 | 283 | 330 | 378 | 425 |
| 474 | 47 | 95 | 142 | 190 | 237 | 284 | 332 | 379 | 427 |
| 476 | 48 | 95 | 143 | 190 | 238 | 286 | 333 | 381 | 428 |
| 478 | 48 | 96 | 143 | 191 | 239 | 287 | 335 | 382 | 430 |
| 480 | 48 | 96 | 144 | 192 | 240 | 288 | 336 | 384 | 432 |
| 482 | 48 | 96 | 145 | 193 | 241 | 289 | 337 | 386 | 434 |
| 484 | 48 | 97 | 145 | 194 | 242 | 290 | 339 | 387 | 436 |
| 486 | 49 | 97 | 146 | 194 | 243 | 292 | 340 | 389 | 437 |
| 488 | 49 | 98 | 146 | 195 | 244 | 293 | 342 | 390 | 439 |
| 490 | 49 | 98 | 147 | 196 | 245 | 294 | 343 | 392 | 441 |
| 492 | 49 | 98 | 148 | 197 | 246 | 295 | 344 | 394 | 443 |
| 494 | 49 | 99 | 148 | 198 | 247 | 296 | 346 | 395 | 445 |
| 496 | 50 | 99 | 149 | 198 | 248 | 298 | 347 | 397 | 446 |
| 498 | 50 | 100 | 149 | 199 | 249 | 299 | 349 | 398 | 448 |
| 500 | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 |
| 502 | 50 | 100 | 151 | 201 | 251 | 301 | 351 | 402 | 452 |
| 504 | 50 | 101 | 151 | 202 | 252 | 302 | 353 | 403 | 454 |
| 506 | 51 | 101 | 152 | 202 | 253 | 304 | 354 | 405 | 455 |
| 508 | 51 | 102 | 152 | 203 | 254 | 305 | 356 | 406 | 457 |
| 510 | 51 | 102 | 153 | 204 | 255 | 306 | 357 | 408 | 459 |
| 512 | 51 | 102 | 154 | 205 | 256 | 307 | 358 | 410 | 461 |
| 514 | 51 | 103 | 154 | 206 | 257 | 308 | 360 | 411 | 463 |
| 516 | 52 | 103 | 155 | 206 | 258 | 310 | 361 | 413 | 464 |
| 518 | 52 | 104 | 155 | 207 | 259 | 311 | 363 | 414 | 466 |
| 520 | 52 | 104 | 156 | 208 | 260 | 312 | 364 | 416 | 468 |
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| 524 | 52 | 105 | 157 | 210 | 262 | 314 | 367 | 419 | 472 |
| 526 | 53 | 105 | 158 | 210 | 263 | 316 | 368 | 421 | 473 |
| 528 | 53 | 106 | 158 | 211 | 264 | 317 | 370 | 422 | 475 |
| 530 | 53 | 106 | 159 | 212 | 265 | 318 | 371 | 424 | 477 |
| 532 | 53 | 106 | 160 | 213 | 266 | 319 | 372 | 426 | 479 |
| 533 | 53 | 107 | 160 | 214 | 267 | 320 | 374 | 427 | 481 |
| 536 | 54 | 107 | 161 | 214 | 268 | 322 | 375 | 429 | 482 |
| 538 | 54 | 108 | 161 | 215 | 269 | 323 | 377 | 430 | 484 |
| 540 | 54 | 108 | 162 | 216 | 270 | 324 | 378 | 432 | 486 |
| 542 | 54 | 108 | 163 | 217 | 271 | 325 | 379 | 434 | 488 |
| 544 | 54 | 109 | 163 | 218 | 272 | 326 | 381 | 435 | 490 |
| 546 | 55 | 109 | 164 | 218 | 273 | 328 | 382 | 437 | 491 |
| 548 | 55 | 110 | 164 | 219 | 274 | 329 | 384 | 438 | 493 |
| 550 | 55 | 110 | 165 | 220 | 275 | 330 | 385 | 440 | 495 |
| 552 | 55 | 110 | 166 | 221 | 276 | 331 | 386 | 442 | 497 |
| 554 | 55 | 111 | 166 | 222 | 277 | 332 | 388 | 443 | 499 |
| 556 | 56 | 111 | 167 | 222 | 278 | 334 | 389 | 445 | 500 |
| 558 | 56 | 112 | 167 | 223 | 279 | 335 | 391 | 446 | 502 |
| 560 | 56 | 112 | 168 | 224 | 280 | 336 | 392 | 448 | 504 |
| 562 | 56 | 112 | 169 | 225 | 281 | 337 | 393 | 450 | 506 |
| 564 | 56 | 113 | 169 | 226 | 282 | 338 | 395 | 451 | 508 |
| 566 | 57 | 113 | 170 | 226 | 283 | 340 | 396 | 453 | 509 |
| 568 | 57 | 114 | 170 | 227 | 284 | 341 | 398 | 454 | 511 |
| 570 | 57 | 114 | 171 | 228 | 285 | 342 | 399 | 456 | 513 |
| 572 | 57 | 114 | 172 | 229 | 286 | 343 | 400 | 458 | 515 |
| 574 | 57 | 115 | 172 | 230 | 287 | 344 | 401 | 459 | 516 |
| 576 | 58 | 115 | 173 | 230 | 288 | 346 | 403 | 461 | 518 |
| 578 | 58 | 116 | 173 | 231 | 289 | 347 | 405 | 462 | 520 |
| 580 | 58 | 116 | 174 | 232 | 290 | 348 | 406 | 464 | 522 |
| 582 | 58 | 116 | 175 | 233 | 291 | 349 | 407 | 466 | 524 |
| 584 | 58 | 117 | 175 | 234 | 292 | 350 | 409 | 467 | 526 |
| 586 | 59 | 117 | 176 | 234 | 293 | 352 | 410 | 469 | 527 |
| 588 | 59 | 118 | 176 | 235 | 294 | 353 | 412 | 470 | 529 |
| 590 | 59 | 118 | 177 | 236 | 295 | 354 | 413 | 472 | 531 |
| 592 | 59 | 118 | 178 | 237 | 296 | 355 | 414 | 474 | 533 |
| 594 | 59 | 119 | 178 | 238 | 297 | 356 | 416 | 275 | 535 |
| 596 | 60 | 119 | 179 | 238 | 298 | 358 | 417 | 477 | 536 |
| 598 | 60 | 120 | 179 | 239 | 299 | 359 | 419 | 478 | 538 |
| 600 | 60 | 120 | 180 | 240 | 300 | 360 | 420 | 480 | 540 |
| 602 | 60 | 120 | 181 | 241 | 301 | 361 | 421 | 482 | 542 |
| 604 | 60 | 121 | 181 | 242 | 302 | 362 | 423 | 483 | 544 |
| 606 | 61 | 121 | 182 | 242 | 303 | 364 | 424 | 485 | 545 |
| 608 | 61 | 122 | 182 | 243 | 304 | 365 | 426 | 486 | 547 |
| 610 | 61 | 122 | 183 | 244 | 305 | 366 | 427 | 488 | 549 |
| 612 | 61 | 122 | 184 | 245 | 306 | 367 | 428 | 490 | 551 |
| 614 | 61 | 123 | 184 | 246 | 307 | 368 | 430 | 492 | 553 |
| 616 | 62 | 123 | 185 | 246 | 308 | 370 | 431 | 493 | 554 |
| 618 | 62 | 124 | 185 | 247 | 309 | 371 | 433 | 494 | 556 |
| 620 | 62 | 124 | 186 | 248 | 310 | 372 | 434 | 496 | 558 |
| 622 | 62 | 124 | 187 | 249 | 311 | 373 | 435 | 498 | 560 |
| 624 | 62 | 125 | 187 | 250 | 312 | 374 | 437 | 499 | 562 |
| 626 | 63 | 125 | 188 | 250 | 313 | 376 | 438 | 501 | 563 |
| 628 | 63 | 126 | 188 | 251 | 314 | 377 | 440 | 502 | 565 |
| 630 | 63 | 126 | 189 | 252 | 315 | 378 | 441 | 504 | 567 |
| 632 | 63 | 126 | 190 | 253 | 316 | 379 | 442 | 506 | 569 |
| 634 | 63 | 127 | 190 | 254 | 317 | 380 | 444 | 507 | 571 |
| 636 | 64 | 127 | 191 | 254 | 318 | 382 | 445 | 509 | 572 |
| 638 | 64 | 128 | 191 | 255 | 319 | 383 | 447 | 510 | 574 |
| 640 | 64 | 128 | 192 | 256 | 320 | 384 | 448 | 512 | 576 |
| 642 | 64 | 128 | 193 | 257 | 321 | 385 | 449 | 514 | 578 |
| 644 | 64 | 129 | 193 | 258 | 322 | 386 | 451 | 515 | 580 |
| 646 | 65 | 129 | 194 | 258 | 323 | 388 | 452 | 517 | 581 |
| 648 | 65 | 130 | 194 | 259 | 324 | 389 | 454 | 518 | 583 |
| 650 | 65 | 130 | 195 | 260 | 325 | 390 | 455 | 520 | 585 |
| 652 | 65 | 130 | 196 | 261 | 326 | 391 | 456 | 522 | 587 |
| 654 | 65 | 131 | 196 | 262 | 327 | 392 | 458 | 523 | 580 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
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| 658 | 66 | 132 | 197 | 263 | 329 | 395 | 461 | 526 | 592 |
| 660 | 66 | 132 | 198 | 264 | 330 | 396 | 462 | 528 | 594 |
| 662 | 66 | 132 | 199 | 265 | 331 | 397 | 463 | 530 | 596 |
| 664 | 66 | 133 | 199 | 266 | 332 | 398 | 465 | 531 | 598 |
| 666 | 67 | 133 | 200 | 266 | 333 | 400 | 466 | 533 | 599 |
| 668 | 67 | 134 | 200 | 267 | 334 | 401 | 468 | 534 | 601 |
| 670 | 67 | 134 | 201 | 268 | 335 | 402 | 469 | 536 | 603 |
| 672 | 67 | 134 | 202 | 269 | 336 | 403 | 470 | 538 | 605 |
| 674 | 67 | 135 | 202 | 270 | 337 | 404 | 472 | 539 | 607 |
| 676 | 68 | 135 | 203 | 270 | 338 | 406 | 473 | 541 | 608 |
| 678 | 68 | 136 | 203 | 271 | 339 | 407 | 475 | 542 | 610 |
| 680 | 68 | 136 | 204 | 272 | 340 | 408 | 476 | 544 | 612 |
| 682 | 68 | 136 | 205 | 273 | 341 | 409 | 477 | 546 | 614 |
| 684 | 68 | 137 | 205 | 274 | 342 | 410 | 479 | 547 | 616 |
| 686 | 69 | 137 | 206 | 274 | 343 | 412 | 480 | 549 | 617 |
| 688 | 69 | 138 | 206 | 275 | 344 | 413 | 482 | 550 | 619 |
| 690 | 69 | 138 | 207 | 276 | 345 | 414 | 483 | 552 | 621 |
| 692 | 69 | 138 | 208 | 277 | 346 | 415 | 484 | 554 | 623 |
| 694 | 69 | 139 | 208 | 278 | 347 | 416 | 486 | 555 | 625 |
| 696 | 70 | 139 | 209 | 278 | 348 | 417 | 487 | 557 | 626 |
| 698 | 70 | 140 | 209 | 279 | 349 | 419 | 489 | 558 | 628 |
| 700 | 70 | 140 | 210 | 280 | 350 | 420 | 490 | 560 | 630 |
| 702 | 70 | 140 | 211 | 281 | 351 | 421 | 491 | 562 | 632 |
| 704 | 70 | 141 | 211 | 282 | 352 | 422 | 492 | 563 | 634 |
| 706 | 71 | 141 | 212 | 282 | 353 | 424 | 494 | 565 | 635 |
| 708 | 71 | 142 | 212 | 283 | 354 | 425 | 496 | 566 | 637 |
| 710 | 71 | 142 | 213 | 284 | 355 | 426 | 497 | 568 | 639 |
| 712 | 71 | 142 | 214 | 285 | 356 | 427 | 498 | 570 | 641 |
| 714 | 71 | 143 | 214 | 286 | 357 | 428 | 500 | 571 | 643 |
| 716 | 72 | 143 | 215 | 286 | 358 | 430 | 501 | 573 | 644 |
| 718 | 72 | 144 | 215 | 287 | 359 | 431 | 503 | 574 | 646 |
| 720 | 72 | 144 | 216 | 288 | 360 | 432 | 504 | 576 | 648 |
| 722 | 72 | 144 | 217 | 289 | 361 | 433 | 505 | 578 | 650 |
| 724 | 72 | 145 | 217 | 290 | 362 | 434 | 507 | 579 | 652 |
| 726 | 73 | 145 | 218 | 290 | 363 | 436 | 508 | 581 | 653 |
| 728 | 73 | 146 | 218 | 291 | 364 | 437 | 510 | 582 | 655 |
| 730 | 73 | 146 | 219 | 292 | 365 | 438 | 511 | 584 | 657 |
| 732 | 73 | 146 | 220 | 293 | 366 | 439 | 512 | 586 | 659 |
| 734 | 73 | 147 | 220 | 294 | 367 | 440 | 514 | 587 | 661 |
| 736 | 74 | 147 | 221 | 294 | 368 | 442 | 515 | 589 | 662 |
| 738 | 74 | 148 | 221 | 295 | 369 | 443 | 517 | 590 | 664 |
| 740 | 74 | 148 | 222 | 296 | 370 | 444 | 518 | 592 | 666 |
| 742 | 74 | 148 | 223 | 297 | 371 | 445 | 519 | 594 | 668 |
| 744 | 74 | 149 | 223 | 298 | 372 | 446 | 521 | 595 | 670 |
| 746 | 75 | 149 | 224 | 298 | 373 | 448 | 522 | 597 | 671 |
| 748 | 75 | 150 | 224 | 299 | 374 | 449 | 524 | 598 | 673 |
| 750 | 75 | 150 | 225 | 300 | 375 | 450 | 525 | 600 | 675 |
| 752 | 75 | 150 | 226 | 301 | 376 | 451 | 526 | 602 | 677 |
| 754 | 75 | 151 | 226 | 302 | 377 | 452 | 528 | 603 | 679 |
| 756 | 76 | 151 | 227 | 302 | 378 | 454 | 529 | 605 | 680 |
| 758 | 76 | 152 | 227 | 303 | 379 | 455 | 531 | 606 | 682 |
| 760 | 76 | 152 | 228 | 304 | 380 | 456 | 532 | 608 | 684 |
| 762 | 76 | 152 | 229 | 305 | 381 | 457 | 533 | 610 | 686 |
| 764 | 76 | 153 | 229 | 306 | 382 | 458 | 535 | 611 | 688 |
| 766 | 77 | 153 | 230 | 306 | 383 | 460 | 536 | 613 | 689 |
| 768 | 77 | 154 | 230 | 307 | 384 | 461 | 538 | 614 | 691 |
| 770 | 77 | 154 | 231 | 308 | 385 | 462 | 539 | 616 | 693 |
| 772 | 77 | 154 | 232 | 309 | 386 | 463 | 540 | 618 | 695 |
| 774 | 77 | 155 | 232 | 310 | 387 | 464 | 542 | 619 | 697 |
| 776 | 78 | 155 | 233 | 310 | 388 | 466 | 543 | 621 | 699 |
| 778 | 78 | 156 | 233 | 311 | 389 | 467 | 545 | 622 | 700 |
| 780 | 78 | 156 | 234 | 312 | 390 | 468 | 546 | 624 | 702 |
| 782 | 78 | 156 | 235 | 313 | 391 | 469 | 547 | 626 | 704 |
| 784 | 78 | 157 | 235 | 314 | 392 | 470 | 549 | 627 | 706 |
| 786 | 79 | 157 | 236 | 314 | 393 | 472 | 550 | 629 | 707 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 788 | 79 | 158 | 236 | 315 | 394 | 473 | 552 | 630 | 709 |
| 790 | 79 | 158 | 237 | 316 | 395 | 474 | 553 | 632 | 711 |
| 792 | 79 | 158 | 238 | 317 | 396 | 475 | 554 | 934 | 713 |
| 794 | 79 | 159 | 238 | 318 | 397 | 477 | 556 | 635 | 715 |
| 796 | 80 | 159 | 239 | 318 | 398 | 478 | 557 | 637 | 717 |
| 798 | 80 | 160 | 239 | 319 | 399 | 479 | 559 | 638 | 718 |
| 800 | 80 | 160 | 240 | 320 | 400 | 480 | 560 | 640 | 720 |
| 802 | 80 | 160 | 241 | 321 | 401 | 481 | 561 | 642 | 722 |
| 804 | 80 | 161 | 241 | 322 | 402 | 482 | 563 | 643 | 724 |
| 806 | 81 | 161 | 242 | 322 | 403 | 484 | 564 | 645 | 725 |
| 808 | 81 | 162 | 242 | 323 | 404 | 485 | 566 | 646 | 727 |
| 810 | 81 | 162 | 243 | 324 | 405 | 486 | 567 | 648 | 729 |
| 812 | 81 | 162 | 244 | 325 | 406 | 487 | 568 | 650 | 731 |
| 814 | 81 | 163 | 244 | 326 | 407 | 488 | 570 | 651 | 733 |
| 816 | 82 | 163 | 245 | 326 | 408 | 490 | 571 | 653 | 734 |
| 818 | 82 | 164 | 245 | 327 | 409 | 491 | 572 | 654 | 736 |
| 820 | 82 | 164 | 246 | 328 | 410 | 492 | 574 | 656 | 738 |
| 822 | 82 | 164 | 247 | 329 | 411 | 493 | 575 | 658 | 740 |
| 824 | 82 | 165 | 247 | 330 | 412 | 494 | 577 | 659 | 742 |
| 826 | 83 | 165 | 248 | 330 | 413 | 496 | 578 | 661 | 743 |
| 828 | 83 | 166 | 248 | 331 | 414 | 497 | 580 | 662 | 745 |
| 830 | 83 | 166 | 249 | 332 | 415 | 498 | 581 | 664 | 747 |
| 832 | 83 | 166 | 250 | 333 | 416 | 499 | 582 | 666 | 749 |
| 834 | 83 | 167 | 250 | 334 | 417 | 500 | 584 | 667 | 751 |
| 836 | 84 | 167 | 251 | 334 | 418 | 502 | 585 | 669 | 753 |
| 838 | 84 | 168 | 251 | 335 | 419 | 503 | 587 | 670 | 754 |
| 840 | 84 | 168 | 252 | 336 | 420 | 504 | 588 | 672 | 756 |
| 842 | 84 | 168 | 253 | 337 | 421 | 505 | 589 | 674 | 758 |
| 844 | 84 | 169 | 253 | 338 | 422 | 506 | 591 | 675 | 760 |
| 846 | 85 | 169 | 254 | 338 | 423 | 508 | 592 | 677 | 761 |
| 848 | 85 | 170 | 254 | 339 | 424 | 509 | 594 | 678 | 763 |
| 850 | 85 | 170 | 255 | 340 | 425 | 510 | 595 | 680 | 765 |
| 852 | 85 | 170 | 256 | 341 | 426 | 511 | 596 | 682 | 767 |
| 854 | 85 | 171 | 256 | 342 | 427 | 512 | 598 | 683 | 769 |
| 856 | 86 | 171 | 257 | 342 | 428 | 514 | 599 | 635 | 771 |
| 858 | 86 | 172 | 257 | 343 | 429 | 515 | 601 | 686 | 773 |
| 860 | 86 | 172 | 258 | 344 | 430 | 516 | 602 | 688 | 774 |
| 862 | 86 | 172 | 259 | 345 | 431 | 517 | 603 | 690 | 776 |
| 864 | 86 | 173 | 259 | 346 | 432 | 518 | 605 | 691 | 778 |
| 866 | 87 | 173 | 260 | 346 | 433 | 520 | 606 | 693 | 779 |
| 868 | 87 | 174 | 260 | 347 | 434 | 521 | 608 | 694 | 781 |
| 870 | 87 | 174 | 261 | 348 | 435 | 522 | 609 | 696 | 783 |
| 872 | 87 | 174 | 262 | 349 | 436 | 523 | 611 | 698 | 785 |
| 874 | 87 | 175 | 262 | 350 | 437 | 524 | 612 | 699 | 787 |
| 876 | 88 | 175 | 263 | 350 | 438 | 526 | 613 | 701 | 789 |
| 878 | 88 | 176 | 263 | 351 | 439 | 527 | 615 | 702 | 791 |
| 880 | 88 | 176 | 264 | 352 | 440 | 528 | 616 | 704 | 793 |
| 882 | 88 | 176 | 265 | 353 | 441 | 529 | 617 | 706 | 795 |
| 884 | 88 | 177 | 265 | 354 | 442 | 530 | 619 | 707 | 796 |
| 886 | 89 | 177 | 266 | 354 | 443 | 532 | 620 | 709 | 797 |
| 888 | 89 | 178 | 266 | 355 | 444 | 533 | 622 | 710 | 799 |
| 890 | 89 | 178 | 267 | 356 | 445 | 534 | 623 | 712 | 801 |
| 892 | 89 | 178 | 268 | 357 | 446 | 535 | 624 | 714 | 803 |
| 894 | 89 | 179 | 268 | 358 | 447 | 536 | 626 | 715 | 805 |
| 896 | 90 | 179 | 269 | 358 | 448 | 538 | 627 | 717 | 806 |
| 898 | 90 | 180 | 269 | 359 | 449 | 539 | 629 | 718 | 808 |
| 900 | 90 | 180 | 270 | 360 | 450 | 540 | 630 | 720 | 810 |
| 903 | 90 | 181 | 271 | 361 | 451 | 542 | 632 | 722 | 813 |
| 906 | 91 | 181 | 272 | 363 | 453 | 544 | 634 | 725 | 815 |
| 909 | 91 | 182 | 273 | 364 | 454 | 545 | 636 | 727 | 818 |
| 912 | 91 | 182 | 274 | 365 | 456 | 547 | 638 | 730 | 821 |
| 915 | 91 | 183 | 274 | 366 | 457 | 549 | 640 | 732 | 823 |
| 918 | 92 | 184 | 275 | 367 | 459 | 551 | 643 | 734 | 826 |
| 921 | 92 | 184 | 276 | 368 | 460 | 553 | 645 | 737 | 829 |
| 924 | 92 | 185 | 277 | 370 | 462 | 554 | 647 | 739 | 832 |
| 927 | 93 | 185 | 278 | 371 | 463 | 556 | 649 | 742 | 834 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 930 | 93 | 186 | 279 | 372 | 465 | 558 | 651 | 744 | 837 |
| 933 | 93 | 187 | 280 | 373 | 466 | 560 | 653 | 746 | 839 |
| 936 | 94 | 187 | 281 | 374 | 468 | 562 | 655 | 749 | 842 |
| 939 | 94 | 188 | 282 | 376 | 469 | 563 | 657 | 751 | 845 |
| 942 | 94 | 188 | 283 | 377 | 471 | 565 | 659 | 754 | 848 |
| 945 | 94 | 189 | 283 | 378 | 472 | 567 | 661 | 755 | 850 |
| 948 | 95 | 190 | 284 | 379 | 474 | 569 | 664 | 758 | 853 |
| 951 | 95 | 190 | 285 | 380 | 475 | 571 | 666 | 761 | 856 |
| 954 | 95 | 191 | 286 | 382 | 477 | 572 | 668 | 763 | 859 |
| 957 | 96 | 191 | 287 | 383 | 478 | 574 | 670 | 766 | 861 |
| 960 | 96 | 192 | 288 | 384 | 480 | 576 | 672 | 768 | 864 |
| 963 | 96 | 193 | 289 | 385 | 481 | 578 | 674 | 770 | 867 |
| 966 | 97 | 193 | 290 | 386 | 483 | 580 | 676 | 773 | 869 |
| 969 | 97 | 194 | 291 | 388 | 484 | 581 | 678 | 775 | 872 |
| 972 | 97 | 194 | 292 | 389 | 486 | 583 | 680 | 778 | 875 |
| 975 | 97 | 195 | 292 | 390 | 487 | 585 | 682 | 780 | 878 |
| 978 | 98 | 196 | 293 | 391 | 489 | 587 | 685 | 782 | 880 |
| 981 | 98 | 196 | 294 | 392 | 490 | 589 | 687 | 785 | 883 |
| 984 | 98 | 197 | 295 | 394 | 492 | 590 | 689 | 787 | 886 |
| 987 | 99 | 197 | 296 | 395 | 493 | 592 | 691 | 790 | 888 |
| 990 | 99 | 198 | 297 | 396 | 495 | 594 | 693 | 792 | 891 |
| 993 | 99 | 199 | 298 | 397 | 496 | 596 | 695 | 794 | 894 |
| 996 | 99 | 199 | 299 | 398 | 498 | 598 | 697 | 797 | 897 |
| 999 | 100 | 200 | 300 | 400 | 499 | 599 | 699 | 799 | 899 |
| 1005 | 100 | 201 | 301 | 402 | 502 | 603 | 703 | 804 | 904 |
| 1009 | 101 | 202 | 303 | 404 | 504 | 605 | 706 | 807 | 908 |
| 1013 | 101 | 203 | 304 | 405 | 505 | 608 | 709 | 810 | 912 |
| 1017 | 102 | 203 | 305 | 407 | 508 | 610 | 712 | 814 | 915 |
| 1021 | 102 | 204 | 306 | 408 | 510 | 613 | 715 | 817 | 919 |
| 1025 | 102 | 205 | 307 | 410 | 512 | 615 | 717 | 820 | 923 |
| 1029 | 103 | 206 | 309 | 412 | 514 | 617 | 720 | 823 | 926 |
| 1033 | 103 | 207 | 310 | 413 | 516 | 620 | 723 | 826 | 930 |
| 1037 | 104 | 207 | 311 | 415 | 518 | 622 | 726 | 830 | 933 |
| 1041 | 104 | 208 | 312 | 416 | 520 | 625 | 729 | 833 | 937 |
| 1045 | 104 | 209 | 313 | 418 | 522 | 627 | 731 | 836 | 941 |
| 1049 | 105 | 210 | 315 | 420 | 524 | 629 | 734 | 839 | 944 |
| 1053 | 105 | 211 | 316 | 421 | 526 | 632 | 737 | 842 | 948 |
| 1057 | 106 | 211 | 317 | 423 | 528 | 634 | 740 | 846 | 951 |
| 1061 | 106 | 212 | 318 | 424 | 530 | 637 | 743 | 849 | 955 |
| 1065 | 106 | 213 | 319 | 426 | 532 | 639 | 745 | 852 | 959 |
| 1069 | 107 | 214 | 321 | 428 | 534 | 641 | 748 | 855 | 962 |
| 1073 | 107 | 215 | 322 | 429 | 536 | 644 | 751 | 858 | 966 |
| 1077 | 108 | 215 | 323 | 431 | 538 | 646 | 754 | 862 | 969 |
| 1081 | 108 | 216 | 324 | 432 | 540 | 649 | 757 | 865 | 973 |
| 1085 | 108 | 217 | 325 | 434 | 542 | 651 | 759 | 868 | 977 |
| 1089 | 109 | 218 | 327 | 436 | 544 | 653 | 762 | 871 | 980 |
| 1093 | 109 | 219 | 328 | 437 | 546 | 656 | 765 | 874 | 984 |
| 1097 | 110 | 219 | 329 | 439 | 548 | 658 | 768 | 878 | 987 |
| 1101 | 110 | 220 | 330 | 440 | 550 | 661 | 771 | 881 | 991 |
| 1105 | 110 | 221 | 331 | 442 | 552 | 663 | 773 | 884 | 994 |
| 1109 | 111 | 222 | 333 | 444 | 554 | 665 | 776 | 887 | 998 |
| 1113 | 111 | 223 | 334 | 445 | 556 | 668 | 779 | 890 | 1002 |
| 1117 | 112 | 223 | 335 | 447 | 558 | 670 | 782 | 894 | 1005 |
| 1121 | 112 | 224 | 336 | 448 | 560 | 673 | 785 | 897 | 1009 |
| 1125 | 112 | 225 | 337 | 450 | 562 | 675 | 787 | 900 | 1013 |
| 1129 | 113 | 226 | 339 | 452 | 564 | 677 | 790 | 903 | 1016 |
| 1133 | 113 | 227 | 340 | 453 | 566 | 680 | 793 | 906 | 1020 |
| 1137 | 114 | 227 | 341 | 455 | 568 | 682 | 795 | 910 | 1023 |
| 1141 | 114 | 228 | 342 | 456 | 570 | 685 | 799 | 913 | 1027 |
| 1145 | 114 | 229 | 343 | 458 | 572 | 687 | 801 | 916 | 1031 |
| 1149 | 115 | 230 | 345 | 460 | 574 | 689 | 804 | 919 | 1034 |
| 1153 | 115 | 231 | 346 | 461 | 576 | 692 | 807 | 922 | 1038 |
| 1157 | 116 | 231 | 347 | 463 | 578 | 694 | 810 | 926 | 1041 |
| 1161 | 116 | 232 | 348 | 464 | 580 | 697 | 813 | 929 | 1045 |
| 1165 | 116 | 233 | 349 | 466 | 582 | 699 | 815 | 932 | 1049 |
| 1169 | 117 | 234 | 351 | 468 | 584 | 701 | 818 | 935 | 1052 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7. | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1173 | 117 | 235 | 352 | 469 | 586 | 704 | 821 | 938 | 1056 |
| 1177 | 118 | 235 | 353 | 471 | 588 | 706 | 824 | 942 | 1059 |
| 1181 | 118 | 236 | 354 | 472 | 590 | 709 | 827 | 945 | 1063 |
| 1185 | 118 | 237 | 355 | 474 | 592 | 711 | 829 | 948 | 1067 |
| 1189 | 119 | 238 | 357 | 476 | 594 | 713 | 832 | 951 | 1070 |
| 1193 | 119 | 239 | 358 | 477 | 596 | 716 | 835 | 954 | 1074 |
| 1197 | 120 | 239 | 359 | 479 | 598 | 718 | 838 | 958 | 1077 |
| 1201 | 120 | 240 | 360 | 480 | 600 | 721 | 841 | 961 | 1081 |
| 1205 | 120 | 241 | 361 | 482 | 602 | 723 | 843 | 964 | 1084 |
| 1209 | 121 | 242 | 363 | 484 | 604 | 725 | 846 | 967 | 1088 |
| 1213 | 121 | 243 | 364 | 485 | 606 | 728 | 849 | 970 | 1092 |
| 1217 | 122 | 243 | 365 | 487 | 608 | 730 | 852 | 974 | 1095 |
| 1221 | 122 | 244 | 366 | 488 | 610 | 732 | 855 | 977 | 1099 |
| 1225 | 122 | 245 | 367 | 490 | 612 | 735 | 857 | 980 | 1102 |
| 1229 | 123 | 246 | 369 | 492 | 614 | 737 | 860 | 983 | 1106 |
| 1233 | 123 | 247 | 370 | 493 | 616 | 740 | 863 | 986 | 1110 |
| 1237 | 124 | 247 | 371 | 495 | 618 | 742 | 866 | 990 | 1113 |
| 1241 | 124 | 248 | 372 | 496 | 620 | 745 | 869 | 993 | 1117 |
| 1245 | 124 | 249 | 373 | 498 | 622 | 747 | 871 | 996 | 1120 |
| 1249 | 125 | 250 | 375 | 500 | 624 | 749 | 874 | 999 | 1124 |
| 1253 | 125 | 251 | 376 | 501 | 626 | 752 | 877 | 1002 | 1128 |
| 1257 | 126 | 251 | 377 | 503 | 628 | 754 | 880 | 1006 | 1131 |
| 1260 | 126 | 252 | 378 | 504 | 630 | 756 | 882 | 1008 | 1134 |
| 1263 | 126 | 253 | 379 | 505 | 631 | 758 | 884 | 1010 | 1137 |
| 1267 | 127 | 253 | 380 | 507 | 633 | 760 | 887 | 1014 | 1140 |
| 1271 | 127 | 254 | 381 | 508 | 635 | 763 | 890 | 1017 | 1144 |
| 1235 | 127 | 255 | 382 | 510 | 637 | 765 | 892 | 1020 | 1147 |
| 1279 | 128 | 256 | 384 | 512 | 639 | 767 | 895 | 1023 | 1151 |
| 1283 | 128 | 257 | 385 | 513 | 641 | 770 | 898 | 1026 | 1155 |
| 1287 | 129 | 257 | 386 | 515 | 643 | 772 | 901 | 1030 | 1158 |
| 1291 | 129 | 258 | 387 | 516 | 645 | 775 | 904 | 1033 | 1162 |
| 1295 | 129 | 259 | 388 | 518 | 647 | 777 | 906 | 1036 | 1165 |
| 1299 | 130 | 260 | 389 | 520 | 649 | 779 | 909 | 1039 | 1169 |
| 1303 | 130 | 261 | 391 | 521 | 651 | 782 | 912 | 1042 | 1173 |
| 1307 | 131 | 261 | 392 | 523 | 653 | 784 | 915 | 1046 | 1176 |
| 1311 | 131 | 262 | 393 | 524 | 655 | 787 | 918 | 1049 | 1180 |
| 1315 | 131 | 263 | 394 | 526 | 657 | 789 | 920 | 1052 | 1183 |
| 1319 | 132 | 264 | 396 | 528 | 659 | 791 | 923 | 1055 | 1187 |
| 1323 | 132 | 265 | 397 | 529 | 661 | 794 | 926 | 1058 | 1191 |
| 1327 | 133 | 265 | 398 | 531 | 663 | 796 | 929 | 1062 | 1194 |
| 1331 | 133 | 266 | 399 | 532 | 665 | 799 | 932 | 1065 | 1198 |
| 1335 | 133 | 267 | 400 | 534 | 667 | 801 | 934 | 1068 | 1201 |
| 1339 | 134 | 268 | 402 | 536 | 669 | 803 | 937 | 1071 | 1205 |
| 1343 | 134 | 269 | 403 | 537 | 671 | 806 | 940 | 1074 | 1209 |
| 1347 | 135 | 269 | 404 | 539 | 673 | 808 | 943 | 1078 | 1212 |
| 1351 | 135 | 270 | 405 | 540 | 675 | 811 | 946 | 1081 | 1216 |
| 1355 | 135 | 271 | 406 | 542 | 677 | 813 | 948 | 1084 | 1219 |
| 1359 | 136 | 272 | 408 | 544 | 679 | 815 | 951 | 1087 | 1223 |
| 1363 | 136 | 273 | 409 | 545 | 681 | 818 | 954 | 1090 | 1227 |
| 1367 | 137 | 273 | 410 | 547 | 683 | 820 | 957 | 1094 | 1230 |
| 1371 | 137 | 274 | 411 | 548 | 685 | 823 | 960 | 1097 | 1234 |
| 1375 | 137 | 275 | 412 | 550 | 687 | 825 | 962 | 1100 | 1237 |
| 1379 | 138 | 276 | 414 | 552 | 689 | 827 | 965 | 1103 | 1241 |
| 1383 | 138 | 277 | 415 | 553 | 691 | 830 | 968 | 1106 | 1245 |
| 1387 | 139 | 277 | 416 | 555 | 693 | 832 | 971 | 1110 | 1248 |
| 1391 | 139 | 278 | 417 | 556 | 695 | 835 | 974 | 1113 | 1252 |
| 1395 | 140 | 279 | 418 | 558 | 697 | 837 | 976 | 1116 | 1255 |
| 1399 | 140 | 280 | 420 | 559 | 699 | 839 | 979 | 1119 | 1259 |
| 1403 | 140 | 281 | 421 | 561 | 701 | 842 | 982 | 1122 | 1263 |
| 1407 | 141 | 281 | 422 | 563 | 703 | 844 | 985 | 1126 | 1266 |
| 1411 | 141 | 282 | 423 | 564 | 705 | 847 | 988 | 1129 | 1270 |
| 1415 | 141 | 283 | 424 | 566 | 707 | 849 | 990 | 1132 | 1273 |
| 1420 | 142 | 284 | 426 | 568 | 710 | 852 | 994 | 1136 | 1278 |
| 1425 | 142 | 285 | 427 | 570 | 712 | 855 | 997 | 1140 | 1282 |
| 1430 | 143 | 286 | 429 | 572 | 715 | 858 | 1001 | 1144 | 1287 |
| 1435 | 143 | 287 | 430 | 574 | 717 | 861 | 1004 | 1148 | 1291 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
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| 1445 | 144 | 289 | 433 | 578 | 722 | 867 | 1011 | 1156 | 1300 |
| 1450 | 145 | 290 | 435 | 580 | 725 | 870 | 1015 | 1160 | 1305 |
| 1455 | 145 | 291 | 436 | 582 | 727 | 873 | 1018 | 1164 | 1309 |
| 1460 | 146 | 292 | 438 | 584 | 730 | 876 | 1022 | 1168 | 1314 |
| 1455 | 146 | 293 | 439 | 586 | 732 | 879 | 1025 | 1172 | 1318 |
| 1470 | 147 | 294 | 441 | 588 | 735 | 882 | 1029 | 1176 | 1323 |
| 1475 | 147 | 295 | 442 | 590 | 737 | 885 | 1032 | 1180 | 1327 |
| 1480 | 148 | 296 | 444 | 592 | 740 | 888 | 1036 | 1184 | 1332 |
| 1485 | 148 | 297 | 445 | 594 | 742 | 891 | 1039 | 1188 | 1336 |
| 1490 | 149 | 298 | 447 | 596 | 745 | 894 | 1043 | 1192 | 1341 |
| 1495 | 149 | 299 | 448 | 598 | 747 | 897 | 1046 | 1196 | 1345 |
| 1500 | 150 | 300 | 450 | 600 | 750 | 900 | 1050 | 1200 | 1350 |
| 1505 | 150 | 301 | 451 | 602 | 752 | 903 | 1053 | 1204 | 1354 |
| 1510 | 151 | 302 | 453 | 604 | 755 | 906 | 1057 | 1208 | 1359 |
| 1515 | 151 | 303 | 454 | 606 | 757 | 909 | 1060 | 1212 | 1363 |
| 1520 | 152 | 304 | 456 | 608 | 760 | 912 | 1064 | 1216 | 1368 |
| 1525 | 152 | 305 | 457 | 610 | 762 | 915 | 1067 | 1220 | 1372 |
| 1530 | 153 | 306 | 459 | 612 | 765 | 918 | 1071 | 1224 | 1377 |
| 1535 | 153 | 307 | 460 | 614 | 767 | 921 | 1074 | 1228 | 1381 |
| 1540 | 154 | 308 | 462 | 616 | 770 | 924 | 1078 | 1232 | 1386 |
| 1545 | 154 | 309 | 463 | 618 | 772 | 927 | 1081 | 1236 | 1390 |
| 1550 | 155 | 310 | 465 | 620 | 775 | 930 | 1085 | 1240 | 1395 |
| 1555 | 155 | 311 | 466 | 622 | 777 | 933 | 1088 | 1244 | 1399 |
| 1560 | 156 | 312 | 468 | 624 | 780 | 936 | 1092 | 1248 | 1404 |
| 1565 | 156 | 313 | 469 | 626 | 782 | 939 | 1095 | 1252 | 1408 |
| 1570 | 157 | 314 | 471 | 628 | 785 | 942 | 1099 | 1256 | 1413 |
| 1575 | 157 | 315 | 472 | 630 | 787 | 945 | 1102 | 1260 | 1417 |
| 1580 | 158 | 316 | 474 | 632 | 790 | 948 | 1106 | 1264 | 1422 |
| 1585 | 158 | 317 | 475 | 634 | 792 | 949 | 1109 | 1268 | 1426 |
| 1590 | 159 | 318 | 477 | 636 | 795 | 954 | 1113 | 1272 | 1431 |
| 1595 | 159 | 319 | 478 | 638 | 797 | 957 | 1116 | 1276 | 1435 |
| 1600 | 160 | 320 | 480 | 640 | 800 | 960 | 1120 | 1280 | 1440 |
| 1605 | 160 | 321 | 481 | 642 | 802 | 963 | 1123 | 1284 | 1444 |
| 1610 | 161 | 322 | 483 | 644 | 805 | 966 | 1127 | 1288 | 1449 |
| 1615 | 161 | 323 | 484 | 646 | 807 | 969 | 1130 | 1292 | 1453 |
| 1620 | 162 | 324 | 486 | 648 | 810 | 972 | 1134 | 1296 | 1458 |
| 1625 | 162 | 325 | 487 | 650 | 812 | 975 | 1137 | 1300 | 1462 |
| 1630 | 163 | 326 | 489 | 652 | 815 | 978 | 1141 | 1304 | 1467 |
| 1635 | 163 | 327 | 490 | 654 | 817 | 981 | 1144 | 1308 | 1471 |
| 1640 | 164 | 328 | 492 | 656 | 820 | 984 | 1148 | 1312 | 1476 |
| 1645 | 164 | 329 | 493 | 658 | 822 | 987 | 1151 | 1316 | 1480 |
| 1650 | 165 | 330 | 495 | 660 | 825 | 990 | 1155 | 1320 | 1485 |
| 1655 | 165 | 331 | 496 | 662 | 827 | 993 | 1158 | 1324 | 1489 |
| 1660 | 166 | 332 | 498 | 664 | 830 | 996 | 1162 | 1328 | 1494 |
| 1665 | 166 | 333 | 499 | 666 | 832 | 999 | 1165 | 1332 | 1498 |
| 1670 | 167 | 334 | 501 | 668 | 835 | 1002 | 1169 | 1336 | 1503 |
| 1675 | 167 | 335 | 502 | 670 | 837 | 1005 | 1172 | 1340 | 1507 |
| 1680 | 168 | 336 | 504 | 672 | 840 | 1008 | 1176 | 1344 | 1512 |
| 1685 | 168 | 337 | 505 | 674 | 842 | 1011 | 1179 | 1348 | 1516 |
| 1690 | 169 | 338 | 507 | 676 | 845 | 1014 | 1183 | 1352 | 1521 |
| 1695 | 169 | 339 | 508 | 678 | 847 | 1017 | 1186 | 1356 | 1525 |
| 1700 | 170 | 340 | 510 | 680 | 850 | 1020 | 1190 | 1360 | 1530 |
| 1705 | 170 | 341 | 511 | 682 | 852 | 1023 | 1193 | 1364 | 1534 |
| 1710 | 171 | 342 | 513 | 684 | 855 | 1025 | 1197 | 1368 | 1539 |
| 1715 | 171 | 343 | 514 | 686 | 857 | 1029 | 1200 | 1372 | 1543 |
| 1720 | 172 | 344 | 516 | 688 | 860 | 1032 | 1204 | 1376 | 1548 |
| 1725 | 172 | 345 | 517 | 690 | 862 | 1035 | 1207 | 1380 | 1552 |
| 1730 | 173 | 346 | 519 | 692 | 865 | 1038 | 1211 | 1384 | 1557 |
| 1735 | 173 | 347 | 520 | 694 | 867 | 1041 | 1214 | 1388 | 1561 |
| 1740 | 174 | 348 | 522 | 696 | 870 | 1044 | 1218 | 1392 | 1566 |
| 1745 | 174 | 349 | 523 | 698 | 872 | 1047 | 1221 | 1396 | 1570 |
| 1750 | 175 | 350 | 525 | 700 | 875 | 1050 | 1225 | 1400 | 1575 |
| 1755 | 175 | 351 | 526 | 702 | 877 | 1053 | 1228 | 1404 | 1579 |
| 1760 | 176 | 352 | 528 | 704 | 880 | 1056 | 1232 | 1408 | 1584 |
| 1765 | 176 | 353 | 529 | 706 | 882 | 1059 | 1235 | 1412 | 1588 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1770 | 177 | 354 | 531 | 708 | 885 | 1062 | 1239 | 1416 | 1593 |
| 1775 | 177 | 355 | 532 | 710 | 887 | 1065 | 1242 | 1420 | 1597 |
| 1780 | 178 | 356 | 534 | 712 | 890 | 1068 | 1246 | 1424 | 1602 |
| 1785 | 178 | 357 | 555 | 714 | 892 | 1071 | 1249 | 1428 | 1606 |
| 1790 | 179 | 358 | 537 | 716 | 895 | 1074 | 1253 | 1432 | 1611 |
| 1795 | 179 | 359 | 548 | 718 | 897 | 1077 | 1256 | 1436 | 1615 |
| 1800 | 180 | 360 | 540 | 720 | 900 | 1080 | 1260 | 1440 | 1620 |
| 1805 | 180 | 361 | 541 | 722 | 902 | 1083 | 1253 | 1444 | 1624 |
| 1810 | 181 | 362 | 543 | 724 | 905 | 1086 | 1267 | 1448 | 1629 |
| 1815 | 181 | 363 | 544 | 726 | 907 | 1089 | 1270 | 1452 | 1633 |
| 1820 | 182 | 364 | 546 | 728 | 910 | 1092 | 1274 | 1456 | 1638 |
| 1825 | 182 | 365 | 547 | 730 | 912 | 1095 | 1277 | 1460 | 1642 |
| 1830 | 183 | 366 | 549 | 732 | 915 | 1098 | 1281 | 1464 | 1647 |
| 1835 | 183 | 367 | 550 | 734 | 917 | 1101 | 1284 | 1468 | 1651 |
| 1840 | 184 | 368 | 552 | 736 | 920 | 1104 | 1288 | 1472 | 1656 |
| 1845 | 184 | 369 | 553 | 738 | 922 | 1107 | 1291 | 1476 | 1660 |
| 1850 | 185 | 370 | 555 | 740 | 925 | 1110 | 1295 | 1480 | 1665 |
| 1855 | 185 | 371 | 556 | 742 | 927 | 1113 | 1298 | 1484 | 1669 |
| 1860 | 186 | 372 | 558 | 744 | 930 | 1116 | 1302 | 1488 | 1674 |
| 1865 | 186 | 373 | 559 | 746 | 932 | 1119 | 1305 | 1492 | 1678 |
| 1870 | 187 | 374 | 561 | 748 | 935 | 1122 | 1309 | 1496 | 1683 |
| 1875 | 187 | 375 | 562 | 750 | 937 | 1125 | 1312 | 1500 | 1687 |
| 1880 | 188 | 376 | 564 | 752 | 940 | 1128 | 1316 | 1504 | 1692 |
| 1885 | 188 | 377 | 565 | 754 | 942 | 1131 | 1319 | 1508 | 1696 |
| 1890 | 189 | 378 | 567 | 756 | 945 | 1134 | 1323 | 1512 | 1701 |
| 1895 | 189 | 379 | 568 | 758 | 947 | 1137 | 1326 | 1516 | 1705 |
| 1900 | 190 | 380 | 570 | 760 | 950 | 1140 | 1330 | 1520 | 1710 |
| 1905 | 190 | 381 | 571 | 762 | 952 | 1143 | 1333 | 1524 | 1714 |
| 1910 | 191 | 382 | 573 | 764 | 955 | 1146 | 1337 | 1528 | 1719 |
| 1915 | 191 | 383 | 574 | 766 | 957 | 1149 | 1340 | 1532 | 1723 |
| 1920 | 192 | 384 | 576 | 768 | 960 | 1152 | 1344 | 1536 | 1728 |
| 1925 | 192 | 385 | 577 | 770 | 962 | 1155 | 1347 | 1540 | 1732 |
| 1930 | 193 | 386 | 579 | 772 | 965 | 1158 | 1351 | 1544 | 1737 |
| 1935 | 193 | 387 | 580 | 774 | 967 | 1161 | 1354 | 1548 | 1741 |
| 1940 | 194 | 388 | 582 | 776 | 970 | 1164 | 1358 | 1552 | 1746 |
| 1945 | 194 | 389 | 583 | 778 | 972 | 1167 | 1361 | 1556 | 1750 |
| 1950 | 195 | 390 | 585 | 780 | 975 | 1170 | 1365 | 1560 | 1755 |
| 1955 | 195 | 391 | 586 | 782 | 977 | 1173 | 1368 | 1564 | 1759 |
| 1960 | 196 | 392 | 588 | 784 | 980 | 1176 | 1372 | 1568 | 1764 |
| 1965 | 196 | 393 | 589 | 786 | 982 | 1179 | 1375 | 1572 | 1768 |
| 1970 | 197 | 394 | 591 | 788 | 985 | 1182 | 1379 | 1576 | 1773 |
| 1975 | 197 | 395 | 592 | 790 | 987 | 1185 | 1382 | 1580 | 1777 |
| 1980 | 198 | 396 | 594 | 792 | 990 | 1188 | 1386 | 1584 | 1782 |
| 1985 | 198 | 397 | 595 | 794 | 992 | 1191 | 1389 | 1588 | 1786 |
| 1990 | 199 | 398 | 597 | 796 | 995 | 1194 | 1393 | 1592 | 1791 |
| 1995 | 199 | 399 | 598 | 798 | 997 | 1197 | 1396 | 1596 | 1795 |
| 2000 | 200 | 400 | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 |
| 2010 | 201 | 402 | 603 | 804 | 1005 | 1206 | 1407 | 1608 | 1809 |
| 2020 | 202 | 404 | 606 | 808 | 1010 | 1212 | 1414 | 1616 | 1818 |
| 2030 | 203 | 406 | 609 | 812 | 1015 | 1218 | 1421 | 1624 | 1827 |
| 2040 | 204 | 408 | 612 | 816 | 1020 | 1224 | 1428 | 1632 | 1836 |
| 2050 | 205 | 410 | 615 | 820 | 1025 | 1230 | 1435 | 1640 | 1845 |
| 2060 | 206 | 412 | 618 | 824 | 1030 | 1236 | 1442 | 1648 | 1854 |
| 2070 | 207 | 414 | 621 | 828 | 1035 | 1242 | 1449 | 1656 | 1863 |
| 2080 | 208 | 416 | 625 | 832 | 1040 | 1248 | 1456 | 1664 | 1872 |
| 2090 | 209 | 418 | 627 | 836 | 1045 | 1254 | 1463 | 1672 | 1881 |
| 2100 | 210 | 420 | 630 | 840 | 1050 | 1260 | 1470 | 1680 | 1890 |
| 2110 | 211 | 422 | 633 | 844 | 1055 | 1266 | 1477 | 1688 | 1899 |
| 2120 | 212 | 424 | 636 | 848 | 1060 | 1272 | 1484 | 1696 | 1908 |
| 2130 | 213 | 426 | 639 | 852 | 1065 | 1278 | 1491 | 1704 | 1917 |
| 2140 | 214 | 428 | 642 | 856 | 1070 | 1284 | 1498 | 1712 | 1926 |
| 2150 | 215 | 430 | 645 | 860 | 1075 | 1290 | 1505 | 1720 | 1935 |
| 2160 | 216 | 432 | 648 | 864 | 1080 | 1295 | 1512 | 1728 | 1944 |
| 2170 | 217 | 434 | 651 | 868 | 1085 | 1302 | 1519 | 1736 | 1953 |
| 2180 | 218 | 436 | 654 | 872 | 1090 | 1308 | 1526 | 1744 | 1962 |
| 2190 | 219 | 438 | 657 | 876 | 1095 | 1314 | 1533 | 1752 | 1971 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
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| 2220 | 222 | 444 | 666 | 888 | 1110 | 1332 | 1554 | 1776 | 1998 |
| 2230 | 223 | 446 | 669 | 893 | 1115 | 1338 | 1561 | 1784 | 2007 |
| 2240 | 224 | 448 | 672 | 896 | 1120 | 1344 | 1568 | 1792 | 2016 |
| 2250 | 225 | 450 | 675 | 900 | 1125 | 1350 | 1575 | 1800 | 2025 |
| 2260 | 226 | 452 | 678 | 904 | 1130 | 1356 | 1582 | 1808 | 2034 |
| 2270 | 227 | 454 | 681 | 908 | 1135 | 1362 | 1589 | 1816 | 2043 |
| 2280 | 228 | 456 | 684 | 912 | 1140 | 1368 | 1596 | 1824 | 2052 |
| 2290 | 229 | 458 | 687 | 916 | 1145 | 1374 | 1603 | 1832 | 2061 |
| 2300 | 230 | 460 | 690 | 920 | 1150 | 1380 | 1610 | 1840 | 2070 |
| 2310 | 231 | 462 | 693 | 924 | 1155 | 1386 | 1617 | 1848 | 2079 |
| 2320 | 232 | 464 | 696 | 928 | 1160 | 1392 | 1624 | 1856 | 2088 |
| 2330 | 233 | 466 | 699 | 932 | 1165 | 1398 | 1631 | 1864 | 2097 |
| 2340 | 234 | 468 | 702 | 936 | 1170 | 1404 | 1638 | 1872 | 2106 |
| 2350 | 235 | 470 | 705 | 940 | 1175 | 1410 | 1645 | 1880 | 2115 |
| 2360 | 236 | 472 | 708 | 944 | 1180 | 1416 | 1652 | 1888 | 2124 |
| 2370 | 237 | 474 | 711 | 948 | 1185 | 1422 | 1659 | 1896 | 2133 |
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| 2390 | 239 | 478 | 717 | 956 | 1195 | 1434 | 1673 | 1912 | 2151 |
| 2400 | 240 | 480 | 720 | 960 | 1200 | 1440 | 1680 | 1920 | 2160 |
| 2410 | 241 | 482 | 723 | 964 | 1205 | 1446 | 1687 | 1928 | 2169 |
| 2420 | 242 | 484 | 726 | 968 | 1210 | 1452 | 1694 | 1936 | 2178 |
| 2430 | 243 | 486 | 729 | 972 | 1215 | 1458 | 1701 | 1944 | 2187 |
| 2440 | 244 | 488 | 732 | 976 | 1220 | 1464 | 1708 | 1952 | 2196 |
| 2450 | 245 | 490 | 735 | 980 | 1225 | 1470 | 1715 | 1960 | 2205 |
| 2460 | 246 | 492 | 738 | 984 | 1230 | 1476 | 1722 | 1968 | 2214 |
| 2470 | 247 | 494 | 741 | 988 | 1235 | 1482 | 1729 | 1976 | 2223 |
| 2480 | 248 | 496 | 744 | 992 | 1240 | 1488 | 1736 | 1984 | 2232 |
| 2490 | 249 | 498 | 747 | 996 | 1245 | 1494 | 1743 | 1992 | 2241 |
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| 2510 | 251 | 502 | 753 | 1004 | 1255 | 1506 | 1757 | 2008 | 2259 |
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| 2530 | 253 | 506 | 759 | 1012 | 1265 | 1518 | 1771 | 2024 | 2277 |
| 2540 | 254 | 508 | 762 | 1016 | 1270 | 1524 | 1778 | 2032 | 2286 |
| 2550 | 255 | 510 | 765 | 1020 | 1275 | 1530 | 1785 | 2040 | 2295 |
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| 2570 | 257 | 514 | 771 | 1028 | 1285 | 1542 | 1799 | 2056 | 2313 |
| 2580 | 258 | 516 | 774 | 1032 | 1290 | 1548 | 1806 | 2064 | 2322 |
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| 2600 | 260 | 520 | 780 | 1040 | 1300 | 1560 | 1820 | 2080 | 2340 |
| 2610 | 261 | 522 | 783 | 1044 | 1305 | 1566 | 1827 | 2088 | 2349 |
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| 2640 | 264 | 528 | 792 | 1056 | 1320 | 1584 | 1848 | 2112 | 2376 |
| 2650 | 265 | 530 | 795 | 1060 | 1325 | 1590 | 1855 | 2120 | 2385 |
| 2660 | 266 | 532 | 798 | 1064 | 1330 | 1596 | 1862 | 2128 | 2394 |
| 2670 | 267 | 534 | 801 | 1068 | 1335 | 1602 | 1869 | 2136 | 2403 |
| 2680 | 268 | 536 | 804 | 1072 | 1340 | 1608 | 1876 | 2144 | 2412 |
| 2690 | 269 | 538 | 807 | 1076 | 1345 | 1614 | 1883 | 2152 | 2421 |
| 2700 | 270 | 540 | 810 | 1080 | 1350 | 1620 | 1890 | 2160 | 2430 |
| 2710 | 271 | 542 | 813 | 1084 | 1355 | 1626 | 1897 | 2168 | 2439 |
| 2720 | 272 | 544 | 816 | 1088 | 1360 | 1632 | 1904 | 2176 | 2448 |
| 2730 | 273 | 546 | 819 | 1094 | 1365 | 1638 | 1911 | 2184 | 2457 |
| 2740 | 274 | 548 | 822 | 1096 | 1370 | 1644 | 1928 | 2102 | 2466 |
| 2750 | 275 | 550 | 825 | 1100 | 1375 | 1650 | 1935 | 2200 | 2475 |
| 2760 | 276 | 552 | 828 | 1104 | 1380 | 1656 | 1942 | 2208 | 2484 |
| 2770 | 277 | 554 | 831 | 1108 | 1385 | 1662 | 1949 | 2216 | 2493 |
| 2780 | 278 | 556 | 834 | 1112 | 1390 | 1668 | 1956 | 2224 | 2502 |
| 2790 | 279 | 558 | 837 | 1116 | 1395 | 1674 | 1963 | 2232 | 2511 |
| 2800 | 280 | 560 | 840 | 1120 | 1400 | 1680 | 1970 | 2240 | 2520 |
| 2810 | 281 | 562 | 843 | 1124 | 1405 | 1686 | 1977 | 2248 | 2529 |
| 2820 | 282 | 564 | 846 | 1128 | 1410 | 1692 | 1984 | 2256 | 2538 |
| 2830 | 283 | 566 | 849 | 1132 | 1415 | 1698 | 1991 | 2264 | 2547 |
| 2840 | 284 | 568 | 852 | 1136 | 1420 | 1704 | 1998 | 2272 | 2556 |
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| 2870 | | 287 | 574 | 861 | 1148 | 1435 | 1722 | 2019 | 2296 | 2583 |
| 2880 | | 288 | 576 | 864 | 1152 | 1440 | 1728 | 2026 | 2304 | 2592 |
| 2890 | | 289 | 578 | 867 | 1156 | 1445 | 1734 | 2033 | 2312 | 2601 |
| 2900 | | 290 | 580 | 870 | 1160 | 1450 | 1740 | 2040 | 2320 | 2610 |
| 2910 | | 291 | 582 | 873 | 1164 | 1455 | 1746 | 2047 | 2328 | 2619 |
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| 2930 | | 293 | 586 | 879 | 1172 | 1465 | 1758 | 2061 | 2344 | 2637 |
| 2940 | | 294 | 588 | 882 | 1176 | 1470 | 1764 | 2068 | 2352 | 2646 |
| 2950 | | 295 | 590 | 885 | 1180 | 1475 | 1770 | 2075 | 2360 | 2655 |
| 2960 | | 296 | 592 | 888 | 1184 | 1480 | 1776 | 2072 | 2368 | 2664 |
| 2970 | | 297 | 594 | 891 | 1188 | 1485 | 1782 | 2079 | 2376 | 2673 |
| 2980 | | 298 | 596 | 894 | 1192 | 1490 | 1788 | 2086 | 2384 | 2682 |
| 2990 | | 299 | 598 | 897 | 1196 | 1495 | 1794 | 2093 | 2392 | 2691 |
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| 3010 | | 301 | 602 | 903 | 1204 | 1505 | 1806 | 2107 | 2408 | 2709 |
| 3020 | | 302 | 604 | 906 | 1208 | 1510 | 1812 | 2114 | 2416 | 2718 |
| 3030 | | 303 | 606 | 909 | 1212 | 1515 | 1818 | 2121 | 2424 | 2727 |
| 3040 | | 304 | 608 | 912 | 1216 | 1520 | 1824 | 2128 | 2432 | 2736 |
| 3050 | | 305 | 610 | 915 | 1220 | 1525 | 1830 | 2135 | 2440 | 2745 |
| 3060 | | 306 | 612 | 918 | 1224 | 1530 | 1836 | 2142 | 2448 | 2754 |
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| 3080 | | 308 | 616 | 924 | 1232 | 1540 | 1848 | 2156 | 2464 | 2772 |
| 3090 | | 309 | 618 | 927 | 1236 | 1545 | 1854 | 2163 | 2472 | 2781 |
| 3100 | | 310 | 620 | 930 | 1240 | 1550 | 1860 | 2170 | 2480 | 2790 |
| 3110 | | 311 | 622 | 933 | 1244 | 1555 | 1866 | 2177 | 2488 | 2799 |
| 3120 | | 312 | 624 | 936 | 1248 | 1560 | 1872 | 2184 | 2496 | 2808 |
| 3130 | | 313 | 626 | 939 | 1252 | 1565 | 1878 | 2191 | 2504 | 2817 |
| 3140 | | 314 | 628 | 942 | 1256 | 1570 | 1884 | 2198 | 2512 | 2826 |
| 3150 | | 315 | 630 | 945 | 1260 | 1575 | 1890 | 2205 | 2520 | 2835 |
| 3160 | | 316 | 632 | 948 | 1264 | 1580 | 1896 | 2212 | 2528 | 2844 |
| 3170 | | 317 | 634 | 951 | 1268 | 1585 | 1902 | 2219 | 2536 | 2853 |
| 3180 | | 318 | 636 | 954 | 1272 | 1590 | 1908 | 2226 | 2544 | 2862 |
| 3190 | | 319 | 638 | 957 | 1276 | 1595 | 1914 | 2233 | 2552 | 2871 |
| 3200 | | 320 | 640 | 960 | 1280 | 1600 | 1920 | 2240 | 2560 | 2880 |
| 3210 | | 321 | 642 | 963 | 1284 | 1605 | 1926 | 2247 | 2568 | 2889 |
| 3220 | | 322 | 644 | 966 | 1288 | 1610 | 1932 | 2254 | 2576 | 2898 |
| 3230 | | 323 | 646 | 969 | 1292 | 1615 | 1938 | 2261 | 2584 | 2907 |
| 3240 | | 324 | 648 | 972 | 1296 | 1620 | 1944 | 2268 | 2592 | 2916 |
| 3250 | | 325 | 650 | 975 | 1300 | 1625 | 1950 | 2275 | 2600 | 2925 |
| 3260 | | 326 | 652 | 978 | 1304 | 1630 | 1956 | 2282 | 2608 | 2934 |
| 3270 | | 327 | 654 | 981 | 1308 | 1635 | 1962 | 2289 | 2616 | 2943 |
| 3280 | | 328 | 656 | 984 | 1312 | 1640 | 1968 | 2296 | 2624 | 2952 |
| 3290 | | 329 | 658 | 987 | 1316 | 1645 | 1974 | 2303 | 2632 | 2961 |
| 3300 | | 330 | 660 | 990 | 1320 | 1650 | 1980 | 2310 | 2640 | 2970 |
| 3310 | | 331 | 662 | 993 | 1324 | 1655 | 1986 | 2316 | 2648 | 2979 |
| 3320 | | 332 | 664 | 996 | 1328 | 1660 | 1992 | 2324 | 2656 | 2988 |
| 3330 | | 333 | 666 | 999 | 1332 | 1665 | 1998 | 2331 | 2664 | 2997 |
| 3340 | | 334 | 668 | 1002 | 1336 | 1670 | 2004 | 2338 | 2672 | 3006 |
| 3350 | | 335 | 670 | 1005 | 1340 | 1675 | 2010 | 2345 | 2680 | 3015 |
| 3360 | | 336 | 672 | 1008 | 1344 | 1680 | 2016 | 2352 | 2688 | 3024 |
| 3370 | | 337 | 674 | 1011 | 1348 | 1685 | 2022 | 2359 | 2696 | 3033 |
| 3380 | | 338 | 676 | 1014 | 1352 | 1690 | 2028 | 2366 | 2704 | 3042 |
| 3390 | | 339 | 678 | 1017 | 1356 | 1695 | 2034 | 2373 | 2712 | 3051 |
| 3400 | | 340 | 680 | 1020 | 1360 | 1700 | 2040 | 2380 | 2720 | 3060 |
| 3410 | | 341 | 682 | 1023 | 1364 | 1705 | 2046 | 2387 | 2728 | 3069 |
| 3420 | | 342 | 684 | 1026 | 1368 | 1710 | 2052 | 2394 | 2736 | 3078 |
| 3430 | | 343 | 686 | 1029 | 1372 | 1715 | 2058 | 2401 | 2744 | 3087 |
| 3440 | | 344 | 688 | 1032 | 1376 | 1720 | 2064 | 2408 | 2752 | 3096 |
| 3450 | | 345 | 690 | 1035 | 1380 | 1725 | 2070 | 2415 | 2760 | 3105 |
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| Diff. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
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| 3530 | | 353 | 706 | 1059 | 1412 | 1765 | 2118 | 2471 | 2824 | 3177 |
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| 3560 | | 356 | 712 | 1068 | 1424 | 1780 | 2136 | 2492 | 2848 | 3204 |
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| 3590 | | 359 | 718 | 1077 | 1436 | 1795 | 2154 | 2513 | 2872 | 3231 |
| 3600 | | 360 | 720 | 1080 | 1440 | 1800 | 2160 | 2520 | 2880 | 3240 |
| 3610 | | 361 | 722 | 1083 | 1444 | 1805 | 2166 | 2527 | 2888 | 3249 |
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| 3710 | | 371 | 742 | 1113 | 1484 | 1855 | 2226 | 2597 | 2968 | 3339 |
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| 3730 | | 373 | 746 | 1119 | 1492 | 1865 | 2238 | 2611 | 2984 | 3357 |
| 3740 | | 374 | 748 | 1122 | 1496 | 1870 | 2244 | 2618 | 2992 | 3366 |
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| 3760 | | 376 | 752 | 1128 | 1504 | 1880 | 2256 | 2632 | 3008 | 3384 |
| 3770 | | 377 | 754 | 1131 | 1508 | 1885 | 2262 | 2639 | 3016 | 3393 |
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| 3850 | | 385 | 770 | 1155 | 1540 | 1925 | 2310 | 2695 | 3080 | 3465 |
| 3860 | | 386 | 772 | 1158 | 1544 | 1930 | 2316 | 2702 | 3088 | 3474 |
| 3870 | | 387 | 774 | 1161 | 1548 | 1935 | 2322 | 2709 | 3096 | 3483 |
| 3880 | | 388 | 776 | 1164 | 1552 | 1940 | 2328 | 2716 | 3104 | 3492 |
| 3890 | | 389 | 778 | 1167 | 1556 | 1945 | 2334 | 2723 | 3112 | 3501 |
| 3900 | | 390 | 780 | 1170 | 1560 | 1950 | 2340 | 2730 | 3120 | 3510 |
| 3910 | | 391 | 782 | 1173 | 1564 | 1955 | 2346 | 2737 | 3128 | 3519 |
| 3920 | | 392 | 784 | 1176 | 1568 | 1960 | 2352 | 2744 | 3136 | 3528 |
| 3930 | | 393 | 786 | 1179 | 1572 | 1965 | 2358 | 2751 | 3144 | 3537 |
| 3940 | | 394 | 788 | 1182 | 1576 | 1970 | 2364 | 2758 | 3152 | 3546 |
| 3950 | | 395 | 790 | 1185 | 1580 | 1975 | 2370 | 2765 | 3160 | 3555 |
| 3960 | | 396 | 792 | 1188 | 1584 | 1980 | 2376 | 2772 | 3168 | 3564 |
| 3970 | | 397 | 794 | 1191 | 1588 | 1995 | 2382 | 2779 | 3176 | 3573 |
| 3980 | | 398 | 796 | 1194 | 1592 | 1990 | 2388 | 2786 | 3184 | 3582 |
| 3990 | | 399 | 798 | 1197 | 1596 | 1995 | 2394 | 2793 | 3192 | 3591 |
| 4000 | | 400 | 800 | 1200 | 1600 | 2000 | 2400 | 2800 | 3200 | 3600 |
| 4010 | | 401 | 802 | 1203 | 1604 | 2005 | 2406 | 2807 | 3208 | 3609 |
| 4020 | | 402 | 804 | 1206 | 1608 | 2010 | 2412 | 2814 | 3216 | 3618 |
| 4030 | | 403 | 806 | 1209 | 1612 | 2015 | 2418 | 2821 | 3224 | 3627 |
| 4040 | | 404 | 808 | 1212 | 1616 | 2020 | 2424 | 2828 | 3232 | 3636 |
| 4050 | | 405 | 810 | 1215 | 1620 | 2025 | 2430 | 2835 | 3240 | 3645 |
| 4060 | | 406 | 812 | 1218 | 1624 | 2030 | 2436 | 2842 | 3248 | 3654 |
| 4070 | | 407 | 814 | 1221 | 1628 | 2035 | 2442 | 2849 | 3256 | 3663 |
| 4080 | | 408 | 816 | 1224 | 1632 | 2040 | 2448 | 2856 | 3264 | 3672 |
| 4090 | | 409 | 818 | 1227 | 1636 | 2045 | 2454 | 2863 | 3272 | 3681 |
| 4100 | | 410 | 820 | 1230 | 1640 | 2050 | 2460 | 2870 | 3280 | 3690 |
| 4110 | | 411 | 822 | 1233 | 1644 | 2055 | 2466 | 2877 | 3288 | 3699 |
| 4120 | | 412 | 824 | 1236 | 1648 | 2060 | 2472 | 2884 | 3296 | 3708 |
| 4130 | | 413 | 826 | 1239 | 1652 | 2065 | 2478 | 2891 | 3304 | 3717 |
| 4140 | | 414 | 828 | 1242 | 1656 | 2070 | 2484 | 2898 | 3312 | 3726 |
| 4150 | | 415 | 830 | 1245 | 1660 | 2075 | 2490 | 2905 | 3320 | 3735 |
| 4160 | | 416 | 832 | 1248 | 1664 | 2080 | 2496 | 2912 | 3328 | 3744 |
| 4170 | | 417 | 834 | 1251 | 1658 | 2085 | 2502 | 2919 | 3336 | 3753 |

| Diff. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 4180 | 418 | 836 | 1254 | 1672 | 2090 | 2508 | 2926 | 3344 | 3762 |
| 4190 | 419 | 838 | 1257 | 1676 | 2095 | 2514 | 2933 | 3352 | 3771 |
| 4200 | 420 | 840 | 1260 | 1680 | 2100 | 2520 | 2940 | 3360 | 3780 |
| 4210 | 421 | 842 | 1263 | 1684 | 2105 | 2526 | 2947 | 3368 | 3789 |
| 4220 | 422 | 844 | 1266 | 1688 | 2110 | 2532 | 2954 | 3376 | 3798 |
| 4230 | 423 | 846 | 1269 | 1692 | 2115 | 2538 | 2961 | 3384 | 3807 |
| 4240 | 424 | 848 | 1272 | 1696 | 2120 | 2544 | 2968 | 3392 | 3816 |
| 4250 | 425 | 850 | 1275 | 1700 | 2125 | 2550 | 2975 | 3400 | 3825 |
| 4260 | 426 | 852 | 1278 | 1704 | 2130 | 2556 | 2982 | 3408 | 3834 |
| 4270 | 427 | 854 | 1281 | 1708 | 2135 | 2562 | 2989 | 3416 | 3843 |
| 4280 | 428 | 856 | 1284 | 1712 | 2140 | 2568 | 2996 | 3424 | 3852 |
| 4290 | 429 | 858 | 1287 | 1716 | 2145 | 2574 | 3003 | 3432 | 3861 |
| 4300 | 430 | 860 | 1290 | 1720 | 2150 | 2580 | 3010 | 3440 | 3870 |
| 4310 | 431 | 862 | 1293 | 1724 | 2155 | 2586 | 3017 | 3448 | 3879 |
| 4320 | 432 | 864 | 1296 | 1728 | 2160 | 2592 | 3024 | 3456 | 3888 |

*The End of the Table of* PROPORTIONAL PARTS.

AN

# ACCOUNT

OF THE

## Origine, Nature, Conſtruction, Uſes,

AND

## Application of the preceeding TABLES

OF

# LOGARITHMS.

THE Invention of the Logarithms is juſtly eſteemed one of the moſt uſeful Diſcoveries in the Art of Numbers, and accordingly has had an univerſal Reception and Applauſe. And the great Geometricians of this Age have not been wanting to cultivate this Subject, with all the Accuracy and Subtilty as a Matter of that Conſequence doth require; and they have demonſtrated ſeveral very admirable Properties of theſe Artificial Numbers, which have render'd their Conſtruction much more facile, than by thoſe operoſe Methods, at firſt uſed by their truly Noble Inventer, the Lord *Neper*; and our Worthy Country-Man Mr. *Briggs*.

But ſome Account however of the firſt Invention of theſe moſt uſeful Tables, 'tis proper to introduce here.

Logarithms (ſaith Dr. *Wallis* in his Algebra) were firſt of all invented, without any Example before him that I know of, by *John Neper*, Baron of *Merchiſton* in *Scotland*, and by him publiſhed at *Edinburgh*, A. D. 1614. and ſoon after by himſelf (with the Aſſiſtance of *Henry Briggs*, Profeſſor of Geometry, firſt at *London* in *Greſham*-College, and afterwards at *Oxford*) reduced to a better Form and perfected.

The Invention was greedily embraced (and deſervedly) by Learned Men.

Mr. *Briggs* upon the firſt Publication of it, was ſo pleaſed with it, that he preſently repaired into *Scotland*, to conſult the Author's Advice about it, and be aſſiſtant to him in the perfecting of it, and in calculating Tables for it; which was a Work of great Labour, as well as ſubtile Invention.

And it was embraced and promoted abroad by *Benjamin Urſinus*, *John Kepler*, *Adrian Vlacq*, *Petrus Cragerus*, and others.

And at home, by *Henry Gellibrand*, who perfected the *Trigonometria Britannica*, which Mr. *Briggs* began, but died before he had finiſhed it.

So that in a ſhort time it became generally known, and greedily embraced in all Parts, as of unſpeakable Advantage; eſpecially for Eaſe and Expedition in Trigonometrical Calculations.

In the former Volume I have briefly ſhewn the Nature and Conſtruction of Logarithms in general, which therefore I ſhall not repeat here; but go on with their Hiſtory, and the ſeveral Improvements which have been made in this Science, ſome of which are only barely hinted at there.

*A. D.* 1614. The Lord *Neper* publiſhed the firſt Tables of Canon, or Natural and Artificial Sines for each Degree and Minute of the Quadrant.

And whereas it was at his Choice to give to what Number he pleaſed the Logarithm 0, and whether to proceed by Way of Increaſe or Decreaſe, he choſe to make 0 the Logarithm of the whole Sine 10000000, that ſo the Multiplication or Diviſion by the whole Sine (frequent in Trigonometrical Calculation) might be diſpatched without Trouble, requiring here but the Addition or Subtraction of 0.

And becauſe the Uſe of leſſer Sines and Numbers leſs than the *Radius* or whole Sine, were likely to be of more frequent Uſe, than Tangents, Secants, and other Numbers greater than the *Radius*; he choſe to give to thoſe leſſer Numbers Affirmative Logarithms (increaſing the Logarithms from 0, as the Sines decreaſe) which he calls *Abundants*: And conſequently Negative Logarithms (which he calls *Defectives*) to greater Numbers. Deſigning thoſe by +, theſe by —.

And by this means he directs how the Table of Sines (with the Differences there inſerted) may ſerve alſo for a Table of Tangents, and of Secants; ſo that this Canon is a compleat Canon, of Natural Sines, and of Logarithmical Sines, Tangents, and Secants.

He ſhews alſo how this Table may be applied to the Logarithms of Abſolute Numbers; but becauſe with ſome Trouble, he reſerves the fuller Account hereof to a farther Treatiſe.

In the Year 1619, the Lord *Neper* being then dead, the ſame was again publiſhed by his Son *Robert Neper*; with ſome poſthumous Treatiſes of his Father concerning the Conſtruction of this Logarithmical Canon, and concerning his De-

ſign (after Communication had with Mr. *Briggs*) of changing the Form of his Logarithms, making 0, to be the Logarithm of 1, (of which he had before given Notice in the Preface to his *Rabdologia*, publiſhed in the Year 1617;) and concerning ſome things pertaining to Trigonometry; with ſome Lucubrations of Mr. *Briggs* on the ſame Subject.

But the Lord *Neper* being dead the whole Work was devolved on Mr. *Briggs*, who (according to their joint Advice) making the Logarithm of 1 to be 0; and of 10, 100, 1000, *&c.* to be 1, 2, 3, *&c.* which he calls *Indices*, or *Characteriſticks*, and which we may repute as Integer Numbers, with fourteen Cyphers annexed, and eſteem or value as ſo many Places, or Decimal Fractions, below the Place of Units, or of the Characteriſtick: And between theſe he ſets the intermediate Logarithm for the Intermediate Numbers.

And conſequently the Logarithm of 1 being 0, the Logarithm of Fractions leſs than 1, or of Numbers intermediate, between 1 and 0, muſt be Negative Numbers, or Numbers leſs than 0, which he calls Defective Logarithms, denoted by — (the Note of Negative) prefix'd.

Now theſe Defective Logarithms may be two ways expreſſed; either ſo as that the Note of Negation ſhall affect the whole Logarithm, or ſo as to affect only the Characteriſtick, (leaving the Reſt of the Logarithm to be underſtood as Affirmative.)

As for Example; The Fraction $\frac{3}{8}$, or (which is equivalent) 0.375. This Fraction ſuppoſeth the Numerator 3 to be divided by the Denominator 8, which in Logarithms, is to be performed by Subtracting the Logarithm of 8, from that of 3, and the Remainder will be the Logarithm of $\frac{3}{8}$, which will be then the Negative Number,—0.4259687.

| | |
|---|---|
| Log. 3. | 0. 4771213. |
| Log. 8. | 0. 9030900. |
| Log. $\frac{3}{8}$. | — 0. 4259687. |

Or thus; For as much as the Logarithm of 375, (ſuppoſing it to be an Integer Number) is 2. 5740313, And the depreſſing this to the Firſt, Second or Third, or farther Place of Decimal Fractions, doth (without altering the Figures) divide the Value by 10, 100, 1000, *&c.* which in Logarithms is done by ſubtracting 1, 2, 3, *&c.* from the Characteriſtick, or Place of Integers (1, 2, 3, *&c.* in that Place being the Logarithms of 10, 100, 1000, *&c.*) ſuch Alteration of the Value (the Figures remaining) is done by altering the Characteriſtick of the Logarithm, without varying the other Figures, in this Manner:

| | |
|---|---|
| Log. | 3750 = 3. 5740313 |
| Log. | 375 = 2. 5740313 |
| Log. | 37\|5 = 1. 5740313 |
| Log. | 3\|75 = 0. 5740313 |
| Log. | 0\|375 = 1. 5740313 |
| Log. | 0\|0375 = 2. 5740313 |

Which two Forms, tho' they ſeem different, and ſome may rather chuſe the one, ſome the other; or in ſome Caſes the one, and in ſome Caſes the other; yet they are in Subſtance and Value the ſame. For, by ſudducting the lower Number from the upper.

| | |
|---|---|
| | — 1. 0000000 |
| | + 0. 5740313 |
| is = | — 0. 4259687 |

And every one is left to his Liberty whether of the two Ways (or what other Equivalent thereunto) he ſhall pleaſe to uſe.

In this Method Mr. *Briggs* hath calculated a Table of Logarithms (publiſhed in the Year 1624) for 20 Chiliads of Abſolute Numbers (from 1 to 20,000;) and again for 10 more (from 90,000 to 100,000) and one Chiliad ſupernumerary (*viz.* the Hundred and Firſt Chiliad) that is, 31 Chiliads in all.

Before which is prefix'd a large Account of the Nature and Conſtruction of the Logarithmical Canon, and the Uſes thereof; and directing how to ſupply the intermediate Chiliads, which are here wanting. The whole intituled *Arithmetica Logarithmica.*

The ſame was again publiſhed in 1628, by *Adrian Vlacq* (or *Flack*) with a Supplement (as Mr. *Briggs* directed) of the Chiliads before omitted; that is, in all of 100 Chiliads, with one Supernumerary.

But in ſhorter Numbers extended but to 10 Places below that of the Integers, or Characteriſtick. And he ſubjoins alſo a Logarithmical Canon of Sines, Tangents, and Secants (for Degrees and Minutes of the Quadrant) of as many Places.

Mr. *Briggs* proceeded to calculate a Trigonometrical Canon, Logarithmical, ſuited to that for Abſolute Numbers to the Logarithms extending (as in that other) to 14 Places beſides the Characteriſtick. And having before calculated a Table of Natural Sines, Tangents, and Secants (for Degrees and Centeſms of Degrees) in Number extending to 15 Places, he fitted thereunto a Canon of Logarithmical Sines, and Tangents (becauſe thoſe of Secants might be ſpared;) and a Treatiſe prefixed concerning the Conſtruction thereof, with other Things pertinent thereunto; intending a further Treatiſe concerning the Uſe of it.

But dying before this laſt was finiſhed, or the reſt publiſhed, Mr. *Henry Gellibrand* ſupplied this latter, and publiſhed the whole with the Title of *Trigonometria Britannica*, in the Year 1633. To which is ſubjoin'd another Canon of Logarithmical Sines, and Tangents, by *Adrian Vlacq*, for Degrees, Minutes, and Tenth Seconds, extending (as his former did) to 10 Places beſides the Characteriſtick; and Mr. *Briggs* 20 Chiliads for Logarithms of Abſolute Numbers.

So that the whole Doctrine of Logarithms was by this time ſufficiently perfected, with convenient Canons or Tables fitted thereunto in large Numbers: Of which alſo *Petrus Cragerus* gives an Account in the Preface to his *Trigonometria Logarithmica*, Printed in the Year 1634, with his Logarithmical Tables, but in ſhort Numbers.

And the Table of Logarithms above-mentioned, (for 100 Chiliads of Abſolute Numbers, and of Sines and Tangents to Degrees and Centeſms) were the ſame Year (1633) contracted, into a leſſer Form and more manageable (but in ſhorter Numbers, the former not extending to above 7 Places,

Places, beſide the *Characteriſtick*, but the latter to 10) by *Nathanael Row*; with Directions for the Uſe of them (in *Trigonometry*, *Geometry*, *Aſtronomy*, *Geography*, and *Navigation*) by *Edmund Wingate*.

In the mean time, *Benjamin Urſinus*, did alſo publiſh Tables of Logarithms in the Year 1618; and *Claudius Batſchius* about the ſame Time, or ſoon after. And again *Benjamin Urſinus* in the Year 1625, in his *Trigonometria*; and *Johannes Keplerus* alſo in the Year 1624, in his *Chilias Logarithmorum* (which he applies alſo to his *Rudolphine* Tables, publiſhed in 1627;) and *Claudius Batſchius* about the ſame Time, or ſoon after: And *Georgius Ludovicus Frobenius* in the Year 1634, (and perhaps ſome others.)

But all or moſt of them in ſhort Numbers, and conformable to the Lord *Neper*'s firſt Deſign; not to that Form which upon ſecond Thoughts he and Mr. *Briggs* agreed upon as moſt *Eligible*, and which hath ſince been received in common Practice.

Thus far Dr. *Wallis*: What follows is the eaſie and compendious Method of Mr. *Edm. Halley*, Savilian Profeſſor of Geometry in *Oxon*, for conſtructing Logarithms; which was mentioned in the former Volume.

The Invention, ſaith that excellent Geometer, of the Logarithms, is juſtly eſteemed one of the moſt uſeful Diſcoveries in the Art of Numbers, and accordingly has had an univerſal Reception and Applauſe: And the great Geometricians of this Age have not been wanting to cultivate this Subject, with all the Accuracy and Subtilty which a Matter of that Conſequence doth require; and they have demonſtrated ſeveral very admirable Properties of theſe artificial Numbers, which have rendred their Conſtruction much more facile, than by thoſe operoſe Methods, at firſt uſed by their truly noble Inventor, the Lord *Neper*, and our worthy Country-man Mr. *Briggs*.

But notwithſtanding all their Endeavours, I find very few of thoſe, who make conſtant Uſe of Logarithms to have attained an *Adequate Notion of them*; to know how to *make* or *examine* them, or to underſtand the Extent of the *Uſe* of them; contenting themſelves with the Tables of them, as they find them, without daring to queſtion them, or caring to know how to *Rectify* them, ſhould they be found amiſs; being I ſuppoſe under the Apprehenſion of ſome great Difficulty therein.

For the Sake of ſuch, the following Tract is principally intended, but not without hopes however, to produce ſomething that may be acceptable to the moſt knowing in theſe Matters.

But firſt, it may be requiſite to premiſe a *Definition* of Logarithms, in order to render the enſuing Diſcourſe more clear; the rather becauſe the Old one *Numerorum proportionalium æqui-differentes comites*, ſeems too ſcanty to define them fully.

They may much more properly be ſaid to be *Numeri Rationum exponentes*: Wherein we conſider *Ratio* as a *Quantitas ſui generis*, beginning from the *Ratio* of Equality, or 1 to $1-0$; being *Affirmative* when the *Ratio* is *Increaſing*, as of Unity to a greater Number, but *Negative* when *Decreaſing*: And theſe *Ratios* we ſuppoſe to be meaſured by the Number of *Ratiunculæ* contained in each.

Now theſe *Ratiunculæ*, are ſo to be underſtood, as in a continual *Scale* of Proportions, infinite in Number between the two Terms of the *Ratio*; which infinite Number of mean Proportionals is to that infinite Number of the like equal *Ratiunculæ*, between any other two Terms :: as the Logarithm of one *Ratio*, is to the Logarithm of the other: Thus, if there be ſuppoſed between 1 and 10, an infinite Scale of mean Proportionals, whoſe Number is 100000, *&c.* in *infinitum*; between 1, and 2, there ſhall be 30102, *&c.* of ſuch Proportionals, and between 1 and 3, there will be 47712, *&c.* of them; which Numbers therefore are the Logarithms of the *Rationes* of 1, to 10, 1, to 2, and 1, to 3; and not ſo properly to be call'd the *Logarithms* of 10, 2, and 3.

But if inſtead of ſuppoſing the Logarithms compoſed of a Number of equal *Ratiunculæ*, proportional to each *Ratio*; we ſhall take the *Ratio* of Unity to any Number, to conſiſt always of the ſame infinite Number of *Ratiunculæ*; their *Magnitude* in this Caſe, will be as their *Number* in the former. Wherefore, if between Unity and any Number propoſed, there be taken an Infinity of mean Proportionals, the infinitely little *Augment* or *Decrement* of the firſt of thoſe Means from Unity will be a *Ratiunculæ*; that is, the *Momentum* or *Fluxion* of the *Ratio* of Unity to the ſaid Number: And ſeeing that in theſe continual Proportionals all the *Ratiunculæ* are equal; their Summ, or the whole *Ratio*, will be as the ſaid *Momentum* is directly; that is, the Logarithm of each *Ratio*, will be as the Fluxion thereof. Wherefore if the Root of any infinite Power be extracted out of any Number, the *Differentiola* of the ſaid Root from Unity, ſhall be as the Logarithm of that Number.

So that Logarithms thus produced may be of as many Forms as you pleaſe, to aſſume infinite Indices of the Power whoſe Root you ſeek: As if the Index be ſuppoſed 100000, *&c.* infinitely; the Roots ſhall be the Logarithms invented by the Lord *Neper*; but if the ſaid Index were 2302585, *&c.* Mr. *Briggs*'s Logarithms would immediately be produced. And if you pleaſe to ſtop at any Number of Figures, and not to continue them on, it will ſuffice to aſſume an Index of a Figure or two more, than your intended Logarithm is to have; as Mr. *Briggs* did, who, to have his Logarithms true to 14, places by continual Extraction of the Square Root, at laſt came to have the Root of the 140737488355328th Power; but how operoſe that Extraction was, will eaſily be judged by whoſo ſhall undertake to examine his *Calculus*.

Now though the Notion of an infinite Power may ſeem very *ſtrange*; and (to thoſe that know the Difficulty of the Extraction of the Roots of high Powers) perhaps *impracticable*; yet by the Help of that admirable Invention of Sir *Iſaac Newton*, whereby he determines the *Unciæ*, or Numbers prefixed to the Members compoſing Powers (on which chiefly depends the Doctrine of *Series*) the Infinity of the Index contributes to render the Expreſſion much more eaſie: For if the infinite Power to be reſolved be put (after Sir *Iſaac Newton*'s Method) $\overline{p+q}^{\frac{1}{m}}$ or $\overline{1+q}^{\frac{1}{m}}$, inſtead of $1 + \frac{1}{m}q + \frac{1-m}{2m^2}qq +$

$$\frac{1-3m+2mm}{6m^3}q^3+\frac{1-6m+11m^2-6m^3}{24m^4}q^4,\&c.$$

(which is the Root when $m$ is Finite) becomes

$$1+\frac{1}{m}q-\frac{1}{2m}q^2+\frac{1}{3m}q^3+\frac{1}{4m}q^4+\frac{1}{5m}q^5,\ \&c.$$

$m^2$, being *Infinite*, and consequently whatever is divided thereby vanishing. Hence it follows that $\frac{1}{m}$ Multiplied into $q-\frac{1}{2}q^2+\frac{1}{3}q^3-\frac{1}{4}q^4+\frac{1}{5}q^5$, &c. is the Augment of the First of our mean Proportionals between Unity and $1+q$, and is therefore the Logarithm of the *Ratio* of 1, to $1+q$; and whereas the Infinite Index $m$, may be taken at Pleasure; the several Scales of Logarithms to such Indices will be as $\frac{1}{m}$; or reciprocally as the *Indices*. And if the Index be taken 10000, &c. as in the Case of *Neper*'s Logarithms; they will be simple $q-\frac{1}{2}qq+\frac{1}{3}q^3-\frac{1}{4}q^4+\frac{1}{5}q^5-\frac{1}{6}q^6$, &c.

Again, if the Logarithm of a Decreasing *Ratio* be sought, the Infinite *Root* of $1-q$, or $\frac{1}{1-q|m}$, is $1-\frac{1}{m}q-\frac{1}{2m}q^2-\frac{1}{3m}q^3-\frac{1}{4m}q^4-\frac{1}{5m}q^5-\frac{1}{6m}q^6$ &c. whence the Decrement of the First of our infinite Number of Proportionals will be $\frac{1}{m}$ into $q+\frac{1}{2}q^2+\frac{1}{3}q^3+\frac{1}{4}q^4+\frac{1}{5}q^5+\frac{1}{6}q^6$, &c. which therefore will be as the Logarithm of the *Ratio* of Unity to $1-q$.

But if $m$, be put 10000, &c. then the said Logarithm will be $q+\frac{1}{2}q^2+\frac{1}{3}q^3+\frac{1}{4}q^4+\frac{1}{5}q^5+\frac{1}{6}q^6$, &c. Hence, the Terms of any *Ratio* being $a$ and $b$, $q$ becomes $\frac{b-a}{a}$, or the Difference divided by the lesser Term, when it's an *Increasing Ratio*; or $\frac{b-a}{b}$ when 'tis *Decreasing*, or as $b$ to $a$.

Whence the Logarithm of the same *Ratio* may be doubly expressed; for putting $x$, for the Difference of the Terms $a$, and $b$, it will be either $\frac{1}{m}\times\frac{x}{b}+\frac{x^2}{2b^2}+\frac{x^3}{3b^3}+\frac{x^4}{4b^4}+\frac{x^5}{5b^5}+\frac{x^6}{6b^6}$, &c. or $\frac{1}{m}\times\frac{x}{a}-\frac{x^2}{2a^2}+\frac{x^3}{3a^3}-\frac{x^4}{4a^4}+\frac{x^5}{5a^5}-\frac{x^6}{6a^6}$, &c.

But if the *Ratio* of $a$ to $b$, be supposed to be divided into two Parts, *viz.* into the *Ratio* of $a$, to the Arithmetical Mean between the Terms, and the *Ratio* of the said Arithmetical Mean to the other Term $b$; then will the Summ of the Logarithms of those two *Rationes* be the Logarithm of the *Ratio* of $a$ to $b$; and substituting $\frac{z}{2}$ instead of $\frac{a}{2}+\frac{b}{2}$, the said *Arithmetical Mean*, the *Logarithms* of those *Rationes* will be by the foregoing Rule;

$$\frac{1}{m}\text{ into }\frac{x}{z}+\frac{x^2}{2z^2}+\frac{x^3}{3z^3}+\frac{x^4}{4z^4}+\frac{x^5}{5z^5}+\frac{x^6}{6z^6},\ \&c.$$

and

$$\frac{1}{m}\text{ into }\frac{x}{z}-\frac{x^2}{2z^2}+\frac{x^3}{3z^3}-\frac{x^4}{4z^4}+\frac{x^5}{5z^5}-\frac{x^6}{6z^6},\ \&c.$$

the Sum whereof

$$\frac{1}{m}\text{ into }\frac{2x}{z}+\frac{2x^3}{3z^3}+\frac{2x^5}{5z^5}+\frac{2x^7}{7z^7},\ \&c.$$

will be the Logarithm of the *Ratio* of $a$ to $b$; whose Difference is $x$, and Summ $z$. And this *Series* converges twice as swift as the former, and therefore is more proper for the Practice of making of Logarithms: Which if performed, is with that Expedition; that whereas $x$, the Difference, is but the Hundredth-part of the Summ, the first Step $\frac{2x}{z}$ suffices to seven Places of the Logarithm, and the second Step to Twelve. But if *Briggs*'s first twenty Chiliads of Logarithms be supposed to be made, as he hath very carefully computed them, to fourteen Places; the first Step above is capable to give the Logarithm of any intermediate Number, true to all the Places of those Tables.

After the same Manner may the Difference of the said two Logarithms be very fitly applied to find the Log. of Prime Numbers, having the Logarithms of the two next Numbers above and below them: For the Difference of the *Ratio* of $a$, to $\frac{1}{2}z$, and, of $\frac{z}{2}$ to $b$, is the *Ratio* of $a$ $b$, to $\frac{z^2}{4}$; and half of that *Ratio* is that of $\surd\, a\ b$, to $\frac{z}{2}$; or of the Geometrical Mean to the Arithmetical. And consequently the Logarithm thereof will be the half Difference of the Logarithms of those *Rationes* viz.

$$\frac{1}{m}\text{ into }\frac{xx}{2zz}+\frac{x^4}{4z^4}+\frac{x^6}{6z^6}+\frac{x^8}{8z^8},\ \&c.$$

Which is a Theorem of good Dispatch to find the Logarithm of $\frac{z}{2}$.

But the same is yet much more advantageously performed, by a Rule derived from the foregoing; and

and beyond which in my Opinion, Nothing better can be hoped. For the *Ratio* of $a\,b$, to $\frac{z^2}{4}$, or $\frac{a^2}{4} + \frac{a\,b}{2} + \frac{b\,b}{4}$, has the Difference of its Terms, $\frac{a^2}{4} - \frac{a\,b}{2} + \frac{b\,b}{4}$, or the Square of $\frac{a}{2} - \frac{b}{2} = \frac{x^2}{4}$, which in the present Case of finding the Logarithms of Prime Numbers, is always *Unity*: and calling the Sum of the Terms $\frac{z^2}{4} + a\,b = y^2$, the Logarithm of the *Ratio* of $\sqrt{a\,b}$, to $\frac{a}{2} + \frac{b}{2}$, or $\frac{z}{2}$ will be found $\frac{1}{m}$ in $\frac{1}{yy} + \frac{1}{3y^6} + \frac{1}{5y^{10}} + \frac{1}{7y^{14}} + \frac{1}{9y^{18}}$, *&c.* Which converges very much faster than any Theorem hitherto published for this Purpose.

Here note, that $\frac{1}{m}$ is all along applied to adapt these Rules to all Sorts of Logarithms. If $m$ be 10000, *&c.* it may be neglected, and you will have *Neper*'s Logarithms, as was hinted before; but if you desire *Briggs*'s Logarithms, which are now generally received, you must divide your Series by

2.30258, 50929, 94045, 68401, 79914, 54684, 36420, 76011, 01488, 62877, 29760, 33328:

Or, multiply it by the *Reciprocal* thereof, *Viz.*

0.43429, 44819, 03251, 82765, 11289, 18916, 60508, 22943, 97005, 80366, 65661, 14454.

But to save so operose a Multiplication (which is more than all the rest of the Work) it's expedient to divide this Multiplicator by the Powers of $z$, or $y$, continually; according to the Direction of the *Theorem*; Especially where $x$ is Small and Integer, reserving the proper Quotes to be added together, when you have produced your Logarithm to as many Figures as you desire, of which Method I will give you a Specimen.

If the Curiosity of any Gentleman, that has Leisure, would prompt him to undertake to do the Logarithms of all Prime Numbers, under 100000 to 25 or 30 Figures, I dare assure him that the Facility of this Method will invite him thereto; nor can any Thing more easy be desired. And to encourage him, I here give the Logarithms of the first Prime Numbers under 20 to 60 Places, computed by the accurate Penn of Mr. *Abraham Sharp* (from whose Industry and Capacity) the World may expect in Time great Performances, as they were communicated to me by our common Friend Mr. *Euclid Speidall*.

| *N.* | *Log.* |
|---|---|
| 2 | 0.30102, 99956, 63981, 19521, 37388, 94724, 49302, 67681, 89881, 46210, 85413, 10427 |
| 3 | 0.47712, 12547, 19662, 43729, 50279, 03255, 11530, 92001, 28864, 19069, 58648, 29876 |
| 7 | 0.84509, 80400, 14256, 83071, 22162, 58592, 63619, 34835, 72396, 32396, 54065, 03635 |
| 11 | 1.04139, 26851, 58225, 04075, 01999, 71243, 02424, 17067, 02190, 46645, 30945, 96539 |
| 13 | 1.11394, 33523, 06836, 76920, 65051, 57942, 32843, 08297, 29188, 38706, 82718, 01191 |
| 17 | 1.23044, 89213, 78273, 92854, 01698, 94328, 33703, 00075, 67378, 42504, 63973, 80368 |
| 19 | 1.27875, 36009, 52828, 96153, 63334, 75756, 92931, 79511, 29337, 39449, 75989, 06819. |

The next Prime Number is 23, which I will take for an Example of the foregoing Doctrine; and by the first Rules the Logarithm of the *Ratio* of 22 to 23, will be found to be either

$$\frac{1}{22} - \frac{1}{968} + \frac{1}{31944} - \frac{1}{937024} + \frac{1}{25768160}, \text{ \&c.}$$

$$\text{or } \frac{1}{23} + \frac{1}{1058} + \frac{1}{36501} + \frac{1}{1119364} + \frac{1}{32181715}, \text{ \&c.}$$

As likewise that of the *Ratio* of 23 to 24, by a like Process.

$$\frac{1}{23} - \frac{1}{1058} + \frac{1}{36501} - \frac{1}{1119364} + \frac{1}{32181715}, \text{ \&c.}$$

$$\text{or } \frac{1}{24} + \frac{1}{1152} + \frac{1}{41472} + \frac{1}{1327104} + \frac{1}{39813120}, \text{ \&c.}$$

And this is the Result of the Doctrine of *Mercator*, as improved by the Learned Dr. *Wallis*.

But by the second Theorem, *viz.* $\frac{2x}{z} + \frac{2x^3}{3z^3} + \frac{2x^5}{5z^5}$, *&c.* The same Logarithms are obtained by fewer Steps; To wit.

$$\frac{2}{45} + \frac{2}{273375} + \frac{2}{922640625} + \frac{2}{2615686171875}, \text{ \&c.}$$

$$\& \frac{2}{47} + \frac{2}{311469} + \frac{2}{1146725035} + \frac{2}{3546361843241}; \text{ \&c.}$$

Which was invented and demonstrated in the *Hyperbolick Spaces* analogous to the Logarithms, by

by the Excellent Mr. *James Gregory*, in his *Exercitationes Geometricæ*; and since further prosecuted by the aforesaid Mr. *Speidall*, in a late Treatise, in English, by him published on this Subject. But the Demonstration, as I conceive, was never till now perfected, without the Consideration of the *Hyperbola*, which is a Matter purely Arithmetical, as this is, cannot so properly be applied. But what follows, I think I may justly claim as my own, *viz.* That the Logarithm of the *Ratio* of the Geometrical Mean to the Arithmetical between 22 and 24, or of $\sqrt{528}$ to 23, will be found to be either,

$$\frac{1}{1058} + \frac{1}{1119364} + \frac{1}{888215334} + \frac{1}{626487882248}, \text{ \&c. or, } \frac{1}{1057} +$$

$$\frac{1}{3542796579} + \frac{1}{659676558485285}, \text{ \&c.}$$

All these Series being to be multipled into 0.4342944819, *&c.* if you design to make the Logarithm of *Briggs*. But with great Advantage with Respect of the Work, the said 4342944819, *&c.* is divided by 1057, and the Quotient thereof again divided by three Times the Square of 1057, and that Quotient again by $\frac{4}{5}$ of that Square, and that Quotient by $\frac{7}{9}$ thereof, *&c.* 'till you have as many Figures of the Logarithm as you desire. As for Example, the Logarithm of the *Geometrical* Mean between 22 and 24, is found by the Logarithms of 2, 3, and 11 to be

1.3613169612669061294500917266980 5
4108746281014681434731588636 8
1225852154418182946007 4
658323518437617 5
4208829765
2930

1057) 43429, *&c.*
3 in 1117249) 41087, *&c.*
$\frac{5}{3}$ in 1117249) 12258, *&c.*
$\frac{7}{5}$ in 1117249) 65832, *&c.*
$\frac{9}{7}$ in 1117249) 42088, *&c.*

Summ 1.36172783601759287886777711225117

Which is the Logarithm of 23, to 32 Places, and obtained by five Divisions only, with very small Divisors; all which is much less Work, than simply multiplying the Series into the said Multiplicator 43429, *&c.*

Before I pass on to the Converse of this Problem, or to shew how to find the Number appertaining to a Logarithm assigned, it will be requisite to advertise the Reader, that there is a small Mistake in the aforesaid Mr. *James Gregory's Vera Quadratura Circuli*, and *Hyperbolæ*, published at *Padua*, *Anno* 1667, wherein he applies his *Quadrature* of the *Hyperbola*, to the making of the Logarithms: In *p.* 48. he gives the Computation of the Lord *Neper*'s Logarithm of 10. to 25 Places, and finds it 2302585092994045624017870, instead of 2302585092994045684017991; erring in the eighteenth Figure, as I was assured upon my own Examination of the Number I here give you, and by Comparison thereof, with the same wrought by another Hand, agreeing therewith to 5 7 of the 60 Places.

Being desirous to be satisfied how this Difference arose, I took no small Trouble of Examining Mr. *Gregory*'s Work; and at length found that in the inscribed Polygon of 512 Sides in the eighteenth Figure was a 0, instead of 9, which being rectified, and the subsequent Work corrected therefrom, the Result did agree to a Unit with our Number. And this I propose not to cavil at an easy Mistake in managing of so vast Numbers, especially by a Hand that has so well deserved of the Mathematical Sciences; but to shew the exact Co-incidence of two so very differing Methods to make Logarithms, which might otherwise have been questioned.

*From the Logarithm given to find what* Ratio *it expresses*, is a Problem, that has not been so much considered as the Former, but which is solved with the like Ease, and *Demonstrated* by a like Process, from the same general Theorem of Sir *Isaac Newton*: For as the Logarithm of the *Ratio* of 1, to $1 + q$, was proved to be $\overline{1+q|}^{\frac{1}{m}} - 1$, and that of the *Ratio* of 1, to $1 - q$, to be $1 - \overline{1-q|}^{\frac{1}{m}}$: So the Logarithm which we will from henceforth call L, being given $1 + L$, will be equal to $\overline{1+q|}^{\frac{1}{m}}$ in the one Case; and $1 - L$, will be equal to $\overline{1-q|}^{\frac{1}{m}}$, in the other: Consequently $\overline{1+L|}^{\frac{1}{m}}$ will be equal to $1 + q$, and $\overline{1-L|}^{\frac{1}{m}}$ to $1 - q$; that is, according to Sir *Isaac Newton*'s said Rule, $1 + mL + \frac{m^2}{2}L^2 + \frac{m^3}{6}L^3 + \frac{m^4}{24}L^4 + \frac{m^5}{120}L^5$, *&c.* will be equal to $1 + q$, and $1 - mL + \frac{m^2}{2}L^2 - \frac{m^3}{6}L^3 + \frac{m^4}{24}L^4 - \frac{m^5}{120}L^5$, *&c.* will be equal to $1 - q$: $m$, being any infinite Index whatsoever; which is a full and general Proposition from the Logarithm given to find the Number, be the Species of Logarithm what it will.

But

But if *Neper*'s Logarithm be given the Multiplication by $m$ is saved (which Multiplication is indeed no other than reducing the other Species to his) and the Series will be more simple, *Viz.*

$$1 + L + \frac{L^2}{2} + \frac{L^3}{6} + \frac{L^4}{24} + \frac{L^5}{120}, \&c. \text{ or}$$

$$1 - L + \frac{L^2}{2} + \frac{L^3}{6} + \frac{L^4}{24} + \frac{L^5}{120}, \&c.$$

This Series especially in great Numbers converges so slowly, that it were to be wished to be contracted.

If one Term of the *Ratio*, whereof L is the Logarithm, be given, the other Term will be had easily by the same Rule: For if L were *Neper*'s Logarithm of the *Ratio* of $a$ the lesser to $b$ the greater Term; $b$ would be the Product of $a$ into

$$1 + L + \frac{L^2}{2} + \frac{L^3}{6}, \&c. = a + aL + \frac{aL^2}{2} + \frac{aL^3}{6}, \&c.$$

But if $b$ were given, $a$ would be equal

$$b - bL + \frac{bL^2}{2} - \frac{bL^3}{6}, \&c.$$

Whence by the help of the Chiliads, the Number appertaining to any Logarithm, will be exactly had to the utmost Extent of the Tables. If you seek the nearest, next Logarithm, whether greater or lesser, and call its Number $a$, if lesser, or $b$ if greater; then the given $L$, and the Difference thereof from the said nearest Logarithm you call $l$; it will follow that the Logarithm L, answering to the Number, will be either $a$ into

$$1 + l + \frac{l^2}{2} + \frac{l^3}{6} + \frac{l^4}{24} + \frac{l^5}{120}, \&c.$$

or else $b$ into

$$1 - l + \frac{l^2}{2} - \frac{l^3}{6} + \frac{l^4}{24} - \frac{l^5}{120}, \&c.$$

wherein as $l$ is less, the Series will converge the swifter. And if the first 20000 Logarithms be given to fourteen Places, there is rarely Occasion for the three first Steps of this Series, to find the Number to as many Places. But as for *Vlacq*'s great Canon of 100000 Logarithms, which is made but to ten Places; there is scarce ever need for more than the first Step $a + al$, or $a + mal$, in one Case; or else $b - bl$, or $b - mbl$ in the other, to have the Number true, to as many Figures as these Logarithms consist of.

If future Industry shall ever produce Logarithmick Tables to many more Places than now we have; the aforesaid Theorems will be of more Use to deduce the correspondent natural Numbers to all the Places thereof.

In Order to make the first Chiliad to serve all Uses, I was desirous to contract this *Series*, wherein all the Powers of $l$ are present, into one; wherein each alternate Power might be wanting, but found it neither so simple or uniform as the other; yet the first Step thereof is, I conceive, most commodious for Practice, and with all exact enough for Numbers not exceeding fourteen Places, such as are Mr. *Briggs*'s large Tables of Logarithms; and therefore I recommend it to common Use.

It is thus; $a + \frac{al}{1 - \frac{l}{2}}$, or $b - \frac{bl}{1 + \frac{l}{2}}$, will be the Number answering to the Logarithm given, differing from the Truth by half the third Step of the former Series. But that which renders it yet more eligible, is that with equal Facility, it serves for *Briggs*'s, or any other sort of Logarithms, with the only Variation of Writing, $\frac{1}{m}$ instead of 1,

$$\text{that is } a + \frac{al}{\frac{1}{m} - \frac{l}{2}}, \text{ and } b - \frac{bl}{\frac{1}{m} + \frac{l}{2}}, \text{ or } \frac{\frac{1}{m}b - \frac{lb}{2}}{\frac{1}{m} + \frac{l}{2}},$$

which are easily resolved into Analogies, *Viz.*

As 43429, &c. $- \frac{l}{2}$ : to 43429 $+ \frac{l}{2}$ : : so is $a$ to the Number sought. Or,

As 43429, &c. $+ \frac{l}{2}$ : to 43429 $- \frac{l}{2}$ : : so is $b$ to the Number sought.

If more Steps of this Series be desired it will be found as follows.

$$a + \frac{al}{1 - \frac{l}{2}} - \frac{\frac{1}{1 \cdot 2} al^2}{1 - l} + \frac{\frac{1}{3 \cdot 3} al^3}{1 - 2l}, \&c.$$

As may easily be demonstrated by working out the Divisions in each Step, and collecting the Quotes, whose Summ will be found to agree with our former *Series*.

Thus, I hope, I have cleared up the Doctrine of Logarithms, and shewn their Construction and Use independent from the *Hyperbola*, whose Affections have hitherto been made Use of for this purpose; tho' this be a Matter purely Arithmetical, nor properly demonstrable from the Principles of Geometry; nor have I been obliged to have Recourse to the Method of Indivisibles, or the Arithmetick of Infinities; the whole being no other than an easy Corollary to Sir *Isaac Newton*'s General Theorem for forming Roots and Powers.

How easily and compendiously Logarithms may be made according to this Method of Mr. *Halley*'s, as also from the Quadrature of the *Hyperbola*; the Reader may be fully satisfy'd from Mr. *Hen. Sherwin*'s Introduction to his *Excellent Mathematical Tables*, Lond. 1705. where also is a Method for computing the natural Sine, Tangent, or Secant of any Arch, immediately from having only the Length of the Arch given, &c.

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*Some further Uses of the Logarithms not mentioned in* Vol. I.

1. To find the Arithmetical Complement of a Logarithm.

| | | |
|---|---|---|
| Suppose | 2.5065050 | Begin at the Left-hand & write down under it the Complement of each Figure to 9, but of the last to 10. |
| Its Compt. Arith. | 7.49349410 | |

*N. B.*

*N B.* This is all one with ſubducting the Logarithm from 10. 0000000. And 'tis frequently of good Uſe to take the Complement Arithmetical of a Logarithm inſtead of the Logarithm it ſelf; eſpecially when there are *Two* or more Logarithms in any Caſe to be ſubtracted: For then adding their Arithmetical Complements, will anſwer the End as truly as ſubtracting the Logarithms themſelves.

As ſuppoſe in the double Rule of Three, you had this Queſtion about Intereſt.

What is the Intereſt of 5173 *l.* for 321 Days at 6 *l. per Centum?*

| | | | |
|---|---|---|---|
| Write down firſt the *Arith. Comp.* of the Logarithm of | 100 | = | 8.0000000 |
| Next under it the *Arith. Comp.* of the Logarithm of | 365 | = | 7.4377071 |
| The Logarithm of | 6 | = | 0.7781512 |
| The Logarithm of the Principal | 5173 | = | 3.7137425 |
| The Logarithm of the Days | 321 | = | 2.5065050 |
| The Summ of all is the Anſwer | | = | 2.4361058 |

For rejecting the firſt 2 in the Characteriſtick you will find the Number anſwering to the Logarithm 2.4361058 to be 272 *l.* 964. and Reaſon will direct you where to make your Decimal Points in the Numder 272964; for the Intereſt in that Time can't be ſo much as 2729 *l.* nor ſo little as 27 *l.* As well as the Rule determines that Number to conſiſt of 3 Places of Integers, whoſe Characteriſtick is 2.

Therefore the remaining Figures .964 are a Decimal of a Pound, expreſſing ſomething more than 19 Shillings.

2. And indeed all Queſtions of Intereſt are very eaſily and expeditiouſly anſwered by the Logarithms.

As ſuppoſe; At 6 *l. per Cent.* what is the Intereſt of 15 *l.* 7 *s.* 6 *d.* for 12 Years?

| | | | |
|---|---|---|---|
| Write down firſt the Logarithm of 1.06 which expreſſes the Rate of Intereſt. | | = | 0.0253058 |
| Which Logarithm multiplied by 12 makes | | = | 0.3036696 |
| Then write down the Logarithm of the Principal, *Viz.* of the Decimal | 15.875 | = | 1.2007137 |
| The Summ of which Two laſt Logarithms added into one Summ | | = | 1.5043833 |
| which is a Logarithm anſwering to the abſolute Number, | | = | 31.94362 |

a Decimal expreſſing 31 *l.* 18 *s.* 10 *d.* ½ *q.* nearly.

3. It will be very neceſſary rightly to underſtand the Uſe of the Tables of Logarithms with regard to Decimal Fractions. For the Rule for finding the Logarithm of a Fraction being; *To ſubtract the Logarithm of the Denominator, from the Logarithm of the Numerator, and to take the Remainder as the Logarithm of the Fraction required:* That *Logarithm of the Remainder*, muſt always be the Logarithm of a *Decimal Fraction*, whoſe Value is the ſame with that of a *Vulgar Fraction* propoſed.

Wherefore the moſt natural, eaſy, and uſeful Way to find the Logarithm of a Fraction is this:

Suppoſe the Index of the Logarithms of all Numbers from 1 to 10, to be 10 or 100, from 10 to 100, to be 11 or 101, from 100 to 1000, to be 12 or 102, from 1000 to 10000, to be 13 or 103, and ſo upwards: This being allowed, the Index of the Logarithm of a Number, one Place below Unity muſt be 9, or 99; if two Places below Unity, it muſt be 8, or 98; if three Places below Unity, it muſt be 7, or 97; if four Places below Unity, then the Index muſt be 6, or 96; the *Latter of theſe Ways* is often convenient to diſtinguiſh the Index of a whole Number, from that of a *Decimal Fraction*, and often neceſſary when the Power of the Root of a *Decimal Fraction* is required.

| | | | |
|---|---|---|---|
| *Example*, The Logarithm of ¾ is found thus: | 3 Log. | | 0.4771213 |
| From which Subtract the Denominator, | 4 Log. | | 0.6020600 |
| The Remainder is the Logarithm of | .75 Log. | = | 9.8750613 |

*Note*, That the Denominator of a proper Fraction, is always greater than its Numerator; ſo that ſuppoſing the Index of the Logarithm of 3, to be 10, or 100, the Index of the Remainder will be 9, or 99, (that is one Place below Unity) and the Reſt of the Logarithms, except the Index, is found in the Table of Logarithms to anſwer to 75, 750, 7500, 075, 75, or any other Number, whoſe two ſignificant Figures are 75, and thoſe which follow or preceed, all Cyphers. It was the former of theſe Ways by which Mr. *Briggs* and Mr. *Gunter* made the Characteriſticks of their Tables of Logarithmetick Sines, and Tangents; where it may be noted, when the natural Sine or Tangent, is a *Decimal Fraction* only, the Index is under 10; but where it is a mixt Number,

ber, there the Index is 10, or more: For *Example*, The Natural Tangent of 5 Degrees is .0874887, the Artificial 8.9419518; and the Natural Tangent of 85 Degrees, 11.430052, the Artificial is 11.0580482.

But it is needleſs to uſe theſe new Indices, except ſome Term given or ſought, be leſs than an Unite.

4. *To find the Logarithm of a Mixt Number.*

Reduce the Number given into an Improper Fraction, then ſubtract the Logarithm of the Denominator, from the Logarithm of the Numerator, the Remainder is the Logarithm ſought.

*Example*, Let $4\frac{9}{12}$ be the Mixt Number given; this reduced to an Improper Fraction is $\frac{57}{12}$.

The Logarithm of the Numerator, *viz.* 57, is 1.7558748
The Logarithm of the Denominator, *viz.* 12, is 1.0791812

The Loarithm of $4\frac{9}{12}$, $= 4\frac{75}{100}$, whoſe Logarithm is 0.6766936

If the Fraction annexed be a Decimal, ſeek for it as if it were a whole Number, obſerving to prefix to its Logarithm a ſuitable Index; which always is an Unit leſs than the Number of Places, in the whole Number to which it belongs; which is further illuſtrated by the adjoyning Table, where the Logarithms, except the Index, are the ſame in theſe Eight *Examples*.

The Index of the Logarithm of 47500 is 4, becauſe the Abſolute Number conſiſts of 5 Places, for the ſame Reaſon in 475, the Index of its Logarithm is 2, in 47.5 it is 1; but the Index of a Proper Decimal Fraction is ſo many Units as the Cyphers before it wants of 9, or 99; ſo the Index of .0475 is 8, or 98, and of .00475 is 7, or 97.

| *Numbers.* | | *Logarithms.* |
|---|---|---|
| 47500 | 4. | 6766936 |
| 4750 | 3. | 6766936 |
| 475 | 2. | 6766936 |
| 47.5 | 1. | 6766936 |
| 4.75 | 0. | 6766936 |
| .475 | 99, or, | 9.6766936 |
| .0475 | 98, or, | 8.6766936 |
| .00475 | 97, or, | 7.6766936 |

*Of raiſing Powers by Logarithms.*

*Multiply the Logarithm of the Number given by the Index of the Power required, the Product will be the Logarithm of the Power ſought*: So the Logarithm of $32 = 1.5051500 \times 3 = 45154500$, the Logarithm of 32768, which is the *Cube* of 32.

In the Multiplication, or Raiſing of Powers, *viz.* Squaring, or Cubing, *&c.* of any Decimal Fraction by Logarithms; the Index of the Logarithm of the Product or Power, muſt conſiſt of ſo many Units, as the Number of Cyphers intercepted between the Place of Units, and the firſt ſignificant Figure in the natural Number wants of 9, 99, 999, *&c.* only to the Index of the Logarithm of the Power (*i. e.* the *Square*, or *Cube*, *&c.*) there will be ſuch a Figure prefix'd as wants an Unit of the Index of that Power, or Number, by which the Logarithm was multiplied: For

*Example*, Let the Cube of .009 be required; the Logarithm of .009 is $7.9542425 \times 3 = 23.8627275 = .000000729$, the Cube of .009, and the Index of the Logarithm of the Power, or Product is 3; therefore 6 Cyphers muſt preceed the firſt ſignificant Figure of the natural Number; and 2, is prefix'd ſince the Index or Number multiplying was 3. But when the Number of Cyphers, preceeding the ſignificant Figures of the Power or Product exceeds 10, 'tis neceſſary to admit another Figure into the Index of the Logarithm, and make it the Complement to a Hundred: As ſuppoſe the 6 Power, or the

*Cubo*— Cube of the Sine of $0^{\circ}\,0'\,1''$ be requir'd its Logarithm in the Table is 6.4637261; but in this Caſe muſt be 96.4637261, which multiplied by 6, the Index of the Power propoſed, becomes 578.7823566, whoſe Index being 78, ſubtracted from 99, leaves 21 for the Number of Cyphers, that muſt preceed the firſt Figure of the natural Number or Power, which is .000000000000000000006058383. Here the Figures preceeding the Index, as the Reſult of the Multiplication is 5, leſs by an Unit than the Number multiplying, being 6, the Index of the Power.

This ſuggeſts a certain *Rule for Extracting the Roots of Fractions by the Logarithms*; *Viz.* Prefix a Figure to the Index of the Logarithm of the Number whoſe Root is to be Extracted, leſs by an Unit than the Index proper to the Root required, which is to be the Diviſor; then Divide the whole Logarithm together with its Index and Number prefixed by that Index, the Quotient is the Logarithm of the Root deſired. *Ex. Gr.* If the *Cubo*—Cube Root or Root of the 6. Power of .000000000000000000006058383, whoſe Logarithm is 78.7823566, be demanded; prefix 6—1, *i. e.* 5 to its Index, it is then 578.7823566; which being divided by 6, the Index proper to the Root ſought, the Quotient is 96.4637261, whoſe natural Number is .0002908882; 3 Cyphers preceeding the firſt Figure, becauſe the Index 96, wants ſo much of 99. But when the Root of an abſolute Number is required, there needs no Figure to be prefixed to the Index of its Logarithm; ſince it is always ſuppoſed, that the Index of the Power (which muſt be the Diviſor) preceeds it. *Ex. Gr.* If the Cube-Root of 6751269, whoſe Logarithm is 6.82993854, be required; it is an indif-

indifferent Thing, whether 3, the Index of the Root to be Extracted, be prefixed or not, since that alters Nothing: For 3)36. 82993854( Quotes 12. 2764618, the Logarithm of 189, the Cube-Root sought.

### *Another Method to Raise any Powor of a Decimal Fraction.*

Multiply the Arithmetick Complement of the Logarithm of the Fraction given by the Index of the Power required, the Arithmetick Complement of the Product is the Logarithm of the Power sought: For instance the .625 Power of .0032 is found to be .0275879.

| | |
|---|---|
| .0032 Logarithm | 7. 5051500 |
| Arithmetick Complement | 2. 4948500 |
| Multiply by | .625 |
| | 124742500 |
| | 49897000 |
| | 149691000 |
| Product | 15592812500 |
| Its Arithmetick Complement | 8.4407187500 |

Note, That so many Cyphers must the Logatithm of .0275879, preceed the Fraction as the Index of its Logarithm wants Units of 9, or 99, which in this Example is *one*, and in the next 15, being always the same Number with the Index of the Product.

Again, Let the 6. 25 Power of .0032 be sought: The Logarithm of .0032 (as before) is 7. 5051500, and its Arithmetick Complement 2. 4948500 × 6. 25 = 15. 5928125, its Arithmetick Complement is 84. 4071875, which answers to .00000, 00000, 00000, 25538, which is the 6. 25 Power of .0032.

### *To extract any Root of a Decimal Fraction.*

Divide the Arithmetical Complement of the Logarithm of the Fraction given, by the Index of the Root required, the Arithmetical Complement of the Root sought: For instance, let the .625 Root of .0275879 be required, its Logarithm is 8. 4407188, and its Arithmetical Complement = 1.5592812 Divided by .625, the Quotient is 2. 4948500, and its Arithmetick Complement is 7. 5051500 the Logarithm of .0032, which is the Root required.

Again, Let the 6. 25 Root of .00000, 00000, 00000, 25538 be required, its Logarithm is 84. 4071875, and its Arithmetick Complement is 15. 5928125, Divided by 6. 25, the Quotient is 2. 4948500, and its Arithmetick Complement is 7. 5051500, the Logarithm of .0032 the Root required.

LOGISTICA *Linea*, is that which is otherwise called the *Logarithmick Line*; where the Ordinates apply'd in equal Parts of the Axis are in Geometrical Proportion.

LOGISTICK *Spiral*. See *Logarithmick Spiral*.

LONGITUDE *of a Place*, is only the Distance counted in the Equator between *its* Meridian, and the *first*; or indeed between that and any other: It may be found by the Difference of Time between the coming of any Point in the Heavens first to one Meridian and then to the other. For every 15°. of the Equator answering to an Hour in Time, one Degree of it being 4 Minutes of Time, and one Minute of a Degree there being 4 Seconds of Time; and 15 Minutes one Minute of Time. The Difference of Time being turned into Degrees will truly give the *Longitude*, or *Vice Verso*. Hence several Ways have been thought of to find the Longitude at Sea; the great *Desideratum* of the Art of Navigation. As by the *Eclipse* of the Moon, her *Transit* over or *Appulse* to any eminent fix'd Star; the Eclipses of *Jupiter's Satellites*, &c. which are all true in Theory, and may be practised a-shore with the greatest Exactness. For the Time of any one of these *Phænomena* being truly calculated for the Meridian of *London* (suppose, or any other:) And Tables may be easily made of all of them, which the Navigator may carry to Sea with him. If then he could but observe the Time of the Eclipse or Transit at Sea with accurate Exactness, the Difference of Time of the Eclipse happening to him sooner or later than at *London*, would give him the exact Longitude of the Place of the Ship either East or West from the Meridian of *London*. But the Misfortune is, such an Observation of an Eclipse, and the exact Time of the Impression or Emersion of the deficient Body into or out of the Shadow, is not to be made without Telescopes of such a Length as the Motion of the Ship will not permit to be used at Sea. Tho', by the by, if Ships were sent with good Instruments and Men that know how to use them, to do this at all the Capes and Head-lands of the World, it would be a Thing of the greatest Use; and by settling the Longitude of all those Places, would cut all long Voyages into many short ones, and afford means of continually rectifying the dead Reckoning at Sea. But to return: Others being fully satisfied of the Impracticableness of the Method of Eclipses for finding the Longitude at Sea; have happily thought of doing it by a Clock or Watch: Which if indeed it could be made to go right all the Time of a long Voyage, would infallibly give the Longitude at any Time when the true Hour of the Day or Night could be had under any Meridian or in any Place of the Earth: For the Clock going true for the Meridian it was first set at, will shew the true Hour exactly in that Place, and then the true Hour being found by the Sun or Stars in the Place where the Ship is, the Difference between that and the Clock's Hour, will be the Difference of Meridians in Time, or Longitude in Degrees. But no such Movement hath ever yet been made, and I fear scarce ever will, which will keep going, and going true in all Climates, and especially in some of the *Southern* ones, where the Dews are so great as to rust the Parts of it, and so retard, if not stop its Motion entirely, I don't mention the Inconvenience arising from the Motion of the Ship, because I believe that may be obviated, and a Movement made to go true notwithstanding that, as perhaps the World may see in some Time, there being now some very ingenious and skilful Heads and Hands employing themselves that Way. But in the mean while, I judge the best Way would be to depend on the Movement only for 24 Hours; for if it will go true for so long by the Motion of the fix'd Stars, it may be rectify'd every Day to the Stars or Sun's Hour; and so will shew the Difference of Longitude the Ship hath gained in that Time. How the Seamen find their *Departure of Longitude* by Trigonometrical Calculation, you will find in *Plain and Mercators Sailing*.

LOOP, in the Iron Works at the Forge; is the Term for about ¾ of C. lb. of Iron which is melted and broken off from a Sow in the Fire of the *Finery*, and at last is brought into a *Bloom*. This Work they call *Shingling the Loop*.

LOOP-HOLES, are Holes made in the Comings of the Hatches of Ships, and in their Bulkheads, to fire Muskets thro' in a close Fight; and the same are they in the covert Defences of all Fortifications.

LOPHIA, a Term in Anatomy, for the upper Part of the *Cervix*, or back Part of a Humane Neck.

LOQUELA *sine die*, was formerly the Term for an Inparlance or a Respite in Law; or for a Demur to an Indefinite Time.

LOT, or *Lothe*, is every thirteenth Dish of Lead in the *Derby-shire* Mine, which is a Duty paid to the King.

LOURGULARY, is a Word in *Statuto pro Stratis Lond.* printed *A. D.* 1573. *Art.* 43. and then signified, casting any corrupt Thing into it, to spoil or poyson the Water.

LUCRATIVE *Interest*, in the Civil Law, is such as is paid where there hath been no Advantage made by the Debtor, and no Delay nor Deceit in him. This is condemned by both the Civil and Canon Law.

LUNDRESS, did formerly signify a Silver Penny; or a *Sterling* or *Easterling* in a restrained Sense, and was so called, because coined only at *London* and not at the Country Mints.

LUNE or *Lunula*. In *Phil. Trans. N.* 265. you have a Way to find the Dimensions of the Solids, which will be formed by the Revolution of the *Lunes* of *Hippocrates* of *Scio*, by Mr. *Abr. de Moivre*.

LUNGS. These Organs of Respiration are seated in the middle of the Cavity of the *Thorax*; and divided into two *Lobes* by the *Mediastinum*, of which, the *left* is ordinarily subdivided into 2 more. The Figure of both *Lobes* together resemble the Foot of an Ox or Cow, being a little concave between the 2 *Lobes*, where they embrace the Heart; and behind, where they lie upon the *Vertebræ*: But before, where they touch the *Sternum* and *Ribs*, they are Convex.

The Colour of the Lungs in a *Fœtus* is of a pale Red; but after the Air hath once entred into them they lose their Red, and remain always pale; yet in adult Persons, they are often variegated with the one and the other.

They are tied to the *Sternum* by the *Mediastinum* before, and to the *Vertebræ* by the *Pluræ* behind, when it rises from the *Vertebræ* to the Heart, by the *Vena* and *Arteria Pulmonaris*; and some-

times to the *Pleura*, where it covers the Ribs, particularly in the left Side, and eſpecially after a Pleuriſy.

The *Lobes* of the *Lungs* are covered with a double Membrane; of which the *External* is a Production of the *Pleura*: and the *Internal*, not only covers immediately the Subſtance of the Lungs, but its inner *Lumina* fill up the Interſtices which are below the Bunches of the ſmall *Lobes* with little veſicular Cells: The fine Capillary Blood-Veſſels are ſo thick upon this Membrane, that it ſeems to be Nothing but a Net-work of Veins and Arteries.

The Subſtance of the *Lungs* is compoſed of an infinite Number of little *Lobes* of various Figures and Magnitudes; but their Surfaces are ſo adapted to one another, as to leave but very few, and thoſe ſmall Interſtices.

Theſe Lobes are diſpoſed like ſo many Bunches of Grapes upon the Sides of the *Bronchia*. Each little *Lobe* contains within its own proper Membrane an infinite Number of little orbicular Veſſels, which leave ſmall Interſtices between them; and which are full of ſmall Membranes, like thoſe which tie the Lobes together.

The Extremities of the Branches of the Wind-pipe open into the Cavities of Veſicles, which are probably formed by its Membranes; but the Capillary Blood-veſſels are only ſpread upon the Veſicles like a Net, with frequent and large Inoſculations.

The Veſſels which enter the Lungs are the *Trachæa* or *Aſpera Arteria*, by which we draw in and expire Air: And the *Arteria Pulmonalis*, which comes from the *Right Ventricle*, and the *Vena Pulmonalis*, whoſe Trunk opens into the *left Auricle* of the Heart: Each of theſe divides into two Branches, for the two great Lobes of the Lungs, where they are ſubdivided into as many Branches as there are little Lobes or Veſicles in the Lungs. Where-ever there is a Branch of the *Trachæa*, there is alſo a Branch of the Vein and Artery, and the *Trachæa* is always in the middle.

On the Branches of the *Trachæa* (which they call the *Bronchi* or *Bronchia*) runs a ſmall Artery called by *Ruyſh*, *Arteria Bronchialis*, and a ſmall Vein, which *Somnichellius* calls *Vena Pneumonica*: The Artery comes from the *Aorta*, the Vein from the *Subclavian*.

The Blood in the *Arteria Pulmonalis* being of the Nature of Venal Blood, and all Secretion being performed in the Arteries, the Nouriſhment for the Lungs muſt be brought by the *Arteria Bronchialis*: And there is the ſame Contrivance for the Nouriſhment of the Liver.

Upon the *Bronchia*, even to their minuteſt Ramifications, run likewiſe the fine Thread of the eight Pair of Nerves.

Beſides theſe, the Lungs have alſo *Lymphaticks*; which diſcharge themſelves into the *Thoracick Duct*; but they are ſmaller, and make more frequent Inoſculations, almoſt than any other.

This is the Paſſage of the Veſſels thro' the Lungs; but becauſe the *Trachæa* hath a particular Structure, it demands a particular Examination.

The *Trachæa* then, or *Aſpera Arteria*, is a Canal ſituated in the firſt part of the Neck, before the *Oeſophagus*; its upper End is called *Larynx*, from whence it deſcends to the 4th *Vertebra* of the Back, where it divides and enters the Lungs; this Canal is made of Annular Cartilages, at ſmall and equal Diſtances from one another: And theſe grow ſmaller ſtill as they approach the Lungs; and thoſe of the *Bronchi* are ſo cloſe to one another, that in Expiration, the ſecond enters with the firſt, and the third with the ſecond, and ſo the following always enters into the preceeding.

Betwixt the *Larynx* and the *Lungs*, theſe Cartilages make not compleat Rings; but their hinder Part, which is contiguous to the *Oeſophagus*, is membranous, that they may the better contract, dilate, and give Way to the Aliments, as they go down the *Oeſophagus*. But the Cartilages of the *Bronchi* are compleatly Annular; yet their Capillary Branches have no Cartilages; but inſtead of them ſmall circular Ligaments which are at pretty large Diſtances from one another. The uſe of the Cartilages is to keep the Paſſage for the Air always open; but in the Capillary *Bronchi*, they would hinder the ſubſiding of the Veſſels.

Theſe Cartilages are tied together by two Membranes, the one *External* the other *Internal*. The External is compoſed of circular Fibres, and covers the whole *Trachæa* externally, The Internal is of exquiſite Senſe, and it covers the Cartilages internally. It is compoſed of three diſtinct Membranes: The firſt is woven of two Orders of Fibres; thoſe of the firſt of which are *Longitudinal*, for the ſhortning of the *Trachæa*, and theſe make the Cartilages approach to and enter one another. The other Order is of Circular Fibres, for the contracting the Cartilages. When theſe two Orders of Fibres act, they help, with the External Membrane, in Expiration, in Coughing, and in altering the Tone and Notes of our Voice.

The ſecond Membrane is altogether Glandulous, and the Excretory Veſſels of thoſe Glands open into the Cavity of the *Trachæa*, in order to moiſten its Cavity by a Liquor which they ſeparate; and to defend it from the Acrimony of the Air.

The third and laſt Membrane is a Net-work of Veins, Arteries and Nerves: The Veins are Branches of the *Cava*; the Arteries of the *Carotides*; and the Nerves of the *Reeurrent*.

From the Structure of the Lungs thus deſcribed, Dr, *Pitcairn* hath deduced Mechanically the great effect, they by means of the Air produce upon the Blood. For while the *Fœtus* is in the Womb, the Veſicles of the Lungs lying flat one upon another, compreſs all the Capillary Blood-veſſels which are ſpread upon them; but as ſoon as it is *born* and alive, the Air ruſhes into the empty Branches of the *Trachæa*, and blows up the Veſicles into their Spherical Figures; by which Means, the Preſſure or Compreſſion being taken off from the Blood-veſſels, and they equally expanded with the Lungs, all the Blood hath a free Paſſage thro' the Pulmonary Artery. But when the Air is thruſt out again by the Contraction of the Cavity of the Thorax, it being a fluid Body, compreſſes the Veſicles and Blood-veſſels upon them every where equally. By which Compreſſion the red Globules of the Blood, which thro' their lanquid Motion in the Veins, were grown too dry to circulate in the fine Capillary Veſſels, are broken and divided again in the Serum, and the Blood made fit for Nutrition and Secretion.

This Preſſure of the Air upon the Blood-veſſels, Dr. *Keill* ſaith, he hath demonſtrated to be equal to 100 lb. weight; and in Coughing or Crying, it may exceed 400 lb.

But tho' these are the necessary Consequents of Respiration, yet several Experimens incline him to think, that some Particles of the Air must likewise enter the Blood-vessels, and mix with the Blood in the Lungs.

For, *first*, he saith he is assured, from repeated Experiments, that Air will escape the Pores of any Number of Bladders, when compressed only by the Weight of the Water, into which it is sunk; and therefore the Pressure of 100 lb. Weight in ordinary Respiration, must thrust some Particles of it into the Blood-vessels.

2. The Honourable Mr. *Boyle*, in his *New Pneumatical Experiments*, shews us, That Animals cannot live when shut up in common Air, tho' by a Gauge he hath found it to retain its wonted Pressure; and tho' the Receiver hath been immersed in Water cooled with a Solution of *Sal Armoniac*. The same Experiments assure us, That Animals will live longer when shut up in compress'd Air than in common Air, and that when they are dying in the common Air, they may be revived by pressing in more fresh Air.

3. It may be demonstrated, (saith the same Dr. *Keill*) That the Difference between the Gravity of the Air in the City, and that of the Country, (which can be but very small, upon the Account of the *Effluvia*, as the *Barometer* shews it to be) can never be the Cause of that Difficulty of Breathing, which some have in the one and not in the other; for they are not near so sensible of the different Gravities of the Air in the same Place, as they are of a much smaller Difference in two distinct and remote Places, where the Contents of the Air are different.

The Lungs are composed of an infinite Number of little *Lobes*, of different Figures and Magnitudes, but yet so joyned as to leave but small Vacuities behind them. Each *Lobe* consists of an Infinity of small *Spherical Vesiculæ* formed by the Coats of the small Branches of the *Trachæa*; so that they may be considered, when blown up, as so many fine Tubes ending in fine hollow Spheres. On the Sides of these *Vesiculæ*, the Blood-vessels are spread in a fine Net-work: But before the *Fœtus* is brought to light, these *Vesiculæ* lie flat on one another, and by their Pressure on the Blood-vessels hinder its Passage thro' them; but as soon as the *Fœtus* enjoys the Benefit of the Air, that doth by its *Weight* and *elastick Force*, rush in thro' the Pipes of the *Trachæa* into these *Vesiculæ* and blows them up; whereby they stand erect on the Trunks of those like *Wind-pipes*, and give a free Passage to the Blood thro' these Vessels spread upon their Sides. And when by the Weight of the *Thorax*, and the Acts of its Muscles, together with those of the *Abdomen* and *Diaphragma*, this Elastick Fluid, the Air, is thrust out of those *Vesiculæ* thro' the *Trachæa* in Expiration, these *Vesiculæ* pressing one against another, and the elastick Fluid acting on their Sides, and consequently on the Blood-Vessels thereon spread, separate the Globules of the Blood from one another, render it more capable of Circulation, in the narrow Passages of the Capillary Vessels.

And there seems to be a yet more considerable Use of this *Natural Function* behind; which is, *to form those Elastick Globules* of which the Blood principally consists. It is undoubted Fact and Observation, that the Blood consists of a *Lympha*, which is the common Vehicle, several Salts, *Rudiments* of a thick Consistence (which is probably the unformed Part of the Chyle and Aliment) and these Globules of which we are now speaking, tho' sometimes they are of different Colours, as *White*, *Blue*, *Purple*: This any one may discover with an ordinary Microscope. Now 'tis certain that these Globules may be *burst*, as in Obstructions; and all *exhausted*, as in violent *Hæmorrhages*, and yet be all recovered and recruited again; wherefore they must be *formed*, somewhere in the Body, from the Chyle. And since 'tis certain that they are not *solid* Particles, as appears both by Ocular Inspection and Truth; also that they do actually change their Globular Figures into those of *Oblong Sphæroides*, as they move thro' the Capillary Vessels; as therefore from their *Colour*, and from their being coagulated by Acids, and having their Figures destroyed; it is highly probable, that they may *be little Bubbles blown from the viscid Part of the Chyle, by the Force of some more subtle elastick Aura*. Now no Place in the Body can afford this elastick Fluid, but the Lungs; and this may be the Reason why the Chyle enters into *those two Veins only*, which are just returning into the Heart immediately to be sent into the Lungs. For since in our gross Element of Air, there is always lodged a *finer Elastick Fluid*, which is the principal Agent in all the subtle Effects commonly ascribed to the other: tho' the grosser Element cannot, yet this finer Fluid, (by the vast Force used in Expiration) may be thrust in thro' the Sides of these *Vesiculæ*, to the Blood-vessels. And since these Blood Globules must be generated somewhere, and that there is no Place in the Body, this subtle elastick Fluid can be squeezed thro' with sufficient Force to get into the Blood thro' the Sides of the Blood-vessels, but in the *Lungs*: 'tis very probable these *Globules* are there formed, after this manner. The viscous Part of the Chyle being by the shortest and safest Course possible brought into the returning Part of the Blood, is sent from the *right Ventricle* of the Heart to the Lungs, and is spread upon the Sides of the *Vesiculæ* thereof in little fine Tubes: this fine fluid Elastick being squeezed, in the Act of Expiration, thro' a Pore, continned thro' the *Vesicle* of the Lungs and the Side of the Blood-vessels, is forced into the *viscous* Part of the Chyle now running by in the *Serum*, and by its *perpendicular Pressure* on the Sides of that Cavity it forms, produces a little small Bubble, of a determinate Magnitude and Thickness of Shell, from whence it hath its Colour: After this, by the Force of the succeeding Fluid, this little Bubble is broken off from the Pore, and carried along the Artery; and the Cohesion of the Parts of the Shell of this Bubble being greater than the Force from without, whereby the thin *Serum* acts upon it, it is preserved in its Figure in all the various Motions of the compound Fluid of the Blood. And if it happen that these little Bubbles should be burst (as they most certainly are by 1000 Causes) whenever they come to the Lungs they are new formed again; whereby the Circulation is render'd constant and uniform. For should these Bubbles be all destroy'd, there must of Necessity rise a general Obstruction in all the Capillary Arteries. An Instance of the Formation of such kind of little Bubbles a Mixture of Oyl and Vinegar affords, for that look'd on thro' a Microscope, appears to be nothing but an Infinity of such like little Bubbles, formed by the Immission of the Air and Vinegar into little Shells

of

of Oyl. *Vid. Cheyne's Phil. Princip. of Natural Religion, p.* 214.

LUNI-SOLAR *Year*, in Chronology, is a Period made by multiplying the Cycle of the Moon (or 19) into that of the Sun, which is 28; which is 532: and in this ſpace of Time 'twas thought, the Sun and Moon would come to be together again exactly.

LUSHBURG, } was a baſe Sort of Coin
LUSHBOROW, } uſed in the Days of King *Edw.* III. which was coined beyond Sea to counterfeit the *Engliſh* Money; wherefore by a Statute in 25 *Ed.* 3. *c.* 2. it was made Treaſon for any one deſignedly to bring them into the Kingdom.

LUTHERNS, a ſort of Windows in the Roof of a Houſe. See *Dormers*.

LYE *under the Sea*, is the Mariners Term for a Ship, which having her Helm laſh'd faſt *a-Lee*, lies ſo *a-Hull*, that the Sea breaks upon her Bow, or Broadſide.

LYEF-YELD or *Leff-Silver*, was formerly a ſmall Fine or pecuniary Compoſition, paid by the Cuſtomary Tenant to his Lord, for Leave to plow and ſow.

LYMPHÆDUCTS, are ſlender pellucid Tubes, whoſe Cavities are contracted at ſmall and unequal Diſtances by two oppoſite Semi-lunar Valves, which permit a thin and tranſparent Liquor to paſs through them towards the Heart, but which are ſhut up like Flood-gates on its returning. They riſe in all Parts of the Body, but after what Manner needs no great Diſpute; for without Doubt all the Liquids in the Body, excepting the Chyle, are ſeparated from the Blood in the fine Capillary Veſſels by a different Pipe from the common Chanel in which the reſt of the Blood runs: But whether this Pipe be longer or no longer than the Thickneſs of the Coat of the Blood-veſſel, whether it be viſible or inviſible, it is *ſtill a Gland* whilſt it ſuffers ſome Parts of the Blood to paſs thro' it, denying a Paſſage to others. Now the Glands that ſeparate the *Lympha* are of the ſmalleſt kind, *being inviſible to the fineſt Microſcopes*; but their Excretory Ducts, the *Lymphatick Veſſels*, unite with one another, and grow larger as they approach the Heart; yet they do not open into one common Channel, as the Veins do; for ſometimes we find 2 or 3 more Lymphæducts running one by another, which only communicate by ſhort intermediate Ducts, or which unite and immediately divide again. In their Progreſs they always touch at one or two conglobate or veſicular Glands, into which they diſcharge their *Lympha*. Sometimes the whole Lymphæduct opens at ſeveral Places into the Glands, and ſometimes it ſends in only two or three Branches whilſt the main Trunk paſſes over and joyns the Lymphæducts ariſing from the oppoſite Side of the Glands, exporting again the *Lympha* to their common Receptacles. The Glands of the *Abdomen* which receive the Lymphæducts from all the Parts which it contains, as likewiſe from the lower Extremities, are the *Glandulæ Inguinales, Sacræ, Lumbares, Meſentericæ*, and *Hepaticæ*; all which ſend out new Lymphæducts which pour their *Lympha* into the *Receptaculum Chyli*, as thoſe of the Cheſt, Head and Arms do into the *Ductus Thoracicus*, Jugular and Subclavian Veins. The Deſign of the Lymphæducts emtying themſelves into the conglobate Glands ſeems to be, that the ſlow *Lympha* may receive a new Velocity from the Elaſtick Compreſſion of the Fibrous Cells of thoſe Glands, whoſe Fabrick reſembles that of the Spleen; and therefore they are improperly called Glands, becauſe they ſeparate no Liquor from the Blood. *See Keill's Anatomy.* p. 52.



MACE-GRIEF, alias *Macegreffe, Machearii*; are ſuch as willingly and knowingly buy or ſell ſtollen Fleſh.

MAGAZINE or *Arſenal*, is the Place in Fortified Towns, *&c.* where all ſorts of Stores are kept, and where Carpenters, Wheel-Wrights, Smiths, *&c.* are employed in making all things needful to furniſh out a Train of Artillery.

MAGBOTE, was formerly a Recompence made in Money, or otherwiſe, for ſlaying or murdering one's Kinſman; for ſometimes the Corporal Puniſhments in ſuch Caſes due were tranſmuted into Pecuniary Fines; when the Friends or Relations of the Party ſlain, were ſo content. *Leg. Canuti Regis* T. 1. c. 2.

MAGNETISM. See Mr. *Derham's* Experiments and Reaſonings on this Subject in *Phil. Tranſ. N.* 304. where he acquaints us, That he found (as *Grimaldi* and *De la Hire* had in Part done before) that a Piece of very well touched Iron Wire would, upon being bent round into a Ring, or coil'd round upon a Stick, *&c.* moſt times quite loſe its Verticity, and always have it much diminiſhed thereby. But yet that if the whole length of the Wire were not entirely bent, ſo that the Ends of it, tho' but for the length of one tenth of an Inch, were left ſtrait; then the Vertue would not be deſtroyed in thoſe Parts or Ends; tho' it would every where elſe. He found alſo, on repeated tryals, that tho' coyling or bending the Wire as aboveſaid, would always in the Day-time diminiſh and moſt times deſtroy the Verticity of a touch'd Wire; yet it would not do it in the Evenings: And he ſaith, he knows very well, that the Orb of the Activity of Magnets is larger or leſs at different times; which is confirmed by what is found in Fact to be true of our noble large *Loadſtone* which is kept in the Repoſitory at *Greſham College*; for that will keep a Key or other Piece of Iron ſuſpended to another, ſometimes at the Diſtance of 8 or 10 Foot from it; but at other Times, not beyond the Diſtance of four Foot.

He found alſo, that *twiſting* the Wire would conſiderably diminiſh, and ſometimes deſtroy the Verticity; which in ſome Tryals made on twiſted Wire, was ſo *confuſed* and *diſordered*, that he found by drawing one of the Poles of a *Loadſtone* along near the Sides of the Wire, in ſome Places it would attract

attract, in others repell, and ſo *attract* and *repell* all along the Wire; and he fancy'd in ſome places, that one ſide of the Wire would be attracted and the other repelled by one and the ſame Pole.

After this he try'd what *ſplitting* or *cleaving* the Wire would do; and in particular, whether ſplit Wires would have the ſame Properties as *Loadſtones* cut aſunder, and he found the *Phœnomena* of this Experiment very odd; for ſometimes the Poles of the Wire ſo ſplit would be quite chang'd; ſo that the South Pole would become the North, in all Reſpects: Sometimes one half of the Wire would retain its Magnetiſm which it had before its ſplitting, and the other half would have it quite changed, *&c.*

He obſerved alſo one thing to be very ſurprizing in theſe ſplit Wires; which was, *That laying one, or the other Side of the Half uppermoſt*, would cauſe a great Alteration in its Tendency or Averſion to the Poles of the Magnet: But if you lay the contrary ſide of that half uppermoſt, the ſame End ſhall be attracted by one and repelled by the other Pole, In other Pieces where the Ends are regularly attracted or repelled, only in an inverted Order (as if new touched) if it lay with the round ſide uppermoſt at that time, and be then turned upſide down, *viz.* the flat cleft ſide uppermoſt; it is ten to one, he ſaith, that one of the Ends is either attracted by both the Poles, or repelled by both; or elſe attracted and repelled by one, and in Heſitation by the other.

He touched a Wire from End to End with only one Pole of the Magnet; which gave it ſo vigorous a Vertue, that he is almoſt of Opinion, *'tis the beſt Way of touching*; the Conſequence was, that the End where he began always turned contrary to the Pole that touched it: He then touched the ſame Wire (and others likewiſe) with the other Pole of the ſame Magnet, from the ſame End, and then that End turned the contrary Way. For Inſtance, mark one end of the Wire for the North End, and touch that Wire by drawing the North Pole of the Magnet divers times along the Wire from the North to the South End: This Wire ſo touched ſhall have a vigorous Verticity; but the North End ſhall ſtand South. But if you touch that or another Wire, (for it is all one, the latter Touch deſtroying the former) by drawing the North Pole of the Magnet from the South to the North End of the Wire, then this North End will turn North: And ſo it will be if you touch with the Southern Pole from the North to the South.

He found alſo, that if he touc'd an Iron Wire exactly in the Middle with but one Pole of the *Loadſtone*, without drawing it backwards or forwards, in that Place would be the Pole of the Wire; and the two Ends would be the contrary Pole of the Wire, and were accordingly repelled or attracted by the Poles of the Magnet; and the middle, and about an Inch more on each ſide, was attracted only by the Pole that touched it.

MAILE, was anciently a Kind of Money, as ſome think; for *Mailes* were Half-pence in *Henry* the Fifth's Time; being the half of the Silver *Sterling* or Penny: But more largely it ſeems to have been any Proportion of Grain, or any other *Rent*. This latter in the North is called *Black-mail*. See *Black-mail* in Vol. I.

MAIN BODY, of Troops in an Army, is that which marches between the *Advance* and the *Rear Guard*; and in a Camp, that which lies between the two Wings.

MALETENT, or *Maletolte*; in the Statute called the *Confirmation of the Liberties*, 25 *Ed.* 1 *c.* 7. is interpreted to be a Toll of 40 *s.* for every Sack of Wooll; and in the Statute *de Tallagio non concedendo* in the 36th Year of the ſame King *Edw.* I. 'tis appointed, that Nothing for hereafter ſhall be taken of Sacks of Wooll, under the Pretence of *Maletent*. It ſeems to come from *malum Teloniun*.

MAL-VOISIN, was formerly the Name of a warlike Engine uſed in battering of Walls to caſt Stones, *&c.* It was ſo called, becauſe it was an ill or dangerous Neighbour.

MAN-BOTE, was formerly a Recompence for Homicide, or a pecuniary Compenſation for killing a Man.

MANCA, was formerly a ſquare Piece of Gold, commonly valued at 30 Pence; and *Mancuſa* was as much as a *Mark* of Silver. See *Canute*'s Laws. 'Twas called *Mancuſa*, quaſi *Manu cuſa*.

MANCUSA. See *Manca*.

MANCIPLE, a Caterer; there was anciently an Officer in the *Temple* called by this Name, now the *Steward*. And the Name and Office is retained ſtill in our Colleges, in both our Univerſities.

MANNER; beſides what hath been ſaid about *Manner*, I muſt take notice that they ſay in *Architecture*, That an Order Heroically and Gigantically deſigned; where the Diviſion of the principal Members is put into a few Parts; but thoſe having all a bold and ample *Relievo*, is after the *Grand Manner*. As for Example, in a *Corniche*, if the *Gola* or *Cimatium* of the *Corona*; the *Coping*, the *Modillions* or *Dentelli* make a noble Appearance by the Gracefulneſs of their Projectures; and that we ſee none of that ordinary Confuſion which reſults from thoſe little Cavities, *quarter Rounds* of the *Aſtragal*, and ſuch little Ornaments as produce no effect in great and maſſy Works, and which do impertinently juſtle out the graceful and principal Members; then will the *Manner* of this *Corniche* appear *ſolemn* and *great*, and approve it ſelf to be performed after *La Grand Maniere*. In Mr. *Evelyn*'s Parallel of Ancient and Modern *Architecture*, *Chap.* 5. *p.* 25. you have a fine Draught of this Grand *Manner*, in an ancient Dorick Pillar which was found at *Albano*, joining to the Church of St. *Mary* near *Rome*.

MANSE, is a Parſonage or Vicarage-Houſe for the Incumbent to live in, and was originally, and is now, an eſſential Part of the Endowment of a Pariſh-Church, together with the Glebe and Tithes.

MANUALIA *Beneficia*, were formerly ſuch daily Diſtributions or Portions of Meat and Drink, as were allotted to the Petty Canons and other Members of Cathedral Churches for their ordinary Subſiſtence.

MANUMISSION, is the Term for making a Slave or a Bondman free: You have the Form of this as it was uſed in the *Conquerour*'s Time, in *Lambert*'s Αρχαιονομία, *Fol.* 126. The *Terms of the Law* make two Kinds of *Manumiſſion*; one *expreſſed*, and the other *implied*. That *expreſſed* was by Deed, or *Publick Declaration*: That *implyed* was when the Lord made an Obligation for Payment of Money to his Villain at a certain Day; or ſued him when he might enter without Suit;

or when he granted him an Annuity or Leaſed Land to him for Years, or for Life, *&c.*

MANU-OPERA, are ſtollen Goods taken upon a Thief apprehended in the Fact.

MANU-PASTUS, in the Law Dialect is often uſed for a Domeſtick Servant, one fed as it were by the Hand of his Maſter.

MANU-PES, is uſed in the Charter of *Richard* the Third for a *Foot* of full and legal length.

MANU-PRISOR, one who was Bail-pledge or Security for another Perſon.

MANUS, was anciently uſed both for an Oath and him that took it. If a Man ſwore alone in the Court, he was ſaid to do it *propria manu*; but if he brought 3 or more Witneſſes to ſwear for him, he was ſaid *tertia manu jurare.*

MARCHET } *Mulieris*, the ſame with *Mer-*
MARCHETA } *chetum.*

MARCHES, are now the Bounds between *England* and *Wales*, or *England* and *Scotland*; and the Marches of *Scotland* are divided into *Weſt* and *Middle Marches.* The Word *Marches* is uſed alſo in *Stat.* 24. *H.* 8. 12. for the Borders of the King's Dominions in general, as being derived from the *Germ. March*, which ſignifies a Bound or Limit; and thoſe Noblemen who lived near theſe *Marches* are frequently in our Statutes called *Marchers.*

MARITAGIUM *habere*, ſignified formerly to have the free Diſpoſal of an Heireſs in Marriage, which was a Favour granted by the King, who was the Guardian of all Wards or Heirs in Minority, to ſome ſpecial Favourite or Friend.

MARITAGIUM *Liberum, Frank Marriage*; was when a Baron, Knight, or Free-holder granted ſuch a Part of his Eſtate with a Daughter to her Husband, and the Heirs of his Body, to hold without any Homage or Service to the Donor.

MARK, the *Saxons* called it *Mancus*, *Mancuſa*, and *Mearc*; and among them it contained 30 Pence, which of their Money was ſix Shillings. 'Tis not certain when the *Mark* came to be valued as at 13 *s.* 4 *d.* But *M. Paris*, in the Life of *Guarinus* Abbot of St. *Albans*, tells us, that a Mark (*A. D.* 1194.) was of this preciſe Value. Since the Conqueſt there was never any Coin of this Name ſtruck, as appears; but probably there might be ſuch before in the *Saxons* Time, and with ſome *Mark* or Stamp upon it, as may be concluded from the Word *Mark*. *Stow* in his *Annals*, *p.* 32, and 691, ſaith, a Mark of Gold was eight Ounces, twelve Mark of Gold *Troy* was 200 *l.* of *Engliſh* Money; after which Rate each Mark weighed 16 *l.* 13 *s.* 4 *d.*

*Skene de Verb. ſignif.* ſaith, a Mark ſignifies an Ounce Weight, whereof the Drachm is the eighth Part, as the Ounce is the eighth of the Mark.

MARQUIS or } is now a Title of Honour next
MARQUESS } before an Earl, and next after a Duke. The Name ſeems to be derived from the *Germ. March*, a Bound or Limit; and therefore was as much as *Cuſtos Limitis*, or *Comes ſibi Præfectus Limitis.* Among the old *Britains* it was the Cuſtom, and after them of the *Saxons*, to give the Title of *Reguli* to all the Lords that had the cuſtody and charges of their *Marches* or *Bounds*; as *Selden* ſhews in his *Mare Clauſum*, *Lib.* 2. *c.* 19. But in *Richard* 2. his Time, the Title of *Marqueſſes* inſtead of *Lords Marches* came to be given to ſuch as were Governours of the *Marches.*

MARS. Mr. *Flamſtead* and *Caſſini* have by accurate Obſervation found the Horizontal Parallax of this Planet to be about 25 Seconds, and certainly not greater; a large Account of the Method of obſerving and finding which, you will find under the Word *Sun* in this Vol.

MARTYROLOGY, was anciently a Regiſter kept in the Religious Houſes, wherein they ſet down the Donations of their Benefactors, and the Day of their Deaths, that ſo on each Anniverſary they might commemorate and pray for them: And therefore ſeveral Benefactors made this a Condition in their Charters. *Kennet's Paroch Antiq.*

MASSES, in Painting, are the large Parts of a Picture containing the great Lights and Shadows.

MASTER *of the Mint*: In the ſecond Year of *H.* 6. that was the Title of him that now is called the *Warden of the Mint*, whoſe Office it is to receive the Silver and Bullion that comes to the Mint to be coined, and to take Care thereof.

MASTER *of the Court of Wards and Liveries*; was the chief Officer and Judge of that Court of Wards, kept the Seal of it, and was named and aſſigned by the King. But this Court and all its Officers, Members, Power, and Appurtenances, is taken away by a Statute made the 12th of *Car.* 2. *c.* 24.

MASTER *of the Horſe*, hath the Rule and Charge of the King's Stable: This Officer is very honourable, and uſually a Nobleman, is mentioned in 39 *Eliz.* 7. and 1 *E.* 6. 5.

MASTER *of the Poſts*, was an Officer of the King's Court that had the appointing, placing and diſplacing of all ſuch as provided Poſt-Horſes to carry the King's Meſſages and other Buſineſs. He alſo was to pay them their Wages, *&c.* This Officer is mentioned in 2 *Ed.* 6. 3. but now by a Statute made 12 *Car.* 2. *c.* 34. he is appointed by the King's Letters Patent, with Rates and Rules preſcribed in the ſaid Act.

MASTER *of the Armory*, is an Officer mentioned 39 *Eliz. c.* 7. and hath the Care of the King's Armour in any ſtanding Armories; with Power of putting in and out all inferior Officers.

MASTER *of the Jewel Houſe*, is mentioned in 39 *Eliz. c.* 7. and is an Officer of the King's Houſehold of great Credit; being allowed *Bouge of Court*, that is, Diet for himſelf and the Clerks of the Office, and hath a Lodging in the Court. He hath Charge of all the Gold and Silver Plate uſed at the King's Table, or belonging to any Officer of Account attending the Court; and of all Plate remaining in the *Tower* of *London*, as alſo of Chains and looſe Jewels not fixed to any Garment.

MASTER *of the Houſehold.* This Officer is called *Grand Maſter*, &c. and *Lord Steward of the King's Houſehold* in 32 *H.* 8. 39. And in the firſt of Q. *M.* and ever ſince he is called *Lord Steward*, &c. and under him there is a principal Officer called by this Name of the *Maſter of the Houſehold.*

MASTER *of the Ordnance*, mentioned in 39 *Eliz.* 7. and is a great Officer, to whoſe Care all the King's Ordnance and Artillery is committed.

MASTER *of the Faculties*, is an Officer under the Archbiſhop of *Canterbury*, who grants *Licenſes* and *Diſpenſations*; he is mentioned in the Statute of laying Impoſitions at Law of 22, 23. *Car.* 2.

MASTER *of the Wordrobe*, is a great Officer at Court; having his Habitation or Dwelling-Houſe belonging to that Office, called the *Wardrobe* near *Puddle-*

*Puddle-wharf* in *London*. He hath the charge and cuſtody of all former Kings and Queens Robes remaining in the *Tower* of *London*, and of all Arras and Tapeſtry Hangings, Bedding, *&c.* and the Charge and Delivery out of all Scarlet Liveries belonging to the King or Queen. He is mentioned in 39 *Eliz.* 7.

MATERIA *Subtilis*, in the Carteſian Philoſophy is what is produced by the grinding or rubbing one againſt another of the Particles of the ſecond Elements; and ſo theſe compoſe what he calls his firſt Element. See *Carteſian Syſt. of the World* in this 2d Vol.

MATHEMATICKS. Beſides the mention of ſuch Authors as have written on the ſeveral Parts of this noble Science, and of which you have an Account under each particular Head; theſe that follow have written on Mathematicks more generally.

*Franciſci Laurens Specimina Mathematica*, &c.
*Andreæ Tacquet Opera Mathematica*, Antw. 1669.
*The Works of Monſieur Fermat.*
Dr. *Wallis*'s *Mathematical Works*, in 3 Vol. Fol. *Oxon.*
*De Chales Curſus Mathematicus*, 3 Vol. Fol. *Ludg.* 1674.
*A Math. Compendium*, by Sir *Jonas Moore*. *Lond.* 1674. *Twelves.*
*Elements de Mathematiques, ou Principes Generaux de toutes les Sciences qui ont les Grandeurs pour Object. par F. P. a Paris*, 1675. 4*to.*
*Steph. de Angelis de Infinitis Spiralibus Inverſis Infinitis Hyperbolis aliiſque Geometricis* Batavii. 4*to.*
P. *Gregii a St. Vincentio opus Geometr. Quadraturæ Circuli & Sect. Coni.* Antw. 1647. Fol.
*Leybourn*'s *Curſus Mathematicus*. Lond. 1690. Fol.
*Simon Stevin Les Oeuvres Mathematiques.* Leyden, 1694. Fol.
*Clavius*'s *Opera Mathematica.* Fol.
Mr. *Hayes Fluxions*, London, 1704. Fol.
*Foſter*'s *Miſcellanies.* Lond. 1659. Fol.
*Pappus Alexandrinus*'s *Math. Collect. per Commandinum*, Bononiæ, 1650. Fol.
Sir *Jonas Moore*'s *Syſtem of Mathematicks*, 2 Vol. London, 1681. 4to.

*Cavallerii Trigonometria.*
*Directorum generale Uranometricum.*
*Exercitationes Geometricæ.*
*Geometria Indiviſibilis Continuorum.*
} Bononiæ. { 1643, 1632, 1647, 1635 } 4to.

*Barrow*'s *Lectiones Geometricæ et Opticæ.* Lond. 1669. 4to.
*Sturmius*'s *Matheſis Enucleata.* } 1 Vol. 8vo.
——*Juvenilis.* } 2 Vol. 8vo.
*Veteres Mathematici.* Paris, 1693. Fol.
*Math. Collections* in *Eng.* from *Galileo.* Lond. 1661. Fol.
*Hook*'s *Micrographical Lections et Opera Poſthuma.*
*Scotii Curſus Mathemat.* Herbipoli. 1661.
*Herigone*'s *Curſus Mathematicus.* Paris, 1644. 8vo.
Mr. *Blondell*'s *Cours de Mathematique. pour Mr. le Dauphin.* Paris, 1683. 4to.
*Ozanam*'s *Cours de Mathematique*, in 8vo.

MATRICULA, anciently was the Word for a Regiſter. Thus in the Church there was the *Matricula Clericorum*, which was a Liſt or Catalogue of the officiating Clergy, and *Matricula Paupertum*, a Catalogue of the Poor to be received: and to this Day being Regiſtred as a Member in the Univerſity of *Oxon* is called *Matriculation.*

MATROSSES, are Soldiers in the Train of Artillery, next below the Gunners: Their Duty is to aſſiſt the Gunners in Traverſing, Spunging, Firing, and Loading of Guns, *&c.* They carry Fire-locks, and march along with the *Store-Waggons.*

MAUND, was anciently a Meaſure of Capacity with us, being a kind of great Basket or Hamper containing 8 Bales, or 2 Fatts. See the Book of Rates, *Fol.* 3.

MAXY, is the *Tin-miners* Term for a *Weed*, as they call it, of the *Marchaſite* kind, from whence *Maxy* ſeems to be a Corruption. When the *Load* or Vein of Oar degenerates into this or any thing elſe that is not Tin, they call it a *Weed.*

MEASURES *of Capacity*: Theſe (with us) both liquid and dry, were firſt made from Troy Weight. See 9 *H.* 3. 51 *H.* 3. 12 *H.* 7. *&c.* wherein it is enacted, that eight Pound *Troy* Weight of Wheat, gathered from the middle of the Ear, and well dried, ſhould make one Gallon of *Wine Meaſure*, and that there ſhould be but one Meaſure for Wine, Ale, and Corn throughout the Kingdom. See 14 *Ed.* 3. and 15 *Rich.* 2. But Cuſtom in time hath prevailed againſt this, having altered *Meaſures* as well as *Weights*; no other but *Troy Weight* being appointed by our Laws to be uſed. (See 14 and 17 of *Ed.* 3.) we having now three different Meaſures; *viz.* one for Wine, one for Ale and Beer, and one for Corn. See the Table of them under *Meaſures*, Vol. I.

Only let me add further from Mr. *John Ward*'s Arithmetick. *p.* 34. That tho' the common Wine Gallon ſealed at *Guild-Hall* in *London*, by which all Wines, Brandies, Spirits, Strong-waters, Mead, Perry, Sider, Vinegar, Oyl, Honey, *&c.* are meaſured and ſold, is ſuppoſed to contain 231 Cubick Inches; and from thence, the *Tierce* will contain 9702 Cub. Inch. the Hogſhead 14553, the Punchion 19404, the Butt or Pipe 29106, and the Tun 58212. Yet it hath been accurately experimented, that the Wine Gallon at *Guild-Hall* doth hold but 224 Cubick Inches; as indeed Dr. *Wybard* had before taken Notice of in his *Tactometry*, *p.* 289. But yet in *May* 25, 1688, when an Experiment was made for the Lord Mayor of *London* and the Commiſſioners of the Exciſe, in Confirmation of the Truth of the Account above, of the Capacity of the Standard Gallon; *viz.* that it is but 224 Cub. Inches: yet it was then thought fit to continue the common *ſuppoſed* Contents of 231 Cub. Inches for the Wine Gallon, and that all Computation in Gauging ſhould be made from thence; and ſo I ſuppoſe it yet ſtands.

The *Beer* and *Ale* Gallon is larger than the *Wine* Gallon, in Proportion to the Exceſs of the common Pound *Averdupois* above the true Pound *Troy*: that is, as 12. 231 :: ſo $14\frac{13}{20}$ to $281\frac{1}{2}$, which is very near the Cubick Inches in the Ale Gallon. The Ale Quart contains $70\frac{1}{4}$ Cubick Inches; the Gallon will be 282.

Dry Meaſure ſeems to ſtand ſtill in Proportion to the old Wine Gallon of 224 Cub. Inches. The common received Content of the Corn Gallon being 272.$\frac{1}{4}$. for as 12. 14. $\frac{13}{20}$ :: 224. 272$\frac{1}{2}$. and yet by an Act of Parliament made *A. D.* 1697, *it is appointed*, that *every round Buſhel with a plain and even Bottom, being made* 18 *Inches and* $\frac{1}{2}$ *wide throughout, and* 8 *Inches deep, ſhall be eſteemed a legal*

*legal* Winchester *Bushel*, according to the Standard in his Majesty's Exchequer. Now a Vessel thus made will contain 2150.42 Cubick Inches; and consequently the Corn Gallon can be but 268$\frac{4}{5}$ Cub. Inches.

MECHANICAL *Philosophy*, was that which the most ancient of the *Phœnician* and *Greek* Philosophers have adhered to for the Explication of the Phænomena of Nature; and these made use originally of no other *Principles*, than the Consideration of *Empty Space*, the *Doctrine of Atoms*, and in particular, the *Gravitation of Bodies*. These silently attributed the *Cause of Gravity* to something which was plainly distinct from Matter; and this *Cause* our most modern Natural Philosophers, in their Enquiries into Nature, did by no means take into Consideration. They have happily avoided aiming at any *Hypothesis* to explain the *Phœnomena* of natural Effects, and leaving the *Philosophy of Causes* to Metaphysicks, they have rightly considered that it is the chief End, Design, and Business of Natural Philosophy to consider *Effects*; and by reasoning upon them and their various *Phœnomena*, to proceed regularly at last to the *Causes* of Things; and especially to the Knowledge of the *First Cause*. And certain it is, that all true Progress and Proficiency in this Kind of Natural Philosophy, if it don't immediately lead us to the Knowledge of the *First Cause*, yet will surely bring us still nearer and nearer to it; and therefore is a most noble, excellent, and valuable Study. *Vid. Newt. Opt. Lat. Ed. p.* 315.

Authors on this Subject are,

*Guidi Ubaldi Mechanicorum Liber.* Venetiis, 1615. Fol.

*Paulus Guldinus de Centro Gravitatis.* Viennæ, 1635. Fol.

*Christ. Hugenius de Motu Pendulorum.* Paris, 1673. *Fol.*

*Ejusdem Horologium Oscillatorium.* Paris, 1673.

*Gasp. Scotti Mechanica. Ejusdem Technicæ Curiosa.* 1664.

*Cassioli Mechanica.*

*Wilkin's Mathematical Magick.*

*Alphonsi Borelli de Vi Percussionis* Bononiæ, 1677, & Lug. Bat. 1686. 4to.

Dr. *Wallis's Mechanica, sive de Motu. Tractatus Geometricus.*

*Andreæ Boecleri Architectura curiosa nova & Amœnitates Hydrogogices cum* 200 *Fig. Ære incis.* Norimbergæ. Fol.

---- *Theatrum Machinarum novum, exhibens Opera molaria & aquatica: cum Figuris.* Ibid. 1662. Fol.

*M. Vitruvii de Architectura Libr.* 10. *cum Fig. Æneis Ed. opt.* Amst. 1649. Fol.

*Novo Teatro di Machine di vittorio Zonca.* Padua. 1602. Fol.

*Teatro di Machine di Jacobo Bestoni in Lioni.* 1582.

*Pauli Cassaci Mechanica.* Lugd. Bat. 1684. 4to.

*Alexandri Marchetti Exercitationes Mechanicæ.* Pisis 1669. 4to.

*Heronis Alexandrini Spiritalium Liber.* Amster. 1680. 4to.

*Recueil de plusieurs Machines par S. B.* Paris. 1699. Fol.

*La Statique; ou la Science des Forces mouvantes, par P. Ignace Pardies.* Paris, 1673. 12mo.

*Mechanick Exercises,* by *Moxon.* Lond. 1677. 4to.

*Recueil de diverses Pieces touchants quelques nouvelles Machines par D. Papin, à Cassil.* 1695. 8vo.

*Mechanick Powers,* by *Mandey* and *Moxon. Lon.*

*Lucæ Valerii Lib. de Centro Gravitatis Solidorum.* Rom. 1604.

*Galileo de Mechanica & Motu locali Dialogi.* Leyd. 1638.

MEMBRETTO, in Architecture, is the *Italian* Term for a *Pilaster*, that bears up an Arch. These are often *fluted*, but not with above 7 or 9 Channels. They are frequently used to adorn Door-Cases, Gallery Fronts, and Chimney-Pieces, and to bear up the Cornishes and Freezes in Wainscot.

MEMORY. Dr. *Hook*, in his *Op. Posthum. p.* 139, 140, *&c.* supposes *Memory* to be as much an *Organ* as the Eye, Ear, Nose, *&c.* and to have its Situation some where near the Place where the Nerves from the other Senses concur and meet; and he thinks, that the Memory being both improveable and impairable, appears from thence to be plainly Organical; and that it is a Kind of Repository of Ideas formed partly by our Senses, and chiefly by the Soul her self.

MENSALIA } were such Personages or Livings
MENSALS } as were united formerly to the Tables of Religious Houses; and therefore are by Canonists called *mensal Benefices.*

MERCHEN-LAGE; was one of those 3 Laws out of which *W. the Conquerer* framed our Common Laws, with a Mixture of the Laws of *Normandy*; and was the Law of the *Mercians* when they governed a third Part of this Land; for it was divided in the Year 1016. See *Cambden's Britannia, p.* 94.

MERCHETUM, *Merchet*, in Scotch *Marchet*, was anciently a Commutation of Money or Cattle given to the Lord to buy off that old impious Custom of the Lord's lying the first Night with the Bridal Daughter of a Tenant; and after it was used for the Fine or Composition which the Tenants paid to have leave to marry their Daughters: Also no Baron or military Tenant could marry his sole Daughter or Heir, without Licence from the King *pro maritanda Filia.*

MERCURIAL *Phosphorus*, is a Light arising from the shaking of Mercury in *Vacuo*; of which see several Experiments in *Philos. Transf. N.* 303. See *Phosphorus.*

MERCURY, is the Term the Chymists gave and is now generally used for that ponderous Fluid, *Quick-silver*: The Texture of which seems to consist of exceeding small, smooth, solid, spherical or spheroidical Particles; because Mercury in never so small a Quantity, is by no means transparent, but opake, and will let none of the Rays of Light pass thro' its Pores: And therefore since 'tis probable that Light passes not through the *solid* Parts of transparent Bodies, but only thro' their *Pores*, 'tis plain, if the Particles of Mercury be Spherical (as it appears those of all Fluids are) then their Diameters cannot be much greater than those of the Rays of Light; for the Interstices between the Particles are as the Cubes of the Diameters of the Globules by whose meeting they are formed; and therefore seeing Light cannot pass thro' these Interstices, it it plain, that the Diameters of the Corpuscles of Mercury cannot be much greater than those of Light: And if these Particles

should

ſhould be oval or ſpheroidical, their ſhorteſt Diameters muſt be of the Length of thoſe of the Particles of Light, or not much greater.

The Solidity of the Corpuſcles of *Mercury*, and the Smallneſs of the Interſtices left between them, accounts for the wonderful ſpecifick Gravity of *Mercury*, above all other Fluids; and the exceeding Smallneſs of its Parts, for its eaſie Aſcent by Fire.

MERIDIAN *Line*, is a Line of ready Uſe in Practical Navigation. 'Tis always placed on the Foot, or 2 Foot *Gunter*'s Scales, and ſometimes on the Side of *Gunter*'s Sector, (and on the Croſs-Staff, &c.) and continued to its whole Length. 'Tis divided unequally towards 87 degr. (whereof 70 gr. are about one half) in ſuch manner as the Meridian in *Mercator*'s Chart is divided and numbred.

It's Uſes are many: For, 1. *It ſerves them to graduate a Sea Chart according to the true Projection.* 2. Being joined with a Line of Chords, it ſerves for the Protraction and Reſolution of ſuch Right-lined Triangles as are concerned in Latitude, Longitude, Rhumb, and Diſtance in the Practice of Sailing; as Mr. *Gunter* ſhews, *p.* 15. of his Book of the *Croſs-Staff*; as alſo in *pricking the Chart* truly at Sea.

MESOLABIUM, See *Renati Tran. Fluſii Meſolabium; cui acceſſit pars altera de Analyſi & Miſcellanea. Leodii Eburonum*, 1668. 4*to.*

MESSENGER *of the Exchequer*: The four Purſuivants in that Court are called by this Name, and their Duty and Office is to attend the Lord Treaſurer, and to carry his Letters, Precepts, &c.

MESSUAGE, is a Dwelling-Houſe, with ſome Land aſſigned for its Uſe; and by this Name a Garden, Shop, Mill, Chamber or Cellar may paſs, ſaith *Plowden, Fol.* 169. In *Scotland* it is what we call the *Mannor-Houſe*, the principal Dwelling-Houſe within any Barony.

METALS *Lines*: On *Gunter*'s Sector are ſometimes placed two Lines called the *Lines of Metals*; they are noted with the Characters of the 7 Metals, ☉, ☾, ☿, ♄, ♀, ♂, and ♃; and their Uſe is to give the Proportions between the ſeveral Metals in their Magnitudes and Weight, and by them ſuch Problems as theſe are ſolved.

1. *In Bodies of the ſame Figure of different Metals, by the Magnitude of one given, to find the Magnitude of the reſt.*

Take the Magnitude given out of the Lines of Solids, and open the Sector till it be appiled right in its proper Points; then will the Parallels taken between the correſponding Points of the other Metals, and meaſured on the Solids, give their ſeveral Magnitudes.

2. *In Bodies of different Metal, but equal Magnitude, having the Weight of one, to find that of the reſt.*

This Probl. is the Converſe of the former, but not in direct but reciprocal Proportion; apply the Weight given, taken out of the Lines of Solids into the Sector in its proper Points belonging to the Metals of the other Body, ſo the Parallel taken from the Point's belonging to the Body given, and meaſured in the Lines of Solids, ſhall give the Weight of the Body required.

3. *A Body being given of any one Metal, ſuppoſe a Sphere of Lead of* 16 d. *and whoſe Diameter is* a (*let* d *and* a *ſignify any Magnitudes or Lengths*) *to make another like it and of equal Weight, but of another Metal, as ſuppoſe Iron.*

Take out the Diameter *a*, and apply it in the Lines of Metals in the Points of ♄ belonging to Lead; then will the Parallel between the proper Points in ♂, be the Diameter of the Iron Sphere required: And this compared with the other Diameter in the Line of Solids, will give 23 *d.* for the Magnitude of the Body required.

4. *A Sphere of Lead being given, whoſe Diameter is* a, *to make another Sphere of any other, as of Iron, whoſe Weight ſhall be determined; v. gr. that ſhall weigh thrice as much.*

Apply the Diameter *a* over in the proper Points of ♄; and then the Parallel between the proper Points of ♂ will give the Length of the Diameter of an equal Sphere of Iron; and this tripled will be the Diameter required.

See *Webſter*'s *Metallographia.* Lond. 1670. 4to.

*Alonſo Barba*'s *Art of Metals*, Engliſhed by the E. of *Sandwich.* Part 1. & 2. in 8vo. 1674.

Sir *John Bettus*'s *Fleta minor*; or, the Laws of Art and Nature, in knowing, judging, finding, refining, &c. the Body of confined Metals.

*Georgius Agricola de Re metallica.* Fol.

METOPS, the ſame with *Metopa.*

METTESHIP, *Metteſchep, Mettenſcep*, ſeems to have been anciently a Fine or Penalty paid by the Tenant to his Lord for his Neglect or Omiſſion of doing his cuſtomary Service. Perhaps it ſhould be written *Mittenſcep* from the *Saxon Mitten*, to meaſure, and *ceap*, Goods or Chattels.

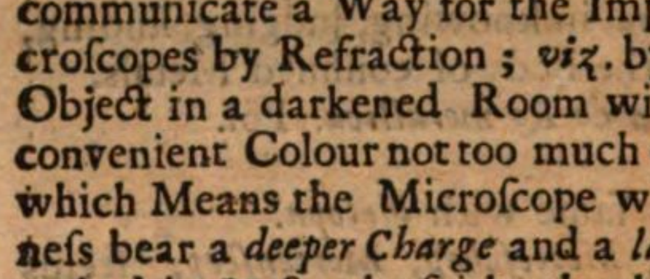
MICROGRAPHY, is the Deſcription of the Parts and Properties of ſuch very ſmall Objects as are only diſcernable by Means of the Microſcope. On this Subject the late Dr. *Hook* hath written deſignedly in his *Micrography*, as hath alſo Dr. *Power*; and *Leuenhoeck* in 2 Vol. in *Quarto*, *Lat.* in which, as well as ſcattered up and down in many other Books written on other Subjects, a very noble Treaſure of uſeful Diſcoveries is to be found, and all made by means of the Microſcope.

MICROMETER. In *Philoſ. Tranſ. N.* 25, you have from Mr. *Richard Townley*, an Account of the Micrometer invented by Mr. *Gaſcoigne*; and by this Inſtrument he found the Moon's Diſtance and Parallax from two Obſervations of her meridional and horizontal Diameter, before Mr. *Auzout* took this matter into Conſideration: Which Micrometer Mr. *Townley* had, and is deſcribed by Dr. *Hook*, in *Phil. Tranſ. N.* 29. and the manner how it is to be applied to a Teleſcope ſhewed. And Mr. *Flamſtead* in *N.* 96. ſaith, that by the Micrometer and a Teleſcope of but 14 Foot he could take the Diameters of the Planets and their Diſtances from the fixed Stars, to a Second almoſt. This Inſtrument is now brought to very great Perfection and ready uſe by our excellent Math. Inſtrument-maker Mr. *John Rowley*, under St. *Dunſtan*'s Church in *Fleetſtreet.* See its Uſe in finding the Sun's Horizontal Parallax, under the Word *Sun* in this Volume.

**MICROSCOPE:** By those excellent Observations and Experiments which the admirable Sir *Is. Newton* hath made on Colours, he shews Ways to conjecture very accurately of the *Sizes* of the component Particles of Bodies by their Colours; and in the Description of those, he tells us, (*Book* 2. *Part* 3. *p.* 64.) he hath been the more particular, because it is not impossible but that Microscopes may (if not done already) at length be improved to that Perfection, as to discover the Particles of Bodies on which their Colours depend. For, saith he, if those Instruments are or can be so far improved, as with sufficient Distinctness to represent Objects five or six hundred Times bigger than at a Foot Distance they appear to the naked Eye, I should hope that we might be able to discover some of the greatest of these Corpuscles; and by one which would magnifie 3 or 4 Thousand Times, perhaps they might all be discovered, but those which produce Blackness. And if this could be attain'd to, (*viz.* by Glasses to discover the constituent Particles of Bodies) he fears it would be the utmost Improvement of the Sense of *Seeing*; for it seems impossible to see the most secret and noble Works of Nature *within* the Corpuscles, because of the Transparency of these Corpuscles.

The same Gentleman in *Philos. Transf.* N. 88. from the Difference he had found between compounded and simple Colours, takes Occasion to communicate a Way for the Improvement of Microscopes by Refraction; *viz.* by illuminating the Object in a darkened Room with Light of any convenient Colour not too much compounded; by which Means the Microscope will with Distinctness bear a *deeper Charge* and a *larger Aperture*.

And in N. 80, he saith, that he hath sometimes thought of making a Microscope which should have, instead of an Object Glass, a *Reflecting Piece of Metal*. For these Instruments seem as capable of Improvements as Telescopes; and perhaps more, because but one Piece of reflecting Metal is requisite in them; as is plain from this Figure; where A B represents the Object Metal, C D the Eye-Glass, F their common *Focus*, and O the other *Focus* of the Metal in which the Object is placed.




The Description and Use of Mr. *Wilson*'s Sett of Pocket-Microscopes, *&c.* mentioned in the *Preface* of Vol. I.

This *Sett* of *Microscopes* has *Nine* different *Magnifying-Glasses*; *Eight* of which may be used with two different Instruments, for the better applying them to various Objects: One of these Instruments is represented Fig. I. A A A A, and is made of Ivory, it hath 3 thin Brass Plates, E E, and a Spring of Steel H within it; to one of the thin Plates of Brass is fixed a Piece of Leather F, with a small Furrow G ..... both in the Leather and Brass to which it is affixed: In one End of this Instrument there is a long Screw, D, with a *Convex-Glass* C, placed in the End of it: In the other End there is a hollow Screw, o o; wherein any of the Magnifying-Glasses M, are screwed when they are to be made use of. The 9 different *Magnifying-Glasses* are all set in Ivory, 8 of which are set in the manner express'd at M. The greatest Magnifier is marked upon the Ivory wherein it is set with N° 1, the next N° 2, and so on till N° 8. The 9th Glass is not marked, but set in the Manner of a little Barrel Box of Ivory, as in *Fig.* II.

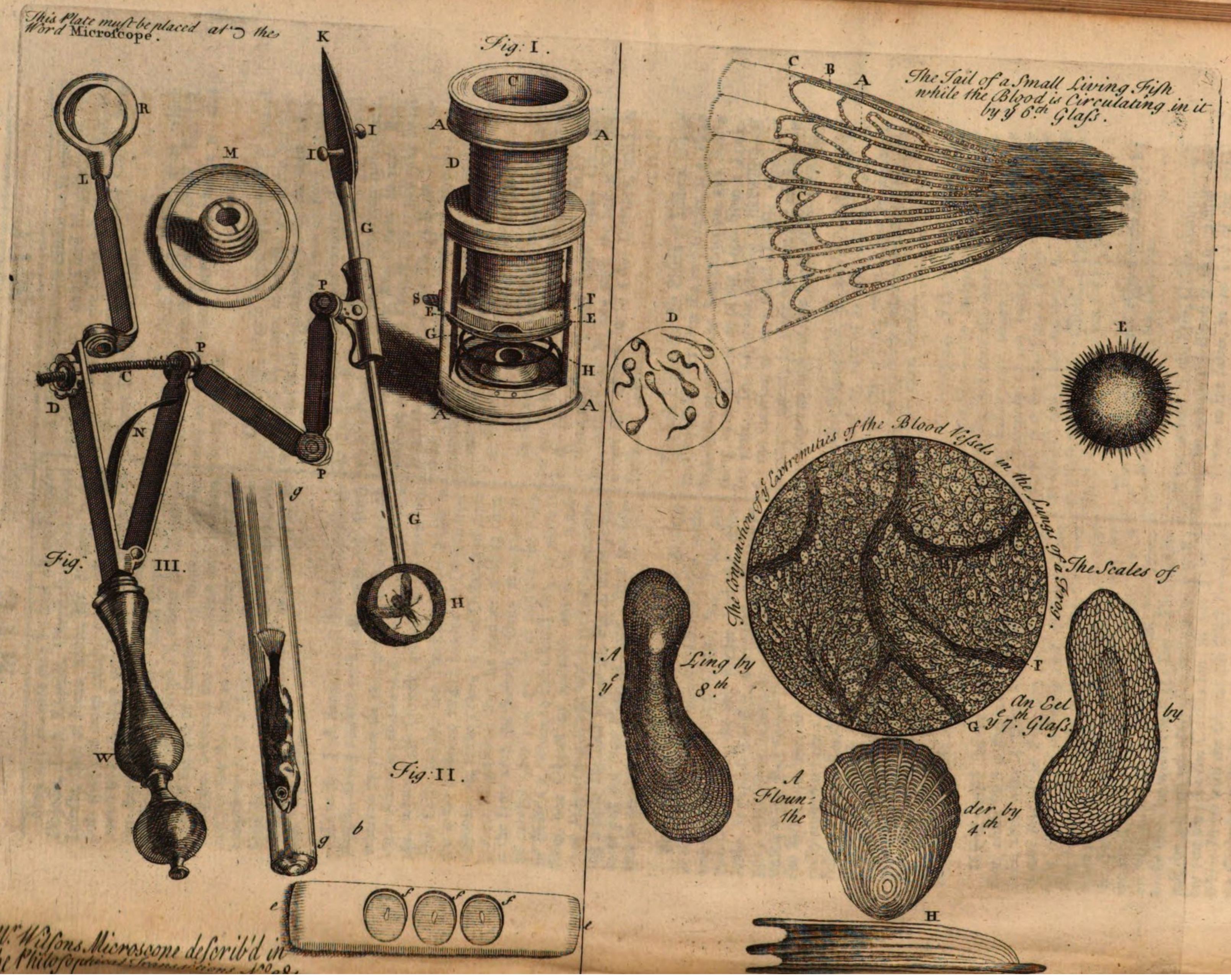
e e A flat Piece of Ivory, whereof there are 8 belonging to this Sett of Microscopes, (tho' any one who has a Mind to keep a Register of Objects may have as many of them as he pleases) in each of which there are three Holes f f f, wherein three or more Objects are placed between two thin *Glasses*, or Talks, when to be used with the greater Magnifiers.

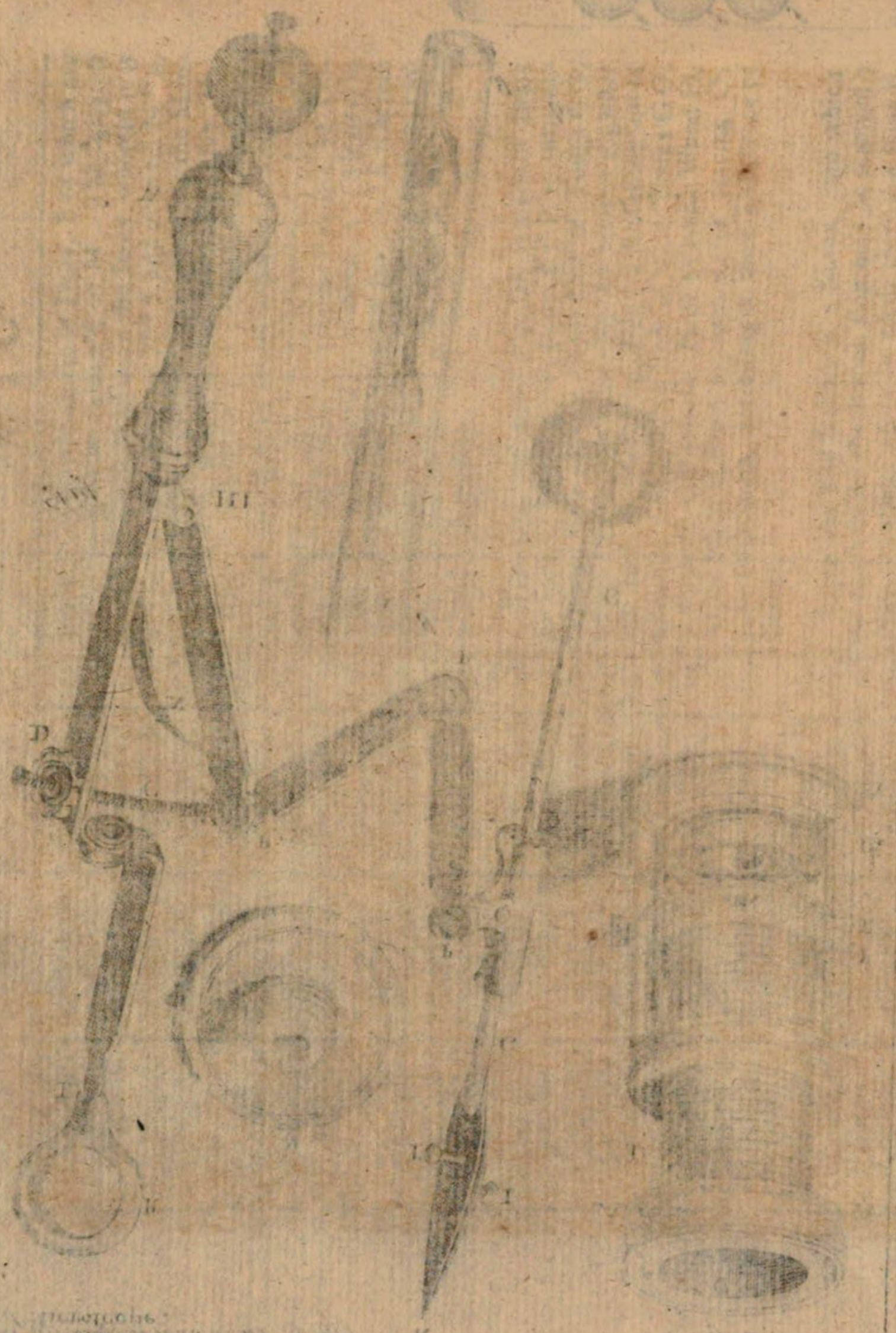
The other *Instrument* Fig. III. is made of Brass or Prince's Metal, with Joints P P P, to turn easily any Way with a small Pair of Tongs G G, which open at the Points K, by pressing together the two Heads of the Pins I I for taking up of Objects: At the other End of these Tongs G G, is screwed on a round Piece of black Wood H, with a Piece of Ivory let into it, for placing Opake Objects on, according to their Difference of Colour,

Upon the End L there is a Screw, into which the *Glass* set in the Barrel Box may be screwed; when the others are to be used, there is a Ring R of Brass to be screwed on the End L, into which Ring all the other *Glasses* M, may be screwed: So when any Object is taken up in the Points of the Tongs K, or laid upon the other End H, it may very easily (as one who sees the Instrument will perceive) be applied to the true Distance of any of the *Glasses* M, by the Help of the Joints P P P, and by means of the Screw C, with the Wheel D, Fig. III. which will bring the Object to the Exactness of the *Centre* or true Distance, being regulated by a Spring N.

The Use of the first mention'd *Instrument*, Fig. I. A A A A is thus: Take one of your flat Pieces of Ivory e e, or *Sliders*, (if you please to call them so) and slide it in betwixt the two thin Plates of Brass E E, in the Body of the Microscope; so that the Object you intend to look upon be just in the middle, remarking that you put that Side of the Plate e e, where the Ring is, fartherest from your Eye: Then you are to screw into o o, (the hollow Screw in the End of the Body of your Microscope) the 3*d*, 4*th*, 5*th*, 6*th*, or 7*th Magnifying-Glass* M; which being done, while you are looking through your *Magnifying-Glass* upon the Object, you are to screw in or out, the long Screw D, Fig. I. in the other End of the Body of your Microscope, till you bring your Object into the true Distance, which you will know by seeing the Object clearly and distinctly: But seeing that in the greater Magnifiers you can see but a small Part of the Object. *viz.* the Legs or Claws of a Flea; while you are looking upon any Part of the Object, if ye take hold of the End of the Plate or Slider, e e, whereon the Object lies, and move it gently, you may see the whole Object successively, or any Part of the Object you please; and if that Part of the Object you design to look upon be out of the true Distance, remember your End Screw D, Fig. I. can always bring it in, by screwing it nearer or farther off.

After


This Plate must be placed at ☽ the Word Microscope.
Fig: I.
Fig: II.
Fig: III.
The Tail of a Small Living Fish while the Blood is Circulating in it by ye 6th Glass.
The Conjunction of ye Extremities of the Blood Vessels in the Lungs of a Frog.
The Scales of
An Eel by ye 7th Glass.
A Ling by ye 8th
A Flounder by the 4th
Mr Wilsons Microscope describ'd in the Philosophical Transactions No 28



After this manner may be ſeen all tranſparent Objects, Duſt, Liquids, Chryſtals of Salt, ſmall Inſects, ſuch as Fleas, Mites, *&c.* If they be *Inſects* that will creep away, or ſuch Objects as one intend to keep, they may be placed between the two *Regiſter-Glaſſes* f f. For by taking out (with the Point of a Penknife or ſmall Plyers) the Ring that keeps in the *Glaſs* f f, where the Object lies *they* will fall out of themſelves; ſo you may lay the Object between the two hollow ſides of *them*, and put the Ring in as it was before: But if the Object be Duſt or Liquids, a ſmall Drop of the Liquid, or a little of the Duſt laid on the outſide of the *Glaſs* f f, and applied as before, will be ſeen very eaſily.

As to the Firſt, Second, and Third *Magnifying-Glaſſes*, being marked with a ✠ upon the Ivory wherein they are ſet, they are only to be uſed with thoſe *Plates* or *Sliders* that are alſo marked with a ✠, wherein the Objects are placed between two thin Talks, becauſe the Thickneſs of the *Glaſſes* in the other *Plates* or *Sliders*, hinder the Object from approaching to the *Centre* or true Diſtance of theſe greater Magnifiers. But the manner of uſing them is the ſame with the former. Only remember to be careful when you put in or pull out the *Plate* or *Slider* e e, whereon the Object lies, or move it from one Object to another, not to let it rub your *Magnifying-Glaſs*, which is done by unſcrewing a little the End Screw D, Fig. I. when ye put in or pull out your *Plate*, or move it from one Object to another.

For ſeeing the *CIRCULATION of the BLOOD* at the Extremities of the *Arteries* and *Veins*, in the tranſparent Parts of *Fiſhes*, *Eels*, &c. There are two *Glaſs Tubes*, the one bigger, and the other leſſer, is expreſs'd at g g, wherein the *Fiſh* is to be put; when theſe *Tubes* are to be uſed, you are to unſcrew the End Screw D, Fig. I. in the Body of the *Microſcope*, until the *Tube* g g, can be receiv'd eaſily into that little Cavity G of the *Braſs-Plate*, faſtened to the Leather F, under the other two thin Plates of Braſs E E: When the *Tail* of your *Fiſh* lies flat to the *Glaſs Tube*, ſet it oppoſite to your *Magnifying-Glaſs*, and by ſcrewing in or out your End Screw D, Fig. I. as is ſaid before, you may eaſily bring it to the true Diſtance, and ſee the Blood circulate with great Pleaſure.

If you would ſee the *Blood circulate* in a *Frog*'s *Foot*, chuſe ſuch a *Frog* as will juſt go into your *Tube*, then with a little Stick, *&c.* expand the *Hinder Foot* of the *Frog*, and apply it cloſe to the Side of the Tube, obſerving that no Part of the *Frog* hinders the Light coming on its *Foot*, and when you have it at the juſt Diſtance, by Means of the Screw D, Fig. I. as aboveſaid, you will ſee the rapid *Motion* of the *Blood* in its *Veſſels*, which are very numerous in the tranſparent thin Membrane that's between the *Frog's Toes*: For this Object the 4th and 5th *Magnifiers* will do very well; but you may ſee the Circulation in the Tails of *Water-Newts* with the 6th and 7th *Glaſs*, by reaſon the Globules of the Blood of thoſe *Newts* are as big again as the Globules of the Blood of *Frogs* or ſmall Fiſh, as has been taken Notice of in N. 280 of the *Philoſophical Tranſactions*, Page 1184.

*N. B.* The *Circulation* cannot be ſo well ſeen by the Firſt, Second, and Third Magnifiers, becauſe the Thickneſs of the Glaſs wherein the Fiſh lies, hinders the Approximation of the Object from the true Focus of the Glaſs.

S, Fig. I. is a little Ivory Screw, upon which the Handles of the *Braſs Inſtrument* W, Fig. III. may be ſcrewed, and ſerve for a Handle to this Ivory one alſo.

The *Glaſs*, plac'd in the Manner of a Barrel Box, Fig. II. is only to be uſed when the Braſs Inſtrument (or in your Hand) being the leaſt Magnifier, for greater Objects, ſuch as Flies and common Inſects, *&c.* A Hole being made in the Side of this Box, Fig. II. whereby it may be ſcrewed on the Point L, Fig. III. of the Braſs Inſtrument, remembring to put the End b next to your Eye, and the other to the Object; ſo if you take up an Inſect in the Point of the Tongs K, or lay any opake Object on H the other End, you may approach them to the true Diſtance by means of the Joints and Screws ſpoken of before C, D, P, N, Fig. *Ibid.*

In the viewing of *Objects*, one ought to be careful not to hinder the Light from falling upon *them*, by the Hat, Peruke, or any other Thing, eſpecially when they are to look upon opake Objects: For nothing can be ſeen with the beſt of Glaſſes, unleſs the Object be in a due Diſtance, with a ſufficient Light.

The beſt Lights for the Plates or Sliders, where the Object lies between the two *Glaſſes*, is a clear Sky-light, or where the Sun ſhines on any white thing, or the Reflection of the *Light* from a Looking-glaſs. The *Light* of a Candle is likewiſe good for the viewing of very ſmall Objects, though it be a little uneaſy to thoſe who are not practis'd in *Microſcopes* to find out the Light of the Candle.

By what is here ſaid, it's hop'd that the Uſe of this *Microſcope*, eaſy of its ſelf, will be much eaſier to thoſe that uſe it; yet it cannot be doubted of *this*, as of all other Inſtruments of this Nature, but that *Uſus plura docebit*.

For the Conveniency of thoſe who would *Draw*, or make any *Sketches* or *Deſigns* after *Microſcopical* Objects, they may alſo have a Pedeſtal to fix the two Inſtruments above deſcribed, and make them ſtationary to any convenient Light. This Pedeſtal may be plac'd on a Table, *&c.* and after the Object and Light are fixed, as many Perſons as pleaſe may view the Object, without any Trouble or Difficulty in finding the Light.

The reſt of the annexed *Figures* were drawn by this *Microſcope* from ſeveral Objects.

A the *Artery*, B, the *Vein*, C their communicant Canal, by which the Blood is ſeen paſſing from the *former* to the *latter*, in the Tail of the *Fiſh*, expreſs'd at g g.

D the *Animalcula* in *Semine maſculino*, by the firſt Glaſs,

E one of the *Farina* of the Flower of *Mallows*, which magnified is the *Area* represented at D.

F the Branch of an Artery, G that of a Vein. The intermediate Spaces shew the Manner they communicate unto one another, in the Sides of the Lungs of *Frogs*, *Newts*, &c.

H one of the Feathers of a *Moth*'s Wing.

MIDDLE *Latitude*, in Navigation, is half the Summ of any two given Latitudes; as suppose the two Latitudes were 50°. 30'. and 45°. 20'. the middle Latitude will be 47°. 55.

There is a Method of working the several Cases of Sailing by *Middle Latitude*, which nearly agrees with *Mercator*'s or *Wright*'s way; and it is performed without the Table of Meridional Parts, either by the Tables of *Logarithms* or by *Gunter*'s Scales. Of this Method you have a short *Synopsis* in Mr. *Jones*'s *Navigation*, *p.* 71.

MID-SHIP-MEN, are Officers aboard a Ship, whose Station when they are on Duty, is some on the Quarter-Deck, others on the Poop, &c. Their Business is to mind the *Braces*, to look out, and to give about the Word of Command from the Captain and other superior Officers. They do also assist on all Occasions both in sailing the Ship, and in storing and rummaging the Hold. They are usually Gentlemen, who having served their Time as Voluntiers, are now upon their Preferment.

MILIARES *Glandulæ*, are those very small and infinitely numerous Glands which secern the Sweat and the Matter that exsudes in insensible Perspiration. See *Skin*.

MILLAINS, according to Mr. *Wingate*, are the third Subdivision of the Primes in *Gunter*'s Line, and express the 1000th Parts of such *Primes*.

MINIUM or *Read Lead*. Mr. *Ray* at the End of his Collect. of *Engl.* Words, gives this Account of the making of *Minium*. First they take Lead and waste it in an Oven or Furnace; by bringing it to a Substance almost like *Litharge*, and by stirring about with an Iron Rake or Hoe. Then they take it out and grind it with two Pair of Stones, which deliver it from one to another; and there is a Mill which moves at once six Pair of these Stones. When 'tis thus reduced to a Powder, they wash it, and then put it into an Oven or Reverberatory Furnace, where by continual stirring with a Rake or Hoe of Iron, it comes to its Colour in 2 or 3 Days. But the Fire must not be violent, for then it will clod and change Colour. The Iron Rake is hung or poised by a Hook, else it would be too heavy to be moved by one Man.

MINT, is the Place where the King or Queen's Coin is formed, be it of Gold or Silver: The chief Mint of *England* is in the *Tower* of *London*; of which the present Officers are (1.) The *Warden*, who is the chief, and is to receive the Bullion, and oversee all the other Officers. (2.) The *Master Worker*, who receives the Bullion from the *Warden*, causes it to be melted and delivered to the *Moniers*, and takes it from them again when coined. (3.) *Comptroller*, who is to see that the Money be made to the just Assize, and to oversee and controll the Officers, if the Money be not as it ought to be. (4.) The *Assay Master*, who weighs the Silver and Gold, and sees whether it be Standard. (5.) The *Auditor*, who takes all the Accounts. (6.) The *Surveyor of the Melting*, who is to see the Silver cast out, and that it be not alter'd after it's deliver'd to the *Melter*; which is after the *Assay-Master* hath made Trial of it. (7.) The *Clerk of the Irons*, who is to see that the Iron be clean and fit to work with. (8.) The *Graver*, who graveth the Dies and Stamps for the Coinage of the Money. (9.) The *Melters*, who melt the Bullion before it comes to coining. (10.) The *Blanchers*, who anneal, boil, and cleanse the Money. (11.) The *Porters*, who keep the Gate of the Mint. (12.) The *Provost of the Mint*, who provides for all the Moniers, and oversees them. And lastly, The *Moniers*; some of which shear the Money, some forge it, and some stamp or coin it, and some round it and mill it.

MITRE, in Architecture, is the Workmens Term for an Angle that is just 45 Degrees, or half a right one; and if it be a Quarter of a Right Angle, they call it a *Half Mitre*: And they have an Instrument made to this Angle which they call the *Mitre Square*, with which they strike Mitre Lines on their Quarters or Battens; and for Dispatch they have a *Mitre Box*, as they call it, which is made of two Pieces of Wood, each about an Inch thick, and one is nailed upright upon the Edge of the other; the upper Piece hath the Mitre Lines struck upon it on both Sides, and a Kerf to direct the Saw in cutting the Mitre Joints readily, by only applying the Piece into this Box.

MITRED *Abbots*, were formerly Governours of such Religious Houses, as had obtained from *Rome* the Privilege of wearing the Mitre, Ring, Crosier, and Gloves of a Bishop. It hath been a vulgar Error, that these *Mitred Abbots* were all the same with those *Conventual Prelates* who were summoned to Parliament as *Spiritual Lords*; but *some* of those summoned to Parliament were not *mitred*; and *some* that were *mitred* were not summoned; the Summons to Parliament not any way depending on their *Mitres*, but on their receiving their Temporals from the King. *Cowel*'s *Interpreter*.

MITTA, was anciently a *Saxon* Measure containing 16 Bushels.

MIXT *Tythes*. See *Tythes*.

MOAT; the Brink of the Moat next the Rampart in any Fortification, is called the *Scarp*, and the opposite one the *Counterscarp*.

MODEL, is an original Pattern which any Workman proposes to imitate; 'tis variously made of Wood, Stone, Plaster, &c. and should be (in Architecture, for Instance) made by a *Scale*, where an Inch or half an Inch represents a Foot, for the more exact compleating of the Design.

MOLMUTAN or *Molmutin Laws*, were the Laws of *Dunwallo Molmutius*, sixteenth King of the *Britains*; they were famous here till the Time of *William* the Conqueror. *Molmutius* was the first that published Laws in *Britain*; and these Laws, with those of Queen *Mercia*, are published in Latin by *Gildas*, out of the *British* Tongue.

MONIERS. See *Mint*.

MONOCHORD. See the accurate Division of the *Monochord*, in *Phil. Transf.* N. 238. by Dr. *Wallis*.

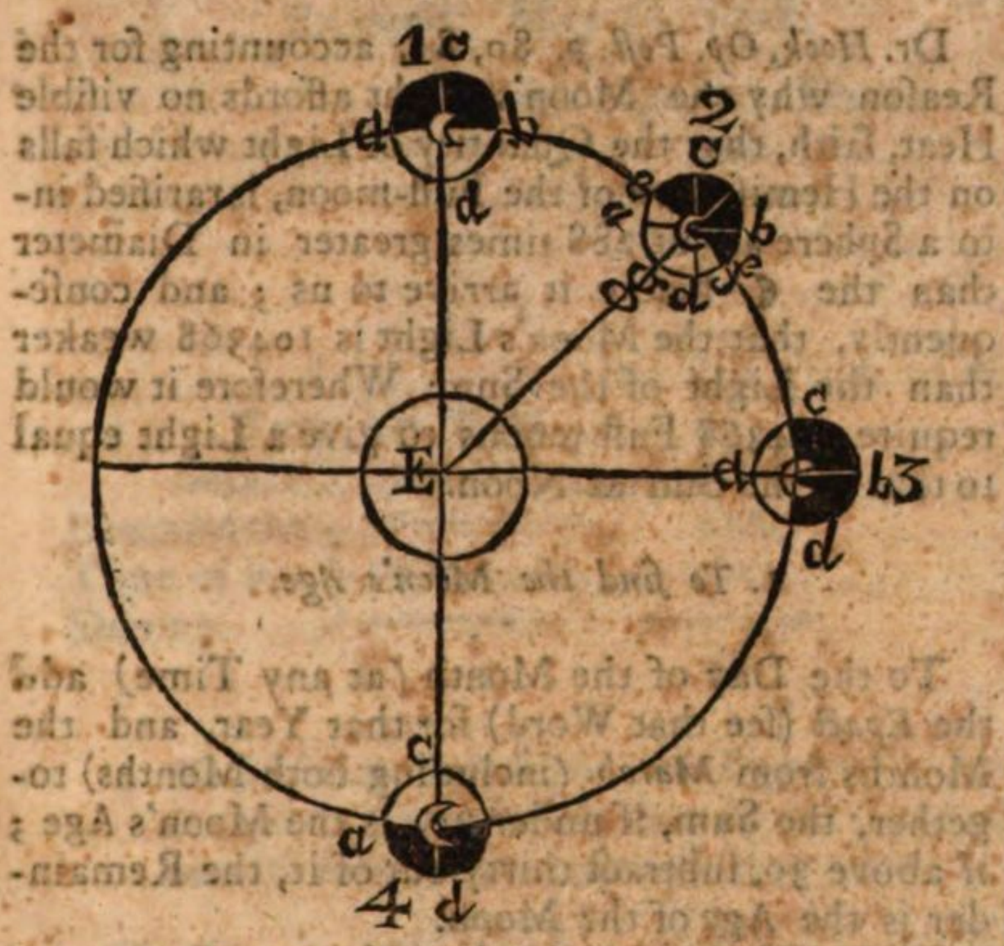
MONOPOLIZERS, are such Persons as combine together to engrols, and to raise the Price of Goods.

MONSOONS, are shifting Trade Winds in the *E. Indian Ocean*, which blows periodically, some for

for half a Year one way, others but for 3 Months, and then ſhift and blow for 6 or 3 Months directly contrary.

MOON. The Reaſon why the ☾ always ſhews the ſame Face towards us, is becauſe ſhe revolves round her Axis in the Time of her Periodical Month.

For if in moving in her Orbit round the Earth ſhe did not do ſo, but that the Horizon of the Disk *a b* kept always parallel to it ſelf in all Poſitions, 'tis plain, that as the Moon moves on in her Orbit, new Parts of the former dark Hemiſphere will begin to be enlighned (or rendred viſible to us ;) as appears plain from the Figure annexed. For ſuppoſe the Moon to have moved in her Orbit from 1 to 2, and that her Diameter *a b* keeps parallel to its ſelf in its firſt Situation ; then her viſible Hemiſphere will be, not as before *a d b*, but *e g f*: and when ſhe comes into Poſition 3, her viſible Hemiſphere will be *c a d*, inſtead of *a d b*, as at firſt : And laſtly, when the Moon is at 4, her viſible Hemiſphere will be *a c b*, which in the firſt Poſition was totally inviſible. And this can't be otherwiſe, if the Moon in her Revolution round the Earth, don't alſo revolve round her own Axis in the ſame exact Space of Time : But if you ſuppoſe her ſo to turn round her Axis, that the Diameter *a b* ſhall always be in a Normal Poſition to the Line E ☾ ; as in the 2d and 3d Poſitions *e f* and *c d* are ; 'tis plain the Moon muſt by ſuch a Motion round her Axis, always ſhew the ſame Face to you, as in Fact (abſtracting from her Vibrations, *&c.*) ſhe really doth.




The annual Regreſſion of the Moon's Nodes is 25 Dregrees, and the *Nutation of her Orbit* about 20 Minutes.

The Phænomena of the Moon, on which, as Foundations, the Lunar Aſtronomy is built, are ſuch are theſe

1. That the Moon moves daily from *Weſt* to *Eaſt*, and almoſt in the ſame Line with the Earth, or nearly in the Ecliptick.

For all the Secondary Planets deſcribe leſſer Orbits round their Primary, as *they do* round the Sun; and the Plains of their Orbits are not very different from that of the Ecliptick, and theſe Secondary Planets do alſo move the ſame Way as the Primary ones.

2. But yet the Moon doth not move accurately in the ſame Plane of the Ecliptick, deviating ſometimes a little to the *North*, and ſometimes to the *South* ; as is apparent from her Meridian Altitudes. The Plane of her Orbit being inclined to that of the Ecliptick, and interſecting it in two Points, which are called the Moon's *Nodes*.

3. The Phaſes of the Moon are continually changing ; ſometimes ſhe cannot be ſeen at all, then ſhe appears horned, biſected, gibbous, and at laſt *round* or *full* : And ſo on again in an inverſe Order.

For being a ſpherical opake Body, and receiving all her Light from the Sun ; tho' he will always illuminate one Hemiſphere of her, yet in the New-moon, when that Hemiſphere is entirely turned from you, and her Body between the Sun and their Eye, 'tis impoſſible for her to appear viſible : But as ſoon as by her Motion forward in her Orbit, Part of that Hemiſphere comes to be obverted to the Earth, ſhe will begin to appear *falcated* or with Horns of Light, and when ſhe is got to be 90 degr. from the Sun, ſhe will ſhew juſt one half of her illuminated Hemiſphere, *&c.*

4. The Eclipſe of the Sun happens only at the New-moon, tho' not at every one ; and that of the Moon only when ſhe is at the Full, tho' not at every Full-moon ; as is plain from the Reaſon and Nature of Eclipſes.

5. That obſcure Part of the Moon's Body which the Sun's Rays do not illuminate, when ſhe is Horned or Gibbous, or even in a Solar Eclipſe, is not totally inviſible, but appears with a reddiſh dirty coloured Light ; and that Light ſeems to come to the Moon by Reflection from the Earth.

For when the Moon is at New to us, the Earth is at Full to the Lunar Inhabitants ; and the Light of the Earth being about 15 times greater than that of the Moon, and the Moon ſo little as not to obſcure above a 20th Part of the Earth, the Light from the Earth may eaſily be ſuppoſed to render her a little viſible in even ſolar Eclipſes.

6. The Eclipſes of the Sun and Moon don't happen always in the *ſame* Places in the Zodiack, but in *others* moving ſtill gradually backward, or *in Antecedentia*.

The Reaſon of which is, that the Moon's Orbit is different from that of the Ecliptick, interſecting it but in one Line, whoſe extreme Points are called the *Nodes*, and which Nodes do annually move backward or in *Antecedentia* : But the Eclipſes cannot happen but when the two Luminaries are in or near theſe Nodes ; wherefore, *&c.*

7. There is a very ſenſible Difference in the apparent Length of the Moon's Diameter, at different Times.

For the Moon's Orbit being Elliptical, her Diſtance from the Earth will be very different, as ſhe is in different Parts of that Ellipſis ; and 'tis found that her apparent Diameter is nearly reciprocally proportional to her Diſtance, which Diſtance is both *greateſt* and *leaſt* in the Syzygies, becauſe the Excentricity of the Ellipſis is there greateſt.

8. The

8. The apparent Motion of the Moon is not always equal, but greater and leſs by Turns, and that very ſenſibly.

Which Phænomenon ariſes from ſeveral Cauſes concurring togerher. The firſt Cauſe of which is ſome Inequality even in the mean Motions of the Moon; for in the Earth's *Perihelia* the Moon is carried ſomething ſlower than in the *Aphelia*.

The next Cauſe is the Elliptick Figure of the Lunar Orbit, from whence the Moon muſt move faſter in her *Perigæum* than in her *Apogæum*; as is the Caſe of all the Planets.

A 3d Cauſe, is the continual changing of the Excentricity of the Moon's Orbit; from whence muſt ariſe a greater Difference of her Velocity in her *Perigæa*, and of her Tardity in her *Apogæa* in the Syzygies of the *Apſes* than in the Quadratures.

To all which we may add, that the Moon's Motion it ſelf is a little retarded from the Syzygies to the Quadratures, and then accelerated a little again from thence to the Syzygies, in every Lunar Month.

9. The monthly Motion of the Moon in the Ecliptick is ſwifteſt (*cæteris paribus*) when ſhe is in the Syzygies, and ſloweſt when ſhe is in her Quadratures to the Sun.

The Reaſon of which is to be had, not from any Syſtem of Aſtronomy, but from the Phyſical Principles of the *Newtonian* Philoſophy.

10. That Place where the Moon appears leaſt, and where her Motion is ſloweſt, doth not keep always in the ſame Degree of the Ecliptick, but moves ſenſibly forward, or *in Conſequentia*.

For tho' her *Apogæum* go forward in the Syzygies, and backward in the Quadratures, yet becauſe the former Motion is near twice as ſwift as the latter, the Exceſs in the whole Revolution of the *Apſes* muſt be forward, and conſequently the *Apogæum* will move on *in Conſequentia*, as by Obſervation 'tis found it really doth.

11. The Latitude of the Moon is moveable or changeable, being ſometimes greater and ſometimes leſſer (according to the various Poſition of her Orbit to the Sun) even in the ſame Degree of proper Longitude.

This Difference of Latitude ariſes from the various Inclination of the Plane of the Moon's Orbit to that of the Ecliptick. For, as was ſaid above, there is an Inequality even in that Inclination; when the Line of the Nodes is in the Syzygies, the Angle of the Inclination is greateſt, and leaſt when that Line is in the Quadratures, and of a mean Quantity in the intermediate Poſitions.

12. The Moon's Orbit is more or leſs circular according to its various Poſition in Reſpect of the Sun.

And ſo it muſt be, ſince as was ſhewn above, the Excentricity of her Orbit is greater when the Line of the *Apſes* is in the Syzygies, than when it is in the Quadratures, by almoſt half the leaſt Excentricity.

13. The Motion of the Moon is very unequal, and diſſimilar to its ſelf, whether you conſider it in different Parts of the ſame Month, or in the ſimilar Parts of different Months.

Nor is this ſtrange, if you conſider the various and diſſimilar Mutations above-mentioned.

14. The Light of the Moon reflected to us is ſo weak, that even in the Full-moon, it will by no Burning-Glaſs be brought to afford the leaſt Degree of Heat.

The Rays of Light have their Force decreaſed, (at leaſt) as the Square of their Diſtance; and conſequently the Force of the Sun's Rays reflected to us from the Moon, to thoſe that come to us directly, is decreaſed, at leaſt in the Proportion of the Square of the Moon's Diſtance from the Earth, to the Square of the Moon's Semi-diameter; and by Calculation it will be found, that the Light of the Moon brought hither, will be in Force but the fifty thouſandth Part of that which comes hither directly from the Sun.

15. The ſame Face of the Moon nearly, is always turned towards the Earth.

The Reaſon of which is, that ſhe turns round her own Axis, in the Time of her menſtrual Motion round the Earth, as I have demonſtrated above.

16. And yet there are ſome Librations of this Face, ſo that ſome more Eaſtern and Weſtern Parts of it, and ſometimes ſome more Northern and Southern do alternately appear.

The Reaſon and Cauſe of which libratory Motion, Sir *Iſ. Newton*, I think, firſt diſcovered or communicated.

Dr. *Hook*, *Op. Poſt. p.* 80, 81. accounting for the Reaſon why the Moon's Light affords no viſible Heat, ſaith, that the Quantity of Light which falls on the Hemiſphere of the Full-moon, is rarified into a Sphere about 288 times greater in Diameter than the ☾ before it arrive to us; and conſequently, that the Moon's Light is 104368 weaker than the Light of the Sun: Wherefore it would require 104368 Full-moons to give a Light equal to that of the Sun at Noon.

### 1. *To find the Moon's Age.*

To the Day of the Month (at any Time) add the *Epact* (ſee that Word) for that Year, and the Months from *March* (including both Months) together, the Sum, if under 30, is the Moon's Age; if above 30, ſubtract thirty out of it, the Remainder is the Age of the Moon.

*N. B.* If the Month have but 30 Days, you muſt ſubtract but 29 inſtead of 30.

*Example*, May 26, 1708.

| | |
|---|---|
| Epact | 18 |
| Days in *May* | 26 |
| Months from March | 3 |
| | 47 |
| Deduct --- | 30 |
| The Moon's Age | 17 Days. |

If the Time propoſed had been between *Jan.* 1. and *March* the firſt, you muſt have uſed the *Epact* for the Year before.

2. To

2. *To find the Moon's being upon the Meridian or or Southing.*

Multiply her Age by 4, and divide the Product by 5, the Quotient will give the *Hours*, and the Remainder multiplied by 12 will give the *Minutes*, when the Moon is less than 15 Days old; but when more than that, you must subduct 15, and work with the Remainder, as before.

*Example.* May 26. 1708.

Moon's Age 17 Days.
Deduct 15

2
Multiply by 4

Divide by 5) 8 (1 hour, 36 m.
5

3
Multiply by 12

36 Minutes.

3. *To find the Time of the Moon's Shining.*

Multiply her Age by 48, and divide the Product by 60; the Quotient shall be the Hours, and the Remainder the Minutes: That is, if the Moon be under 15 Days old; but if above, subtract the Time of her Shining, found as above, from 24 Hours, the Remainder will be the Time of her Shining in the Morning.

*Example.* May 26. 1708.

Moon's Age 17 Days
48

136
68

60) 816 (13 *h.* 36 *m.*
60

216
180

36

4. *To find how many Signs and Degrees the Moon is departed from the Sun since her last Conjunction with him, or since the last New-moon.*

Double the Moon's Age, and divide the Product by 5, the Quotient is the Signs, and the Remainder (multipled by 6) are the Degrees.

*Example.* May 26. 1708.

The Moon's Age 17 Days.
2

5) 34 (6 Signs.
30

Remains 4
Multiply by 6

Therefore the *Moon* is gone from 24 Degrees. the *Sun* 6 Signs, and 24 Degrees.

MOON's *Parallax.* There are two Ways of finding the Moon's Parallax.

1. From the Astronomical Tables, the Moon's Place must be accurately had for the Moment of the Observation; and then you must find by Calculation and by the Tables of Refractions, how many Degrees and Minutes the Centre of the ☾ is elevated above the Rational Horizon. At the same Time also exactly, by a large Astronomical Quadrant, Sextant, *&c.* adjusted with Telescopical Sights. *&c.* the Elevation of the Moon's Centre above the Horizon of the Observer must be taken in Degrees and Minutes. The Difference between those two Altitudes will be the Parallax of the Moon at the Moment of the Observation, and for that particular Place of the Moon; which being found, the *Horizontal Parallax* may be had by this Analogy; As the Cosine of the Moon's Altitude to Radius :: so is the Quantity of the present Parallax, to the Moon's Horizontal Parallax.

2. Without Astronomical Calculation, the Moon's Parallax may be thus found: Let her Diameter be accurately taken by a good Telescope and Micrometer, when she is on or near the *Meridian*, and when near the *Horizon*, the same Night; the meridian apparent Diameter will be the greatest; the Difference of these two apparent Diameters, being given, in the same Night, you may determine the entire Difference between the Horizontal and Vertical Diameter by the former Analogy. And from this Difference, which is proportional to the Earth's Semi-diameter, both the Moon's Distance and her Parallax may be found by an easie Calculation. And by the best Observation, the Moon's mean Horizontal Parallax hath been found to be about 57 Minutes, and consequently her mean Distance from the Earth about 60 Semi-diameters of the Earth; or about 24000 Miles *English.*

MOORS: The Lords Bayliffs in the Isle of *Man* are called by this Name; their Office is to summon the Courts for the several *Sheadings.*

MORAL *Philosophy*, or *moral Discipline*, is what is usually called *Ethicks* in the Schools, being a practical Science which explains the Nature and Reason of, and withal teaches and instructs us how to acquire that Felicity or Happiness which is agreeable to Humane Nature.

MORAL *Actions* or *Acts*, are such as render the Rational and Free Agent *good* or *evil*, and consequently rewardable and punishable, because he doth them.

MORESK-Work or *Morisko-Work*, is a kind of Antick-work in Painting or Sculpture, after the Manner of the *Moors*, consisting of several *Grotesco's.*

MORSUS *Diaboli*, is the Term which some Anatomists give to the outer Ends (*i. e.* those next the *Ovaria*) of the *Tubæ Fallopianæ*; because their Edges there appear jagged and torn.

MORTARS of Mr. *Coehorn*, are made of Hammer'd Iron of about 4 Inches Diameter at the Bore, ten Inches and a half long, and nine Inches in the Chase. They are fixed at an Elevation of 45°. on a Block of *Oak* of about 20 Inches long, and 10 ½ broad, and about 4 thick. These like Hand-Mortars, throw Hand-Grenadoes. They are used chiefly in the bottom of the *Trenches*, where they are placed about a Yard Distance one from another, having each a Soldier to attend it; and there is an Officer to every 40 or 50 of them.

They fire ſometimes 60 or 70 of theſe together, which throw their Shells into the *Covertway*, *&c*, and make a very terrible Slaughter.

MORTISE or *Mortaiſe*, is the Workmens Word in Architecture for the Hole made in one Piece of Timber to receive the Tennon of another Piece.

MORTMAIN *Statute*: There was a Statute made in 7 *Ed.* 1. *de Terris in manum mortuam non ponendis*; to reſtrain the Donation of any Lands or Tenements to Religious or pious Uſes, where they lay in a *Dead Hand*, without Succeſſion or due Service to the Lord and the King. After which Statute the Lands ſo given away were forfeited to the King, if the immediate Lord of the Fee made not his Claim within a Year after ſuch Alienation.

When the King by ſpecial Licence diſpenced with the *Statute of Mortmain*, there was a previous Inquiſition *ad quod Dampnum*, and a Return upon Oath that it would be no Prejudice to the Dignity and Revenues of the Crown. This Law is now relaxed by *Stat.* 39 *Eliz. c.* 5. of giving Lands to Hoſpitals; and by 14 of *Car.* II. *c.* 9. about purchaſing Lands and Tenements for the Poor within *London* and *Weſtminſter*.

MOSAIC *Work*, is corruptly ſo called; it ſhould be *Muſaick*; in Latin *muſivum Opus*, and ſometimes 'tis called alſo *Pavimenta Teſſelata*.

MOTION: From the firſt of Sir *Iſ. Newton*'s three Laws of Motion or Nature mentioned under this Word *Motion* in Vol. I. by way of *Corollary* may be inferred, (1.) That no Particle of Matter, or any Combination of ſuch (that is, no Body whatever) can either move of it ſelf, or alter the Direction of its Motion, becauſe 'tis entirely paſſive and indifferent as to Motion or Reſt; ſo that neither Motion or Reſt are eſſential to Matter. (2.) 'Tis plain alſo from hence, that naturally of it ſelf, no Body can ever move in a Curve Line; for ſince all Motion is originally and naturally rectilinear, 'tis impoſſible that any Body can move in a *Curve* or Line that is not ſtrait of it ſelf; becauſe then it muſt of it ſelf continually alter the Direction of its Motion, which cannot be, by the former *Corollary*; wherefore the Motion of the Heavenly Bodies in Circles or Ellipſes cannot be accounted for by the natural Laws of Motion; but it is owing to the Will of the great Creator that they are kept in their Orbits by an attractive Force.

From the ſecond of the three Laws of Motion, it follows, that all Effects will always be proportional to their *Adequate Cauſes*; and thus if any Degree of any Force will produce any Degree of Motion, a double Degree of the ſame Force will produce a double Degree of Motion, a Triple, a Triple, and ſo on in any Ratio whatſoever. And this Motion muſt proceed on in the ſame Direction with that of the moving Force, becauſe 'tis from *That* only that the Motion ariſes; and Bodies once in Motion, cannot change their Direction of themſelves.

And if a Body be already in Motion, the Motion ariſing from a Force impreſs'd, if it be in the ſame Direction with that of the former Motion, it will increaſe it in Proportion to its Power; but if it be impreſs'd in a contrary Direction, it deſtroys the former Motion either totally or in part, that is, equal to the Force of the Impreſſion. And when it hath a Direction any way oblique to that of the former Motion, it is either added to, or ſubtracted from it, according as a Motion ariſing from a Compoſition of thoſe two, is determined.

MOUNT-EGG; after Tin from the burnt Ore is melted down and remelted, there will ſometimes remain a different Slugg in the Bottom of the *Float*, this they call *Mount-Egg*; and tho' of a Tin Colour, yet is of an Iron Nature, as hath been found by applying a *Magnet* to it.

MUD-SUCKERS, *Limiſugæ*, are a Sort of Water-Fowl which ſuck out of the Mud of Channels, *&c.* ſome oily Juice or Slime with which they are nouriſhed; hence they are always delicate Fleſh, and their very Guts uncleanſed from the Excrements are uſually eaten, as thoſe of *Woodcocks*, &c. Theſe *Mudſuckers* have therefore very long Bills, and broad near the Tip.

MULIER, a Term uſed in our Common Law; ſome think to be a Corruption either from the Latin *Melior*, or the *French Meilieur*, and ſignifies the *Lawful Iſſue* preferred before an elder Brother born out of Matrimony. Others will have it to be derived, *quaſi ex muliere natus & non ex concubina*; and ſo they uſe the Word *Filius mulieratus*, in Oppoſition to a Baſtard; and in this Senſe the *Scotch* alſo uſe the Word, and therefore this laſt Etymology is moſt probable.

MULTA or *Multura Epiſcopi*, was formerly a Fine or Mulct paid to the King, that a Biſhop might have Power to make his laſt Will and Teſtament; as alſo to have the Probate of other Mens, and the granting Adminiſtrations.

MULTIPLICATION: It often happens that 'tis needleſs to expreſs at large all the Figures of the Product, eſpecially where the *Factors* have each many Places of Decimal Parts; and therefore the following Compendium is as uſeful as 'tis curious.

Suppoſe 3.141592 were to be multiplied by 52.7438; and that a Product which ſhould have 4 Places of Decimals, would be enough for the preſent Purpoſe. Firſt write down the *Multiplicand*, and ſet the *Place of Unites* in the *Multiplier* under that Figure of the *Multiplicand*, whoſe Place you intend to keep in the Product. Thus let 3.141592 be the *Multiplicand*, and you would have but 4 Places of Decimals in the Product; place therefore 2, the Place of Units in the *Multiplier*, under 5 the 4th Place of Decimals in the *Multiplicand*. Thus,

```
3.141592
8347.25
---------
157 0796
 62832
  2 1991
    1257
      94
      25
---------
165.6995
```

The Product with 4 places of Decimals only.

After this place all the other Figures of the Multiplier in a contrary Order; *viz.* the 5 Tens in 52 to the Right-hand in the Place of Unites, and all the Decimal Parts to the Left-hand, as you ſee in the Example. Then in multiplying begin always at the Figure in the *Multiplicand* that ſtands over the Figure you multiply by; ſetting down the firſt Figure of each particular Product, directly underneath one another, only you muſt have Regard to the Increaſe which would have ariſen out of the multiplication of the two next Figures, which ſtand to the Right Hand of that Figure in the Multiplicand, which you begin with.

Thus

Thus, ſay 5 times 9 is 45, and one which would ariſe from 5 multiplying 2, makes 46; therefore write down 6 and go on as in common Multiplication.

Then with the next Figure 2, ſay twice 5 is 10; which with the Increaſe that would ariſe from 2 multiplying 9; will be nearly two Tens to be put down inſtead of the Cypher. Then ſay, twice 1 is 2, and one to be added from the twice 5 is 3; therefore write down 3, and go on as uſually.

Next go on with 7, and ſay, 7 times 1 is 7, but from the Conſideration of 7 being multiplied into the two Figures 5 and 9, which ſtand to the Right Hand of the 1, there will be 4 to be added; ſo 7 and 4 make 11, write down 1 and carry 1, *&c.*

Another *Example* will make all plain.

Let 257.356 be to be multiplied by 76.48, and the Product to be entirely conſiſting of Integers without Decimal Parts.

First write down the Multiplicand, and then ſet 6, the Place of Units, in the Multiplier under 7 the Place of Units in the Multiplicand (becauſe you are to have no Decimal Parts) and write down the other Figures in a contrary Order, as above directed; proceeding alſo with each ſingle Figure, as is there taught.

```
257.356
 84.67
-------
180 15
1544
 103
  20
-------
19682
-------
```

The Product clear of Fractions.

MULTONES *Auri*, were formerly Pieces of Gold Coin impreſt with the Figure of a Sheep or Lamb (perhaps the *Agnus Dei*) from whence they had this Name, *Multo* being then uſed for a Sheep, as *Mutto* and *Muto* was alſo, whence our Word *Mutton*. This Coin was more common in *France*; but that it was ſometimes uſed alſo in *England*, appears by a Patent of 33 *Ed.* 1.

MUNDICK, is a Marchaſite found in the *Tinmines*, of a Colour white, yellow, or green. They ſometimes call it *maxy*; it ſeems to be a Kind of *Sulphur*, becauſe Fire only ſeparates it from the *Tin*, and it evaporates into Smoke. The *mundick* Ore is eaſily known by its brown ſad-coloured glittering, and by its ſoon colouring your Fingers. Some ſay this nouriſhes the Tin, and yet they ſay alſo, where much *Mundick* is found there is little or no Tin; and 'tis certain, that if there be any *Mundick* left in melting the Tin, it makes it thick and *cruddy*, as they ſpeak; that is, it is not ſo ductile as otherwiſe it would be.

MUNIONS, in Architecture, are the ſhort upright Poſts or Bars that divide the ſeveral Lights in a Window Frame.

MUSCLE; a Muſcle is only a Bundle of *Fibres*, which being cloſely compacted at each End, make the two Tendons, each of which is inſerted into ſome fixt Parts of the Body. Every one of theſe Fibres conſiſts of a prodigious Number of leſſer *Fibrillæ*, which are ſo many very ſlender *elaſtick Canals* bound about by ſmall tranſverſe parallel Threads, which divide theſe hollow *Fibrillæ* into ſo many elaſtick *Cyſtes* or *Veſiculæ*, which are orbicular, being formed of two concave Segments of a Sphere. Into every one of theſe *Veſiculæ*, an Artery, Vein, or Nerve enter; the firſt to bring and carry back the Blood; the laſt to carry thither the *Liquidum Nervorum* or Nervous Juice, which mingling in the *Veſiculæ*, with the Blood, doth very probably (it having an acid Taſte, and therefore conſiſting of Particles which are pointed and ſo qualified to prick and break the Globules of the Blood) let out the impriſoned elaſtick Air which before was contained in the Globules, into thoſe little *Veſiculæ*, whereby the elaſtick Cells of the Fibres will be blown up, and thereby their Longitudinal Diameters, from Cell to Cell ſtraitned; and this muſt contract the Length of the whole Fibre, and ſo move that Organ, to which one of the Tendons is fixt. This, ſaith Dr. *Cheyne, Phil. Prin. Natural Religion, p.* 221. is undoubtedly the true manner of *muſcular* Motion.

He thinks alſo, that the broken Shells of theſe Globules are carried back by the Veins to the *Lungs* to be new formed; which is the Reaſon that muſcular Motion is ſo conſtantly and uniformly performed, as long as the Blood Globules and Animal Spirits are in ſufficient Plenty.

MUSCULUS *Tubæ novus Valſalvæ* vel *Palato-Salpingæus*, a Muſcle ariſing broad and tendinous from the Edge of all the lunated Part of the *Os Palati*, ſeveral of its Fibres being ſpread upon the Membrane that covers the *Foramen Narium*, then growing into a ſmall thin Tendon, it is reflected about the Hook-like Proceſs of the inner *Ala* of the *Proceſſus Pteregoidæus internus*, and is inſerted carnons into all the membranous, fleſhly, and cartilaginous Parts of the Tube. Its Uſe is to dilate and keep open this Channel. *Myogr. comparatæ Specim, p.* 47.

MUSCULUS *Auriculæ Anterior*, is a new (5*th*) Muſcle of the *Auricle*, and added to the four before diſcovered by *Caſſerius*, by the Diſcoverer of it *Valſalva* in his Treatiſe of the Ear.

It ariſes from the inveſting Membrane of the Temporal Muſcle, above that Part of the *Zygoma* which proceeds from the *Os Temporis*; thence running ſtrait down, it parts into two; one of which is inſerted to the Fore Part of the upper Cavity of the *Concha*; and the other a little higher, into the Fore Part of the Cavity of the *Scapha*. He deſcribes there alſo two new Muſcles more, which from their Situation he gives theſe Names to.

MUSCULUS *Tragi*, and MUSCULUS *Anti-Tragius* } but in lean emaciated Bodies he owns theſe are not to be ſeen.

MUSICK. What follows is a brief Account of the *Elements of Muſick*, communicated by the ingenious Mr. *John Perks*.

The Thing conſidered in Muſick is *Harmonical Sound*, or Sound ſo manageable, as to pleaſe the Ear and Fancy of the Hearers.

The Senſe of Sound is cauſed in us by the trembling motion of the Air, excited by the Percuſſion of ſome ſolid Body, as a Bell, String, Pipe, *&c.*

This Trembling of the Air is quick or ſlow, according to the Impreſſion given by the Voice or Inſtrument. The quicker the Trembling is, the more acute and ſharp is the Sound; and the ſlower, the more grave and flat,

The ſame Degree of Quickneſs of the Trembling or Pulſes of the Air being continued, the ſame Sound or Note is continued alſo. Hence a ſounding String keeping the ſame Note to the laſt, ſhews, that its Vibrations are in equal Time from the greateſt to the leaſt Ranges of its motion.

The ſhorter a muſical String is, *cæteris paribus*, the quicker are its Vibrations, and the more acute its Note: And, contrariwiſe, the longer a String is, the more ſlow are its Vibrations, and the more grave its Note.

Hence the Proportions of the Degrees of *Acuteneſs* and *Gravity* of Notes are computed from the Diviſions of a *Monochord*, or ſtrained *muſical String*.

The Proportion of *Quickneſs* in the Vibrations of two Strings, and alſo of the Pulſes of the Air excited thereby, is *Reciprocal* or *Counter* to the Lengths of the Strings; ſo *twice* the Length gives (*cæteris paribus*) *half* the Quickneſs of Pulſes (or *half* the Number of Pulſes in the ſame time,) If the Lengths are as 3 to 2, the Velocity of Pulſes is as 2 to 3, *&c.* Hence the Relation or Proportion of muſical Notes is determined as follows.

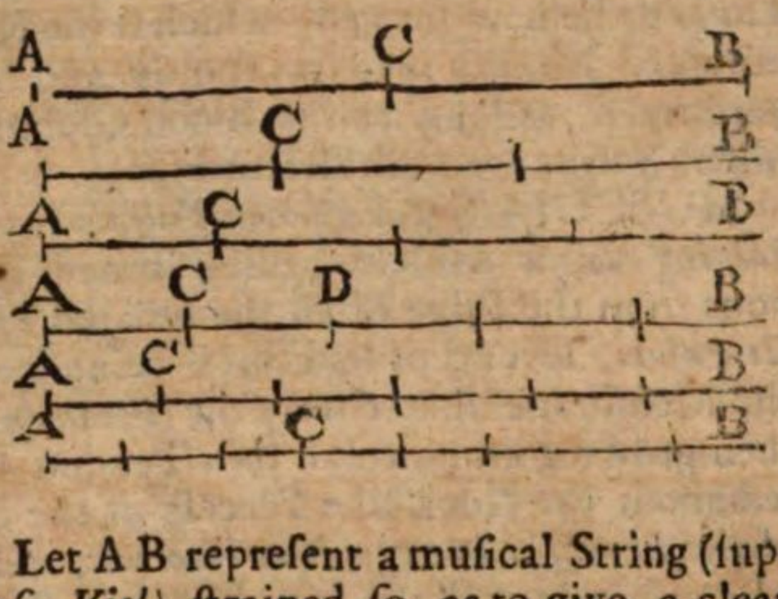



*Fig.* 1.
*Fig.* 2.
*Fig.* 3.
*Fig.* 4.
*Fig.* 5.
*Fig.* 6.

*Fig.* 1. Let A B repreſent a muſical String (ſuppoſe a *Baſs Viol*) ſtrained ſo as to give a clear Sound. Let it be divided into two equal Parts at C. Stop the String at C, and the Part CB (being ſtruck) will ſound an *Octave* or *Eighth* to the Note of the whole String A B when unſtopt. CB is in length to A B as 1 to 2; and the *Vibrations* of C B to thoſe of A B (in the ſame Time) as 2 to 1. Hence the Proportion of an *Octave* or *Diapaſon* is *Dupla*, Double, 2 to 1.

*Fig.* 2. Let the String A B be divided into three equal Parts, of which A C is one. If the String be ſtop'd in C, the Part C B will ſound a *Fifth* to the Note of the whole String. C B is to A B (in length) as 2 to 3, and the Vibrations of C B are to thoſe of A B as 3 to 2 in Quickneſs. Hence the Proportion between the two Notes of a *Fifth* (*Diapente*) is *Seſquialtera*, 3 to 2.

*Fig.* 3. Let A C be a Quarter of the whole String A B. Stop in C, and the Part C B will ſound a *Fourth* to the Note of the whole String A B. Hence the Proportion between the Notes of a *Fourth* (*Diateſſaron*) is *Seſquitertia*, 4 to 3.

*Fig.* 4. Let A C be a Fifth Part of the String A B. Stop in C, ſo will C B ſound a *Greater Third* to the Note of the whole String A B. The Proportion therefore of the Notes of a *Greater* or *Sharp Third* is *Seſquiquarta*, 5 to 4.

*Fig.* 5. Let A C be the ſixth Part of A B. Stop in C, ſo will C B ſound a *Leſſer* or *Flat Third* to A B, whoſe Proportion is therefore *Seſquiquinta*, 6 to 5.

If D B (*Fig.* 4) be $\frac{3}{5}$ of A B, B D will ſound a *Greater Sixth* to A B.

If C B (*Fig.* 6.) be $\frac{5}{8}$ of A B, C D will ſound a *Leſſer Sixth* to A B.

From what hath been ſaid it follows, that

| | | | | |
|---|---|---|---|---|
| | 2 | Pulſes | 1 | *An Eight or Octave.* |
| | 3 | of the | 2 | *A Fifth.* |
| | 4 | Acuter | 3 | *A Fourth.* |
| If | 5 | Note be | 4 | *A greater Third.* |
| | 6 | equal in | 5 | *A leſſer Third.* |
| | 5 | Time | 3 | *A greater Sixth.* |
| | 8 | to | 5 | *A leſſer Sixth.* |

When two Notes in any of the precedent Proportions one to another, are ſounded together; their Sounds are agreeable and pleaſing to the Ear, and are therefore called *Concords*. Of theſe the Eighth and Fifth are called *Perfect Concords*; Thirds and Sixths are called *Imperfect Concords*: The Fourth (anciently accounted a *Concord*) is by modern Muſicians accounted a *Diſcord* to the *Baſs* in Conſort-Muſick, as wanting a Fifth under to compleat the Harmony.

The above-mentioned are all the Simple Concords that the Ear allows of. If the Proportion between any two Notes be *compounded* of the Proportion of an *Octave* with that of any other Concord, it retains the *Name* and *Nature* of the added Concord. So a *Tenth*, that is, an *Eight* and *Third*, is accounted but a *Third*; and ſo of the reſt.

All other Proportions between 2 Notes ſounding together produce *Diſcords*, or Sounds harſh and unpleaſing to the Ear, the Coincidencies of the Pulſes being too remote one from the other.

By this it appears, that *Commenſurability* in the Quickneſs of the Vibrations is neceſſary to *Concordance*; and the *ſmaller* the Numbers are that expreſs the Proportion of the Pulſes in the ſame Time, or the *nearer* their Coincidencies, the more *perfect* is the Harmony. And conſequently if their Pulſes be of *Incommenſurable Velocities*, the *Diſcord* will be in the *higheſt Degree* harſh and diſpleaſing.

From this Account of Concords and Diſcords may a Reaſon be given of ſeveral Phænomena of Sounds, as particularly why two Strings of a *Baſs Viol* that are *Uniſons* or *Octaves* one to the other, if one be ſtruck, the other will tremble ſo as to be ſenſibly perceived if a ſmall Bit of Paper be laid on it. For the String that is ſtruck putting the Air into a certain Degree of trembling, which being the ſame, or next Degree of proportional Quickneſs to that of the unſtruck String, ſets it a trembling alſo. This Experiment, (and others of like Nature) Dr. *Holder* very well illuſtrates by the Inſtance of a *Pendulum*, which if you blow into Motion, and continue to blow uniformly as it begins to go from you, it may be continued in Motion as long as you pleaſe; but if you blow irregularly (ſometimes as it goes and ſometimes as it comes) its Motion will be check'd, and at laſt ceaſe.

Being once in a Room where was a *Baſs Viol*, and ſtriking one of the Strings, a looſe Quarry of Glaſs in the Window jarr'd every Time that String was ſtruck, which it would not do upon ſtriking any of the other diſcording Strings. The Reaſon of which ſeem to be, that the Times of the Vibrations of the looſe Quarry were equal (or in near Concordance) to thoſe of the String.

From the foregoing Proportions may thoſe of all other muſical Intervals be computed by Compounding or Dividing. I'll give a few Inſtances, and for more refer to Dr. *Holder*'s *Grounds and Principles*

*Principles of Harmony*, where all Things are more fully treated of.

Let it be required to find what Proportion the extreme Notes will have of *Fourth* and *Fifth* added together. The Proportion of the Notes of a Fifth is expreſs'd by $\frac{3}{2}$, that of a Fourth by $\frac{4}{3}$: Compound theſe Proportions, ſo $\frac{3}{2} \times \frac{4}{3} = \frac{12}{6} = \frac{2}{1}$, which is the Proportion of an *Octave*: Whence it appears that a Fourth and Fifth added together make an Eighth. Again, to find the *Difference* between a Fifth and a Fourth; Divide $\frac{3}{2}$ by $\frac{4}{3}$ [$\frac{4}{3}$) $\frac{3}{2}$ ($= \frac{9}{8}$] it gives $\frac{8}{9}$, which is therefore the Proportion of a greater Tone by which a Fifth and Fourth differ.

To find the Difference between a Greater Sixth and a Fifth; Divide $\frac{5}{3}$ (the Proportion of a Greater Sixth) by $\frac{3}{2}$ (that of a Fifth) it gives $\frac{10}{9}$ [$\frac{3}{2}$) $\frac{5}{3}$ ($= \frac{10}{9}$] which is the Proportion of a *Leſſer Tone*.

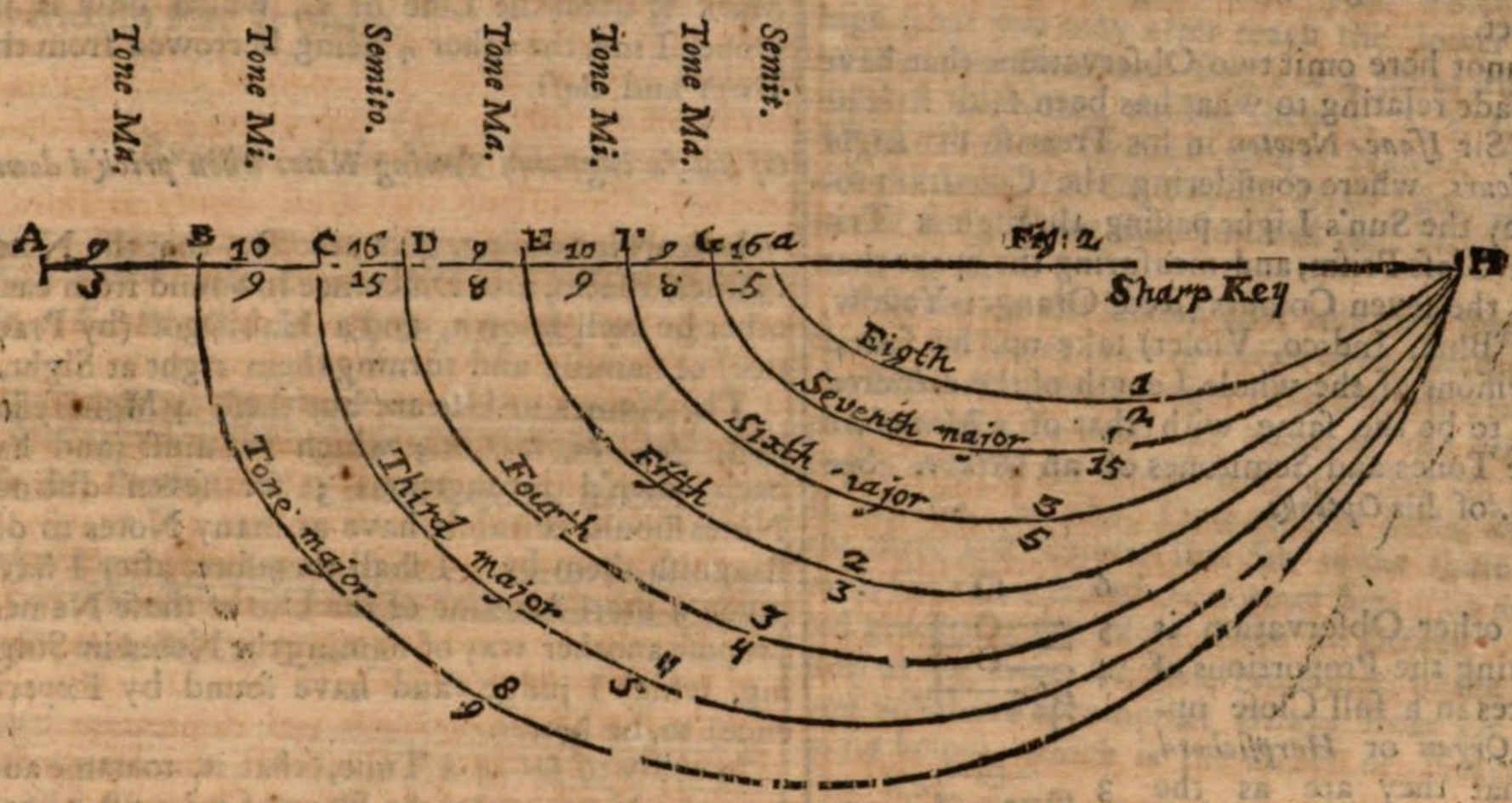
To find the Difference of a Fourth and Greater Third, Divide $\frac{4}{3}$ by $\frac{5}{4}$ [$\frac{5}{4}$) $\frac{4}{3}$ ($= \frac{16}{15}$] it gives $\frac{16}{15}$, which is therefore the Proportion of a *Semi-tone* (or leſſer gradual Interval) by which a greater Third and Fourth differ. In like manner may other Intervals be compared.

In a gradual Series of 8 Notes, there are contained 5 *Tones*, (or whole Notes) 3 Greater and 2 Leſſer, and 2 *Semi-tones* (or half Notes) whoſe Order among themſelves is different according to the *Key*.

The *Key* is the Principal or Fundamental Note of a Tune, to which the reſt have proper Relations, and with which the Baſs always concludes.

The *Key* is called *Flat* or *Sharp*, not as to the Key-Note it ſelf, but with Reſpect to the *Third*, *Sixth*, and *Seventh* above it. A *Flat Key* is that which hath above it (and reckoning from the Key) a *Leſſer* Third, Sixth and Seventh; and a *Sharp Key* is that which hath a *Greater* Third, Sixth and Seventh; the 2*d*, 4*th*, and 5*th* being the ſame Intervals in both Keys.

The annexed Figures ſhew how a String is to be divided to expreſs the Notes in a Flat or Sharp Key.



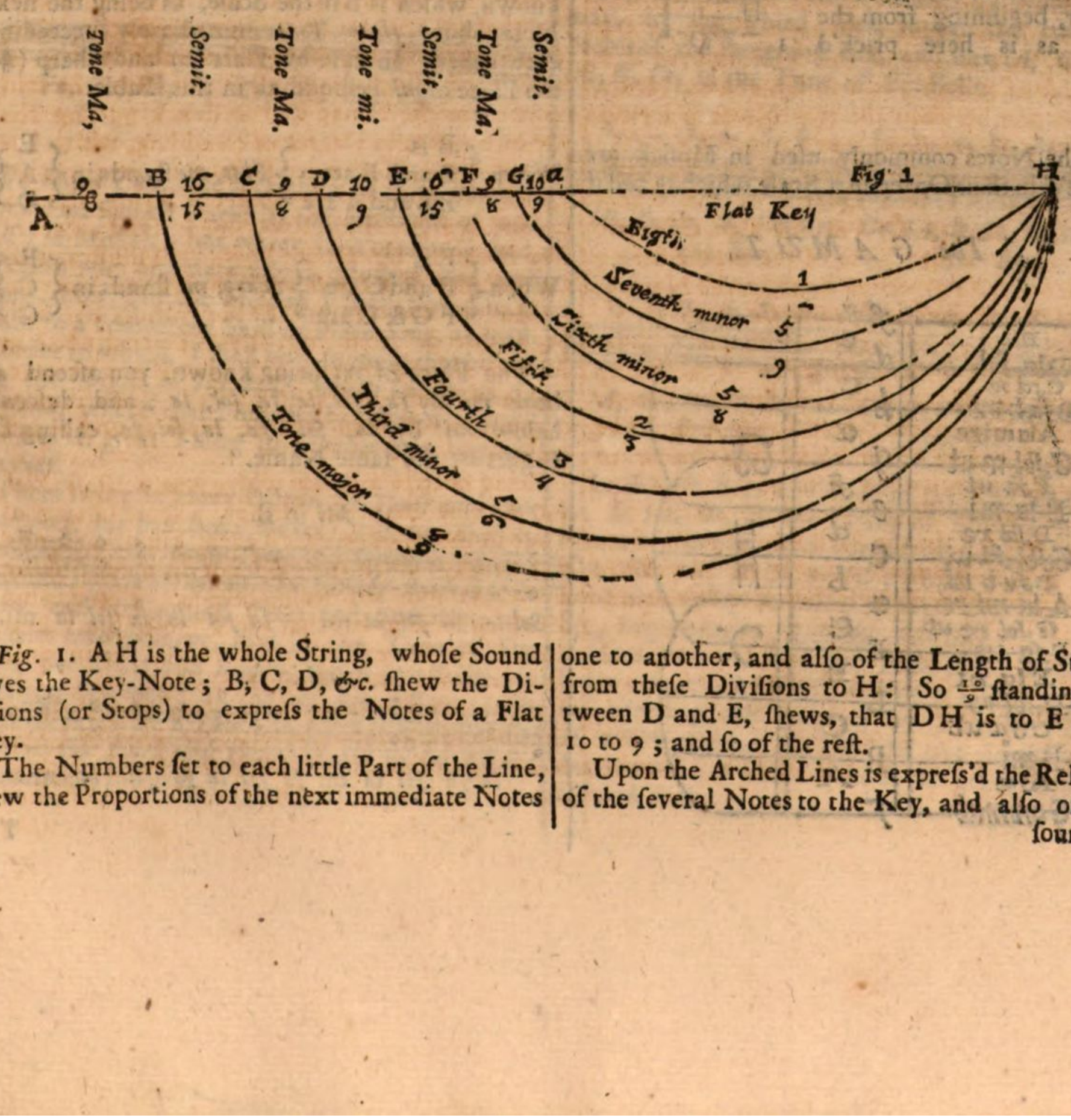




*Fig.* 1. A H is the whole String, whoſe Sound gives the Key-Note; B, C, D, *&c.* ſhew the Diviſions (or Stops) to expreſs the Notes of a Flat Key.

The Numbers ſet to each little Part of the Line, ſhew the Proportions of the next immediate Notes one to another, and alſo of the Length of Strings from theſe Diviſions to H: So $\frac{10}{9}$ ſtanding between D and E, ſhews, that D H is to E H as 10 to 9; and ſo of the reſt.

Upon the Arched Lines is expreſs'd the Relation of the ſeveral Notes to the Key, and alſo of the ſounding

ſounding Part to the whole String. So E H is $\frac{2}{3}$ of a whole String, and ſounds a Fifth to the Key. In like manner *Fig.* 2. ſhews the Diviſions in a Sharp Key.

Suppoſe A H (*Fig.* 1.) be a Line 24 Inches long, then will A B be $2\frac{2}{3}$ Inches; A C 4 Inches, A D 6 Inches, A E 8 Inches, A F 9, A G $10\frac{2}{3}$ Inches, A a 12 Inches.

To expreſs the Notes of a *Sharp Key*, let A H (*Fig.* 2.) be a Line 24 Inches long. then is A B $2\frac{1}{2}$ Inches, A C $4\frac{4}{5}$ Inches, A D 6 Inches, A E 8 Inches, A F $9\frac{3}{5}$, A G $11\frac{1}{5}$, A a 12 Inches.

If a middle-ſiz'd Gut-ſtring be ſtrained over a Line thus divided at about a fifth Part of an Inch Diſtance from the Line, the Diviſions mark'd in the Line will ſhew where to ſtop the String ſo as to expreſs the ſeveral Notes.

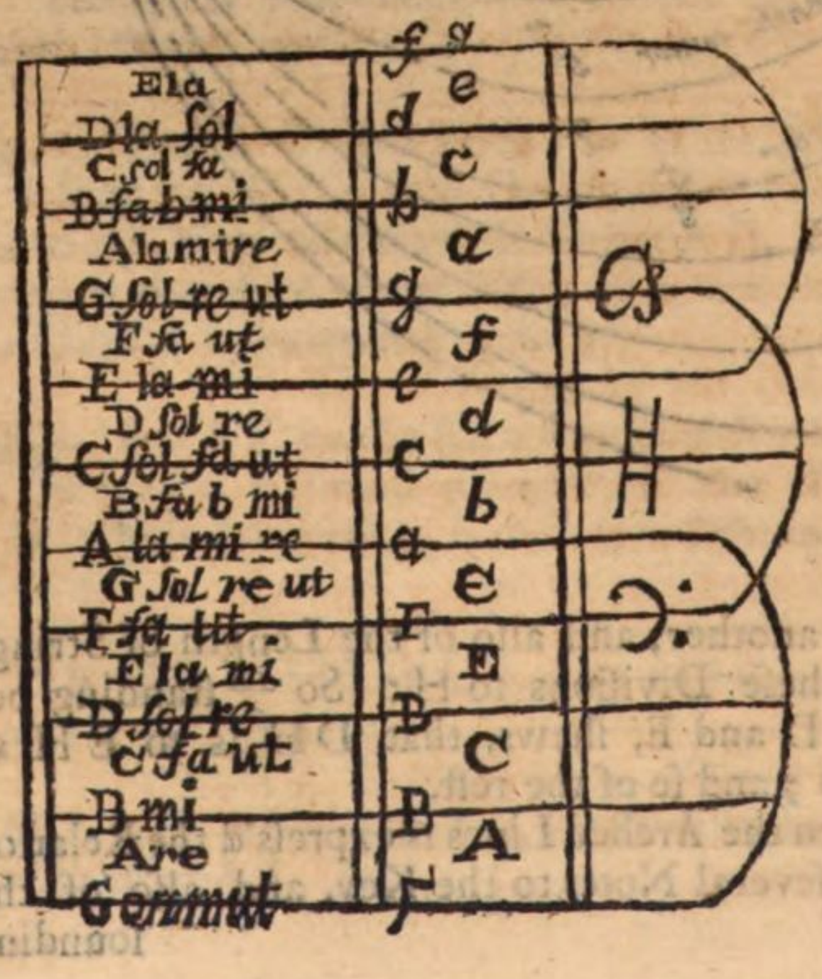
Above and below the Eighth the Notes aſcend and deſcend in the ſame order repeated, and therefore all Eights are called by the ſame Names, and (in the *Gamut*) ſigned with the ſame Letters of the Alphabet.

I cannot here omit two Obſervations that have been made relating to what has been ſaid: The firſt by Sir *Iſaac Newton* in his Treatiſe of *Light* and *Colours*, where conſidering the Colours produced by the Sun's Light paſſing through a Triangular Glaſs Priſm, and meaſuring the Space that each of the ſeven Colours (Red, Orange, Yellow, Green, Blue, Indico, Violet) take up, he found the Diviſions of the whole Length of the coloured Image, to be the ſame with that of a *Monochord* into the Tones and Semitones of an *Octave*. See *pag.* 92. of his *Opticks*.

The other Obſervation is concerning the Proportions of the Notes in a full Cloſe upon an *Organ* or *Harpſichord*, *viz.* That they are as the Numbers 1, 2, 3, 4, 5, 6, in order, beginning from the *Baſs*, as is here prick'd down.

All the Notes commonly uſed in Muſick are compriz'd in their Order in a Scale which is call'd

*The GAMUT.*




Sometimes Ledger Lines are added above and below, as Occaſion requires.

In the firſt Column are ſet the Names by which the Keys, or Notes, are commonly called, as *Gamut*, *A re*, &c. In the ſecond Column are ſet the 7 Letters belonging to the ſeveral Lines and Spaces. The third Column contains the *Cliffs*, and ſhews how many Degrees, or Notes, they are one above or below the other; which being known, the other Degrees of Diſtance are eaſily computed.

Five of theſe Lines, with their Spaces, are commonly ſufficient for the pricking of a Tune; therefore is the whole Scale divided into 3 Syſtems or Staves, compaſſed in by arched Lines. Of theſe the lower 5 belong to the Baſs, and are diſtinguiſh'd by this Mark 𝄢 upon the Line of F. The uppermoſt 5 Lines contains the *Treble* Part, which hath for its *Cliff* 𝄞 or *Gs* upon the Line of G. The *Tenor*, or middle Part, hath for its *Cliff* this Mark 𝄡 upon the Line of C, which only is its proper Line, the other 4 being borrowed from the *Treble* and *Baſs*.

*Of Sol-fa-ing, and Tuning Notes when prick'd down.*

In learning to ſing, it is neceſſary that the Notes Names, Places, and Difference in Sound from each other be well known, and a Habit got (by Practice) of naming and turning them right at Sight.

The Names in Uſe are but theſe 4 Monoſyllables, *ſol*, *la*, *mi*, *fa*; which yet muſt (and has been) own'd incongruous; for ſeven diſtinct Notes ſhould certainly have as many Notes to diſtinguiſh them by. I ſhall therefore, after I have given a ſhort Account of the Uſe of thoſe Names, propoſe another way of naming the Notes in Singing, which I judge (and have found by Experience) to be better.

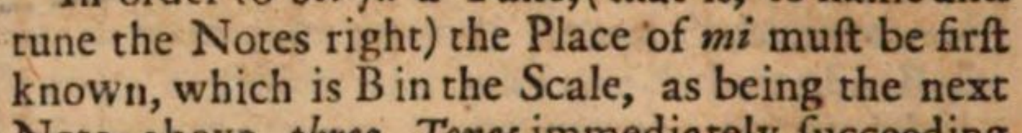
In order to *Sol-fa* a Tune, (that is, to name and tune the Notes right) the Place of *mi* muſt be firſt known, which is B in the Scale, as being the next Note above *three Tones* immediately ſucceeding each other. In caſe of Flats (b) and Sharp (♯) the Place of *mi* is found as in this Table.

When { B is / B and E are / B E and A are } *Flat*, *mi* ſtands in { E / A / D }

When { F is / F and C are / F G & C are } *Sharp*, *mi* ſtands in { F / C / G }

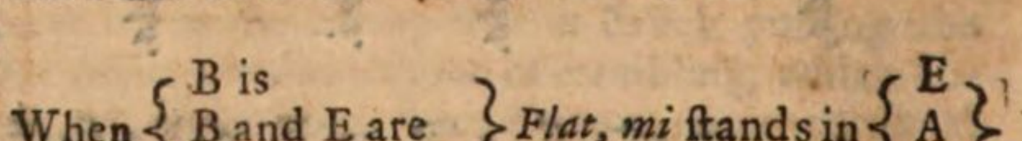
The Place of *mi* being known, you aſcend above *mi* by *fa*, *ſol*, *la*, *fa*, *ſol*, *la*; and deſcend below *mi* by *la*, *ſol*, *fa*, *la*, *ſol*, *fa*, calling all Eights by the ſame Name.

*Mi* in B.



*Sol la fa ſol la* mi *fa ſol la fa ſol la* mi.

*Mi* in A.



*la fa ſol la* mi *fa ſol la fa ſol la* mi.

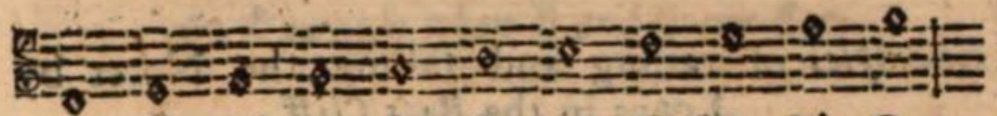
I'll

I'll now propoſe the other way of naming the Notes, that I mention'd before.

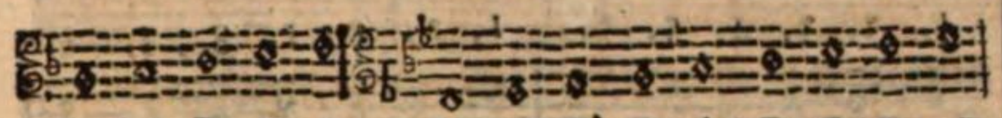
The ſeven muſical Notes being expreſs'd in the *Gamut* by the 7 firſt Letters of the Alphabet, *A. B, C, D, E, F, G*; let theſe Letters be their Names whereby to expreſs them in Singing. Only, for better Sound's ſake, and to accommodate them to the Variations by *Flats* and *Sharps*, let *A* and *E* be call'd *lA* and *lE*. Let *F* be called *Fà* (with a broader Sound as in the Word *Fall.*) *G* and *C* are to be pronounc'd *Ge* and *Ce*; ſo will the 7 Names be *lA, B, Ce, D, lE, Fà, Ge.* When *A* and *E* are mark'd to be flat at the Beginning of the Staff of Lines, let them be called *mA* and *mE*; when *B* is Flat call it *Be*, as in the Word *Benefit*. When *F* is mark'd to be a Sharp, let it be call'd *Fa*, as in the Word *Fatal*. When *C* is Sharp call it *Cee* (its proper Name.) In like manner, when *G* is Sharp, let it be called *Gee*, not *Ge*.

By this means the proper Letter expreſſing each Note is preſerv'd, and alſo a Proviſion made for Variation of the Name, according as the Note is varied to Flat or Sharp.

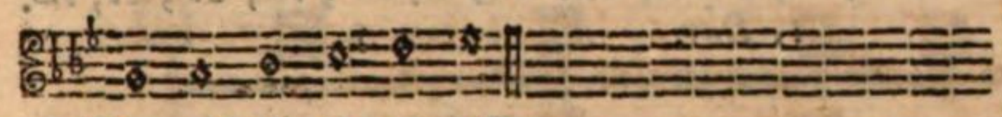
*Examples of the Notes Names.*



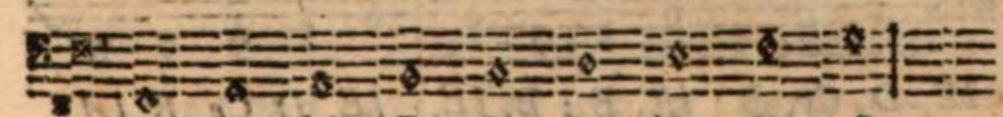
*D, lE. Fà, Ge, lA, B, Ce, D, lE, Fà, Ge.*



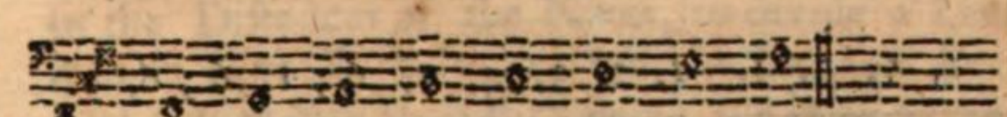
*Ge, lA, Be, Ce, D. D, mE, Fà, Ge, lA, Be, Ce, D, mE.*



*Ge, mA, Be, Ce, D, mE.*



*Fa, Ge, lA, B, Ce, D, lE, Fa, Ge.*

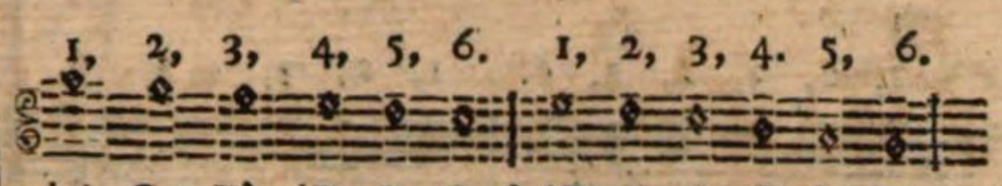


*Fa, Ge, lA, B, Ce, D, lE, Fa.*

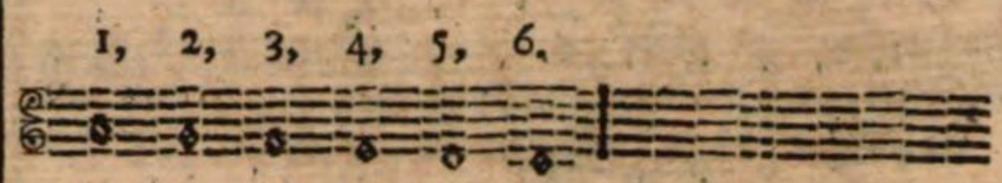
To ſing a Tune true according as it is prick'd, is beſt and ſooneſt learnt by the Aſſiſtance of one skill'd in Muſick; but where ſuch cannot be had, a Perſon who has naturally a Muſical Ear and Fancy, may, (by the Method I ſhall here direct) attain to a competent Skill in *Plain-Song*, at leaſt. In order to which, I ſhall only ſuppoſe that he can ſing the Tune of *Six Bells*, which (with us in *England*, where that Number of Bells is ſo common) is no great Thing to ſuppoſe in a capable Learner.

There being in every *Octave* ſix *Tones* and two *Semitones*, (as has been ſhewn) it is neceſſary to true Singing, that theſe *Tones* and *Semitones* ſhould keep their proper Places. In Order therefore to know and diſtinguiſh *Tones* and *Semitones*, the Learner muſt obſerve, that in the Tune of Six Bells, the *Third* and *Fourth* Notes (or Bells) are diſtant a *Semitone*; all the reſt are diſtant (each from its next) by a *Tone*. A good Ear will eaſily obſerve the *Third* and *Fourth* Notes to be nearer Sound than the reſt.

*To apply the Tune of Six Bells to Notes prick'd in the Treble Cliff.*




*lA, Ge, Fà, lE, D, Ce | lE, D, Ce, B, lA, Ge.*
*1ſt Bar. | 2d Bar.*

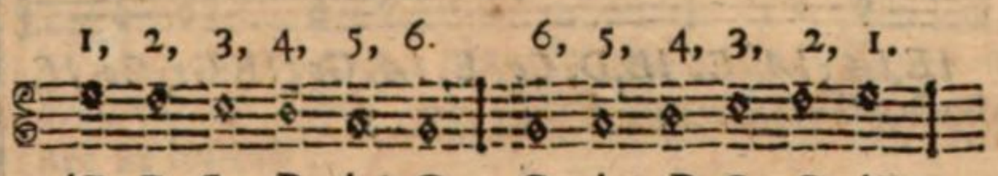



*lA, Ge, Fà, lE, D, Ce.*
*3d. Bar.*

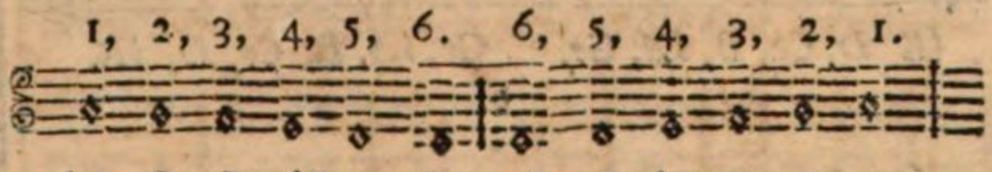
In this Example (conſiſting of 3 Bars or Diviſions) you have in the firſt Bar the Notes of Six Bells, beginning at the Leger-line above the Staff, which is the Place of *A*, (according to the Order in the *Gamut.*) Begin with your Voice pretty high (that you may after reach the lower Notes in the other Bars) and ſing 3 or 4 times diſtinctly the firſt ſix Notes, calling them 1, 2, 3, 4, 5, 6. Then call them by their proper Names, (ſet under the Staff) *lA, Ge, Fa, lE, D, Ce*; ſinging them in the ſame Tune that you did the Numbers 1, 2, 3, 4, 5, 6.

Proceed to the ſecond Bar, but firſt ſing your former ſix Notes once or twice over, holding out the Note *lE* a little longer than the reſt; then repeating only the three laſt Notes of the firſt Six, begin at *lE* in the ſecond Bar, and ſing *lE, D, Ce, B, lA, Ge,* in the Tune of Six Bells, keeping the three firſt Notes of this Six in the ſame Tune with the three laſt of the former Six. So are you led gradually one Note above an *Octave*. If you ſtop at the lower *lA*, (one Note ſhort of the laſt 6, you will have a compleat *Octave* from *lA* above to *lA* below, which is the Order of Notes in a Flat Key.

If your Voice will reach another ſix Notes, you may, in the Third Bar, repeat the two laſt Notes of the foregoing Six, and ſing *lA, Ge, Fa, lE, D, Ce,* in the Tune of Six Bells.




*lE, D, Ce, B, lA, Ge. Ge, lA, B, Ce, D, lE.*
*4th Bar. 5th Bar.*




*lA, Ge, Fa, lE, D, Ce. Ce, D, lE, Fa, Ge, lA.*
*6th Bar. 7th Bar.*

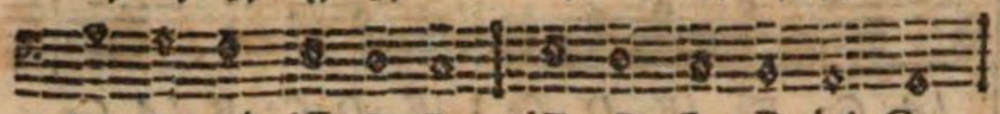
In the 4th Bar, having ſung the 6 Notes *lE, D, Ce, B, lA, Ge,* in the Tune of 6 Bells ſeveral times, try to ſing them backward, as in the 5th Bar, *Ge, lA, B, Ce, D, lE*; which with a little heed may eaſily be done, as may alſo the other Six, beginning at *lA* in the 6th Bar.

Here note, 1. That the Tune of Six Bells may begin either at *lA* or *lE*, and no where elſe without altering the Property by Flats or Sharps, of which anon. 2. That the two *Semitones* lie, one between *B* and *Ce*, and the other between *lE* and *Fa*.

The

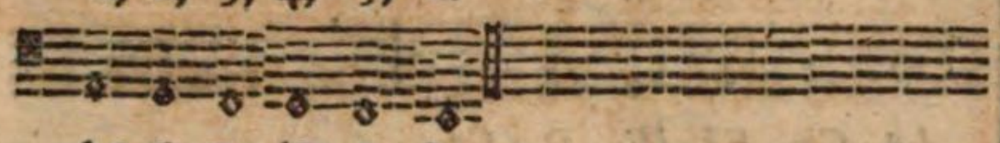
The ſame Directions will ſerve for the following Notes ſet in the *Baſs Cliff*, and therefore I ſhall only ſet down the Notes.

1, 2, 3, 4, 5, 6. 1, 2, 3, 4, 5, 6.



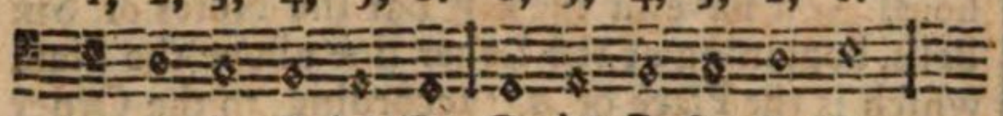
*lA, Ge, Fâ, lE, D, Ce.* *lE, D, Ce, B, lA, Ge.*
1ſt. Bar. 2d. Bar.

1, 2, 3, 4, 5, 6.



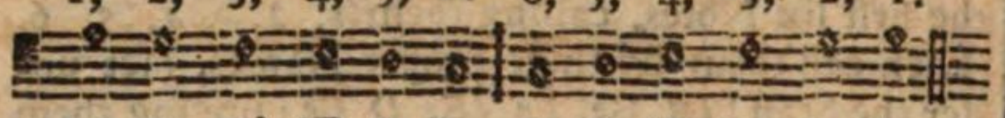
*lA, G, Fa, lE, D, Ce.*
3d. Bar.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



*lE, D, Ce, B, lA, Ge.* *Ge, lA, B, Ce, D, lE.*
4th. Bar. 5th. Bar.

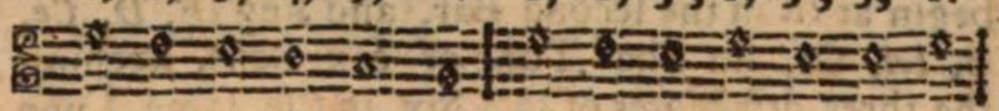
1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



*lA, Ge, Fâ, lE, D, Ce.* *Ce, D, lE, Fa, Ge, lA.*
6th. Bar. 7th. Bar.

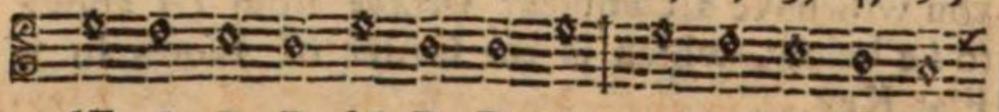
*Examples* of riſing and falling the Voice by Leaps in the *Treble Cliff*.

1, 2, 3, 4, 5, 6. 1, 2, 3; 1, 3; 3, 1.



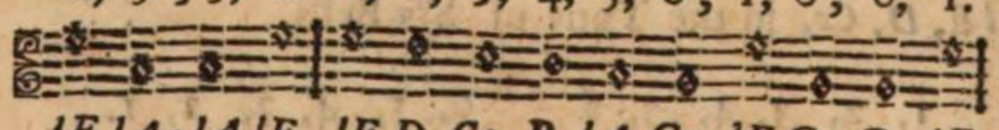
*lE, D, Ce, B, lA, Ge.* *lE, De, Ce; lE, Ce; Ce, lE.*
1ſt. Bar. 2.

1, 2, 3, 4; 1, 4; 4, 1. 1, 2, 3, 4, 5;



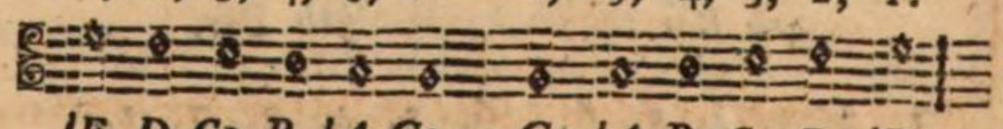
*lE, D, Ce, B; lE, B; B, lE.* *lE, D, Ce, B, lA;*
3. 4.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.



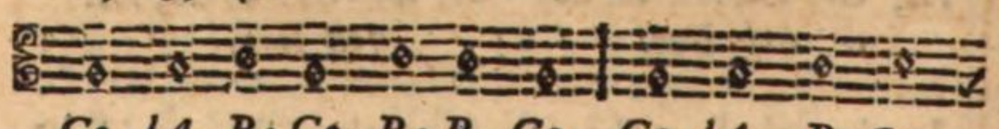
*lE, lA; lA, lE.* *lE, D, Ce, B, lA, Ge; lE, Ge; Ge, lE.*
5.

1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.

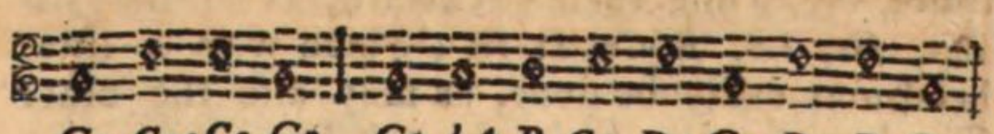


*lE D, Ce, B, lA, Ge.* *Ge, lA, B, Ce, D, lE.*
6.

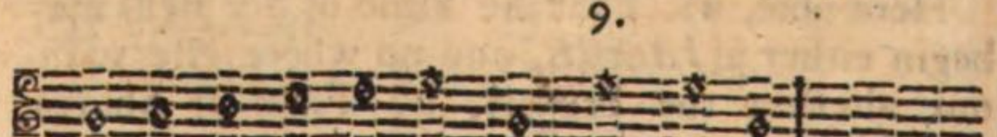
6, 5, 4.



*Ge, lA, B; Ge, B; B, Ge.* *Ge, lA, B, Ce;*
7. 8.



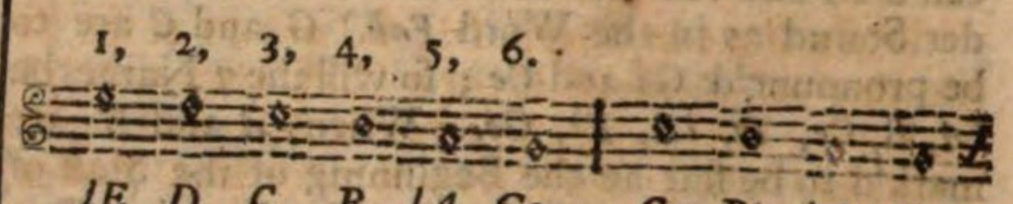
*Ge, Ce; Ce, Ge.* *Ge, lA, B, Ce, D; Ge, D; D, Ge.*
9.



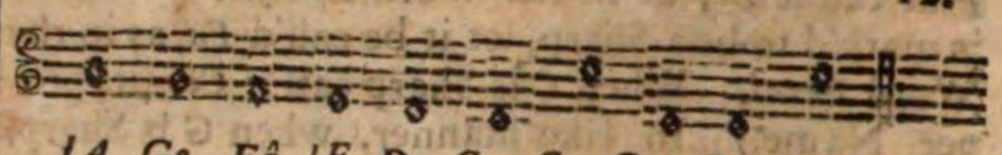
*Ge, lA, B, Ce, D, lE; Ge, lE; lE, Ge.*
10.

In the firſt Bar, ſing the 6 Notes in order. In the 2d Bar, ſing only the 3 firſt two or three times, then skipping the ſecond Note *D*, ſing *lE, Ce* ſeveral times, and then upwards *Ce lE*. In like manner proceed to the following Bars, ſinging the Notes in each Bar as they are prick'd, till you have learnt to raiſe and fall the Voice by the Leaps there ſet down.

1, 2, 3, 4, 5, 6.



*lE D, C, B, lA, Ge.* *Ce, Be, lA, Ge,*
11. 12.

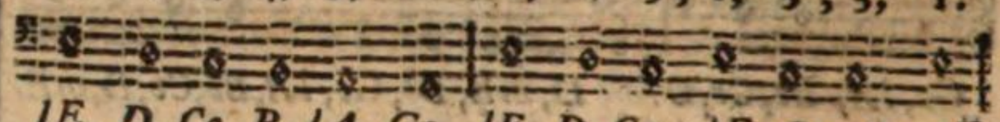


*lA, Ge, Fâ, lE, D, Ce; Ce, Ce; Ce, Ce,*

In the 12th Bar, ſing the 6 Notes, and in ſinging hold *Ce* the 3d Note, ſomewhat longer than the reſt the better to hit it in beginning afterward at that Note: Then in the 12th Bar begin at *Ce*, and repeat *Ce, B, lA, Ge*, ſeveral times, and then going 2 Steps back, ſing Six from *lA* to *Ce*, below, which will be an *Octave* to the Note *Ce* above.

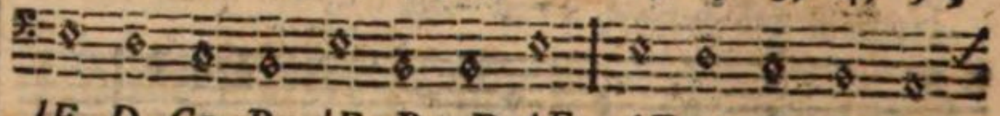
*Examples* of raiſing and falling the Notes by Leaps in the *Baſs Cliff*.

1, 2, 3, 4, 5, 6. 1, 2, 3; 1, 3; 3, 1.



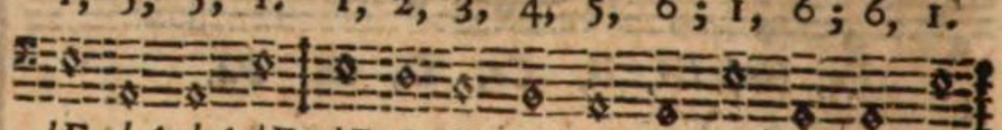
*lE, D, Ce, B, lA, Ge.* *lE, D, Ce; lE, Ce; Ce, lE.*
1. Bar. 2.

1, 2, 3, 4; 1, 4; 4, 1. 1, 2, 3, 4, 5;



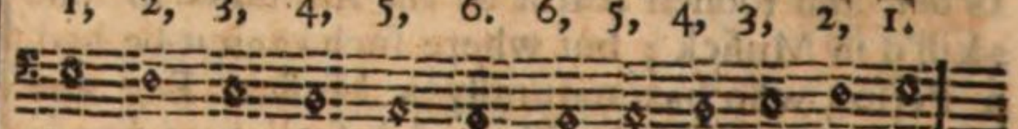
*lE, D, Ce, B; lE, B; B, lE.* *lE, D, Ce, B, lA;*
3. 4.

1, 5; 5, 1. 1, 2, 3, 4, 5, 6; 1, 6; 6, 1.

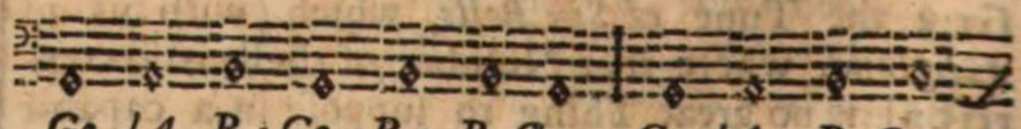


*lE, lA; lA, lE.* *lE, D, Ce, B, lA, Ge; lE, Ge; Ge, lE.*
5.

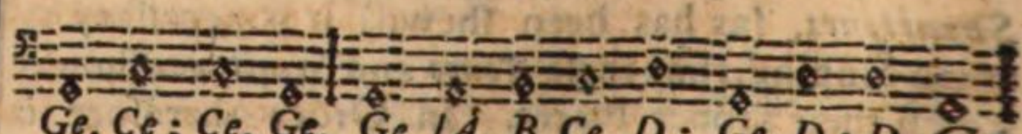
1, 2, 3, 4, 5, 6. 6, 5, 4, 3, 2, 1.



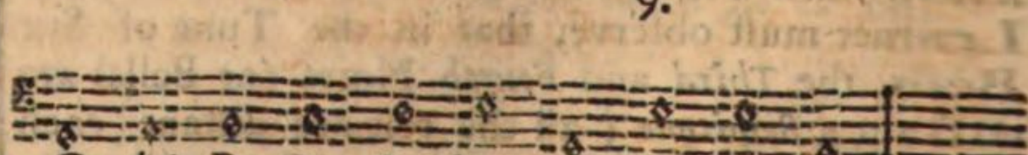
*lE, D, Ce, B, lA, Ge.* *Ge, lA, B, Ce, D, lE.*
6.



*Ge, lA, B; Ge, B; B, Ge.* *Ge, lA, B, Ce;*
7. 8.

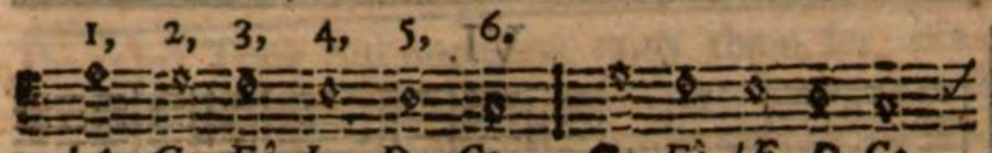


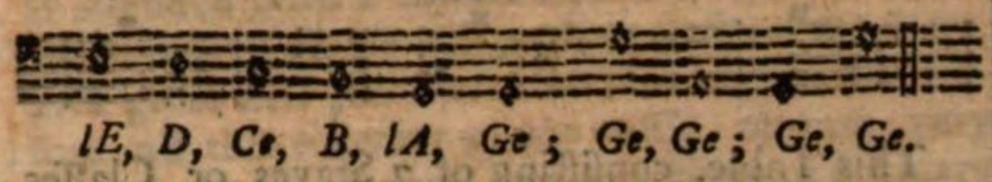
*Ge, Ce; Ce, Ge.* *Ge, lA, B, Ce, D; Ge, D; D, Ge.*
9.



*Ge, lA, B, Ce, D, lE; Ge, lE; lE, Ge.*
10.

*lA,*



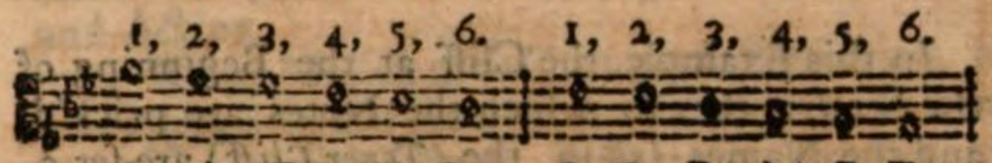




When Flats or Sharps ( b, ♯ ) are set at the Beginning of the Staff by the Cliff, they alter the Places for beginning the 6 Notes, by removing the *Semitones* (one or both) from their original Places ; the Flat [b] removing its Notes a *Semitone* lower ; and the Sharp [♯] removing then a *Semitone* higher. When there are no Flats and Sharps, the Tune of Six Bells begins at *lE* and *lA* only ; in other Cases as follows.

When { *Be* is flat / *Be* and *mE* are flat / *mA*, *Be* & *mE* are flat } begin the Tune of 6 Bells at { *lA* & *D*. / *Ge* & *D*. / *Ge* & *Ce*.

When { *Fa* is sharp / *Fa* and *C* are sharp / *Fa* G & *C* are sharp } begin the Tune of 6 Bells at { *B* & *lE*. / *B* & *Fa*. / *C* & *Fa*.

*An Example when* B *and* E *are flat.*

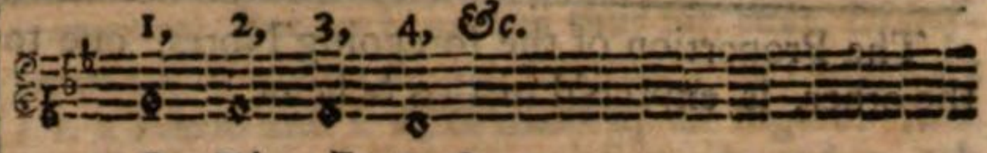


It may be a good Way to give Learners a Notion of the Alterations made by Flats and Sharps ; in the Diſtances of the Notes, to divide a Line into 12 equal Parts (which will do for this Purpoſe, tho' in Strictneſs they ſhould not be all equal) as the Line A a is here divided. Provide 8 little ſquare Papers with theſe 8 Letters, *A*, *B*, *C*, *D*, *E*, *F*, *G*, *a*, upon each, one ; and place them as on the underſide of the Figure, which ſhews their natural Order, and the Places of the *Semitones* between B and C, and between E and F. Suppoſe I ſhould now ſee the Order of the *Tones* and *Semitones* when B and E are ſigned flat in the Staff thus,  to do this, I remove the Papers mark'd with B and E, one Degree (anſwering to a *Semitone*) lower, or nearer to A ; and then the Papers will ſtand in Order as above the Line, and the two *Semitones* are now between A, B, and D, E. In caſe of *Sharps*, the Letter deſign'd to be ſharp muſt be removed one Degree (or twelfth Part) higher, or nearer to *a*.

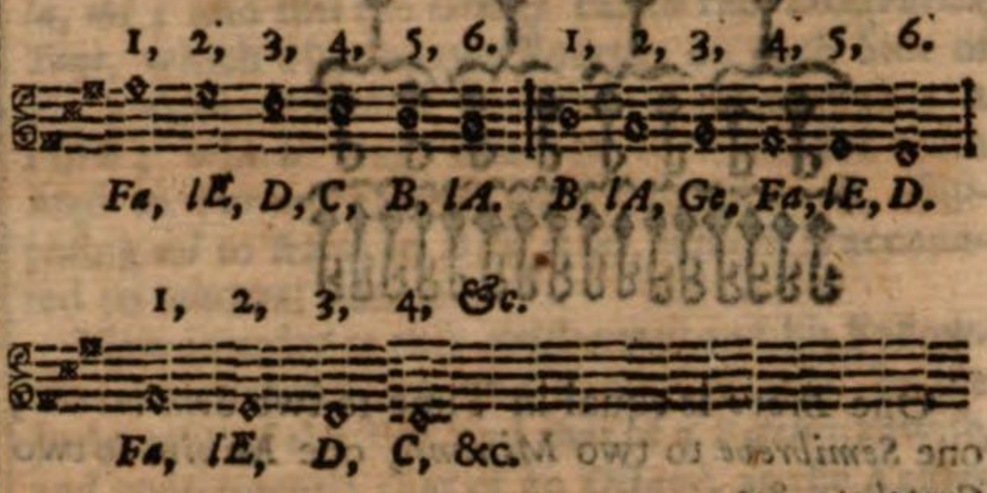
Thus may all the Varieties be repreſented to the Eye, and the Reaſon of beginning the Six Notes as is directed, be alſo underſtood.

### *Of the Quantity of Notes as to Time.*

Beſides the giving to Notes their right Tune




*An Example when* F *and* C *are ſharp.*



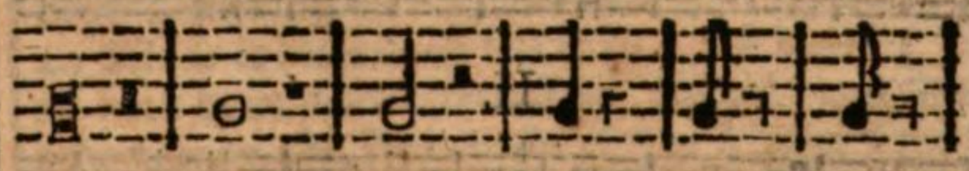

By the Table above, and theſe two Examples, may be underſtood how to place the Six Notes in any other Caſe of Flats and Sharps, or in other Cliffs. The *Semitones* in all Caſes, lie between the 3d and 4th Notes of the Six.

See more, with Application to *Pſalmody*, in a Treatiſe called, *A New and Eaſy Method to learn to Sing by* Book ; Printed for *W. Rogers* in *Fleetſtreet*.

(according to their Places in the Staff of 5 Lines) Regard is alſo to be had to the *Length* or *Shortneſs* of *Time* they are expreſs'd in, which is known by the Figure or Shape of the Character by which they are pricked on the Lines.

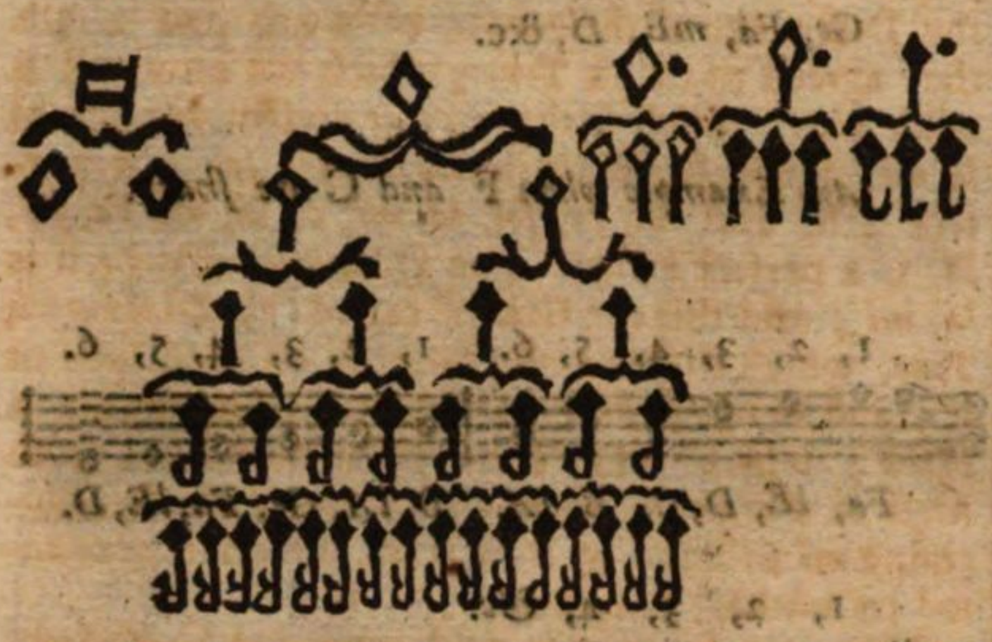
The Names and Figures of the uſual Notes in Reſpect of *Time*, and their correſpondent Reſts are as follow :

*Breve, Semibreve, Minim, Crochet, Quaver, Semiquaver.*



The Strokes or Marks ſet after each Note are called *Reſts* or *Pauſes*, and denote a Ceaſing or Intermiſſion of the Sound for the Time of the Notes they are join'd to.

The Proportion of the foregoing Notes, one to the other, is expreſs'd in this Scheme.



One *Breve* is equal in Time to two *Semibreves*; one *Semibreve* to two *Minims*; one *Minim* to two *Crotchets*, &c.

When a Prick (.) is ſet after any Note, it increaſes its Quantity half as much more. So (𝅗𝅥.) is equal in Time to (𝅗𝅥𝅗𝅥) a *Semibreve* and *Minim*. A prick'd *Minim* (𝅗𝅥.) is equal in Time to (𝅗𝅥𝅘𝅥) a *Minim* and *Crotchet*.

If the Words *one, two, three, four* be pronounc'd in a reading Tenor, the Time of pronouncing each Syllable may be acounted the Meaſure or Time of one *Crotchet*; and conſequently, *one, two*, gives the Time of a *Minim*; *one, two, three*, of a prick'd *Minim*; *one, two, three, four*, of a *Semibreve*.

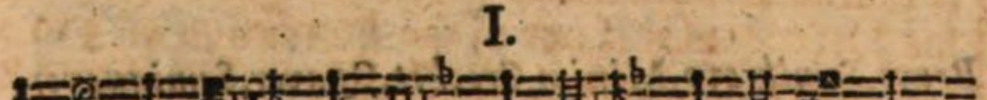
This may ſuffice for an Entrance, referring the Reader to Books for farther Information.

## *Of Singing in different Cliffs.*

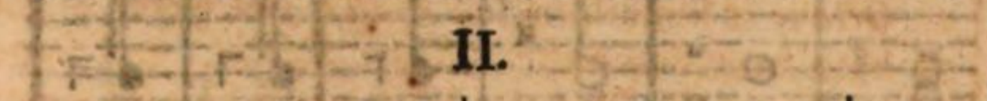
The Difference of Cliffs is what doth perplex Learners. They who can ſing in the *Treble Cliff*, are at a Loſs when they come to the *Tenor* or *Baſs Cliffs*: I will therefore here give a Table, wherein all the uſual Cliffs (or Poſitions of them) are ſo compar'd and order'd, that he who can ſing readily in one Cliff, may ſing in any other in the Table.

*A Table whereby all the uſual* Cliffs *may be reduced to any one* Cliff *deſired.*

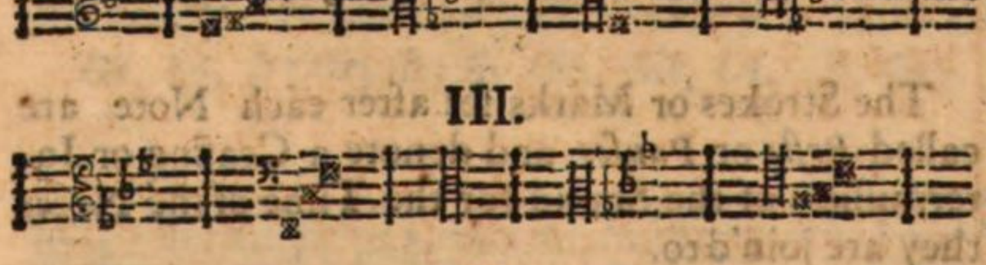
I.



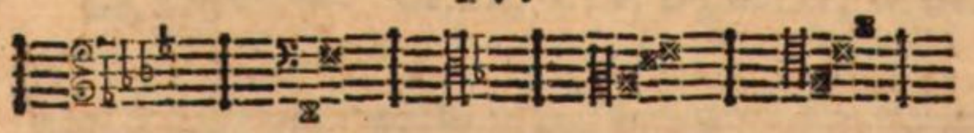
II.



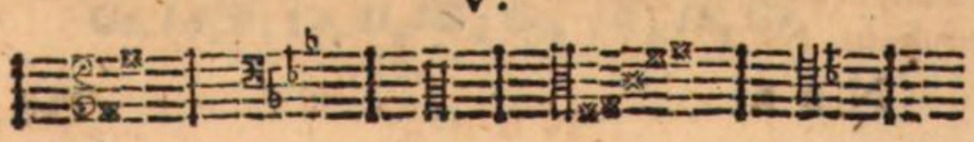
III.



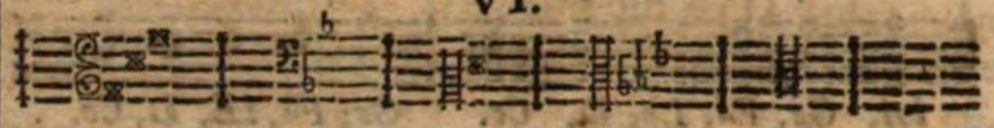
IV.



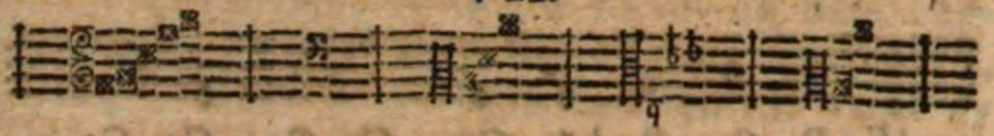
V.



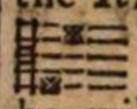
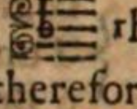
VI.



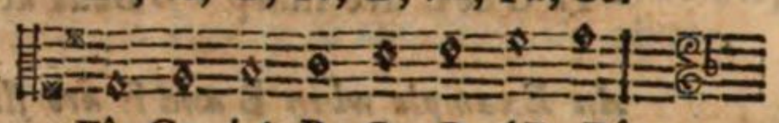
VII.



This Table, conſiſting of 7 Staves or Claſſes, contains in each Claſs all thoſe (uſual) Cliffs wherein the *Semitones* lie in the ſame Places of the Staff; and conſequently what is prick'd in any Cliff, may be ſung (or play'd) as if it were prick'd in any other Cliff of the ſame Claſs.

*E. G.* Suppoſe a Perſon hath learnt to ſing in the *Treble Cliff* only, and would ſing Notes prick'd in the *Tenor Cliff* on the middle Line with *F* ♯, thus  let him look for this Cliff in the Table and he will find it in the ſecond Claſs, where, at the Beginning is  that is, the *Treble Cliff* with *B flat*. If he therefore ſing the Notes as if they were in the *Treble Cliff* with *B flat*, he'll ſing them as true as if he had underſtood the *Tenor Cliff*.

*Ge, lA, B, Ce, D, lE, Fa, Ge.*

*Examp* 

*Fâ, Ge, lA, Be, Ce, D, lE, Fâ.*

In this Example, the Cliff at the Beginning of the Staff, is that to which the Notes are prick'd, and the Names (as in the *Tenor Cliff*) are ſet above them. At the End is ſet the *Treble Cliff*, in which the Notes may be ſung, and their Names (as accounted in the *Treble Cliff*) as ſet under.

Dr. *Wallis*, in *Phil. Tranſact. N.* 243. takes into Conſideration the ſtrange Reports we have of the Power of the ancient Muſick; and tho' he judges they are in a great Degree Hyperbolical, if not Fabulous; yet he thinks too that ſome Account may be given of the great Effects it's ſaid to have had, from theſe Conſiderations.

1. That Muſick was then, if not *new*, a rare *Thing*; which the Ruſticks, on whom it is reported to have had mighty Effects, had ſcarce ever heard before; and on *ſuch*, a little Muſick will do great Feats; as we find at this Day a Fiddle or a Bagpipe hath at a Country Morice-Dance.

2. Their Muſick was much more Simple and Plain than ours now: They had no Conſorts of 2, 3, 4, or more Voices or Parts; but one ſingle Voice or Inſtrument a-part; which to a *rude* Ear is much more taking than compounded Muſick: *That* not exceeding their Capacity, whereas *This* confounds them quite, and is by no means diſtinguiſhable by them, ſo as to affect them with the Harmony of its Parts.

3. Muſick, with the Ancients, was of a much larger Extent than what we now call by that Name; for *Poetry* and *Dancing* (*i. e.* comely Motion) were then accounted Parts of Muſick when it had arriv'd to ſome Degree of Perfection. And we ſee that *Verſe* of it ſelf alone, if in good Meaſure, and moving Words, and this ſet to a Muſical Tune, ſung by a decent agreeable Voice, accompanied with ſoft Inſtrumental Muſick only, if with any; *i. e.* ſuch as doth not drown or obſcure the emphatical Expreſſions (like what we call *Recitative Muſick*, tho' I doubt not more juſtly managed; for I hope the

the ſame Tone did not ſerve with them for making Love, Fighting, and delivering Letters) will work ſtrangely upon the Ear, and move all the Affections ſuitable to the Tune and Ditty, eſpecially if attended with a *Geſture* and *Action* ſuitable; for we ſee that *ſuitable Action* alone doth on the *Stage*, give great Life and Force to Words; and therefore all this together might eaſily operate very ſtrongly on the Fancies and Affections of ordinary People not uſed to ſuch kind of Treatments: For if the deliberate reading of a Romance, (when well penn'd) will produce Mirth, Tears, Joy, Grief, Pity, Wrath or Indignation, ſuitable to the reſpective Intents of it, much more would it do, if accompanied with all theſe Attendants.

4. If it be ask'd, why may not all this be done now? I anſwer, no doubt it may: If the Addreſs be made in proper Words, emphatically ſpoken, and in juſt Meaſures, with moving Arguments, pronounced by an agreeable Voice, and attended with a decent Geſture, and not drown'd by too much Muſick, or over acted by apparent Affectation.

5. We ſhould underſtand alſo, that the uſual Deſign of what we *now* call *Muſick* is very different from that of the Ancients; for that which we call ſo, was but with them the *Harmonick*, *i. e.* but one Part of their whole Muſick, which conſiſted of Words, Verſe, Voice, Tune, Inſtrument, and Acting.

6. When Muſick arriv'd to good Perfection, it was applied by the Ancients to the exciting this or that particular Affection, Paſſion, or Temper of Mind; the Tunes and Meaſures being ſuitably adapted to ſuch Deſigns, whereas thoſe are now almoſt quite neglected in our preſent Muſick; the chief Deſign being now to pleaſe the Ear, when by a ſweet Mixture of different Parts and Voices, with juſt Cadences and Concords intermix'd, a grateful Sound is produced: But this only the Judicious Muſician, or one a good while uſed to ſuch Compoſitions and Performances can diſtinguiſh,

7. 'Tis true, that even this Compound Muſick admits of different Characters; ſome is more brisk and airy, others more ſolemn and grave, as the different Subjects do require. But that which is moſt proper to excite particular Paſſions or Diſpoſitions, is ſuch as is more Simple and Uncompounded; ſuch as a Nurſe's languid Tone lulling her Babe to Sleep, or a continued Tale (as in *Ireland*) or reading in an even Tone; or the ſoft Murmur of a little Rivulet running upon Gravel or Pibbles inducing a quiet Repoſe to the Spirits: and on the other Hand, the Briskneſs of a Jig, *&c.* on a Violin exciting to Dance; for theſe are more operative for ſuch Ends than elaborate Compoſitions of full Muſick.

The ſame excellent Author in *N.* 249. hath a judicious Diſcourſe about the Imperfection of that noble Inſtrument an *Organ*; where he obſerves, That each Pipe is deſigned to expreſs a diſtinct Sound at ſuch a Pitch, or at ſuch a determinate Degree of *Gravity* or *Acuteneſs*, *i. e.* as it is now called of *Flatneſs* or *Sharpneſs*; and the Relative or Comparative Conſideration of the two or more ſuch Sounds or Degrees of Flatneſs or Sharpneſs is the Ground of what we call *Concord* and *Diſcord*; that is, a ſoft or harſh Coincidence. Concerning which there was among the ancient *Greeks* two Sects of Muſicians; the *Ariſtoxenian* and *Pythagorean*: But both agreed thus far, that *Diateſſaron* and *Diapente* do together make up *Diapaſon*; *i. e.* a *Fourth* and a *Fifth* make up an *Eighth*. And the Difference of theſe two, of a 4th and a 5th they agreed to call a *Tone*; which we now call a *whole Note*. Such is that in our preſent Muſick of *la mi*; for *la, fa, ſol, la*, or *mi, fa, ſol, la*, is a perfect 4th, and *la, fa, ſol, la, mi*, or *la, mi, fa, ſol, la*, is a perfect *Fifth*. The Difference of which is *la, mi*; and this the *Greeks* called the *Diazeutick Tone*, which diſjoins two Fourths on each Side of it; and being added to either of them, makes a *Fifth*; which was That, in their Muſick from *Meſe* to *Parameſe*, or in *Ours* from *A* to *B*, ſuppoſing *mi* to ſtand in *B fa B mi*, which is accounted its natural Poſition.

Now in order to this *Ariſtoxenus* and his Followers took that of a *4th*, as a known *Interval*, by the Judgment of the Ear, and that of a *Fifth* likewiſe, and conſequently that of an *Octave*, as the Aggregate of both, and that of a *Tone* as the Difference of thoſe two. And this of a *Tone* (as a known Interval) they took as a common Meaſure by which they eſtimated other *Intervals*: And accordingly they accounted a *Fourth* to contain two Tones and $\frac{1}{2}$, a *Fifth* three Tones and $\frac{1}{2}$, and conſequently an *Eighth* ſix Tones, or five Tones and two half Tones; and at this Rate our practical Muſicians talk of *Notes* and *half Notes* at this Day; ſuppoſing an *Octave* to conſiſt of twelve half Notes.

But *Pythagoras* and thoſe that follow'd him, not taking the Ear alone to be a competent Judge in a Caſe ſo nice, choſe to diſtinguiſh theſe, not by *equal Intervals* but by *due Proportions*. And this is followed by *Zarline*, *Kepler*, *Cartes*, and other Writers on *Speculative Muſick*, in this and the laſt Age. Accordingly they accounted an *Octave* to be, when the *Degree* of *Gravity* or *Acuteneſs* of one Sound to another is *double*, or as 2 to 1. That of a 5th when 'tis *Seſquialteral*, or as 3 to 2. That of a 4th, when 'tis *Seſquitertian*, or as 4 to 3; accounting that the ſweeteſt Proportion which is expreſt in the ſmalleſt Numbers; and therefore next to an *Uniſon* they accounted the *Octave*, or of 2 to 1. Then that of a 5th, or of 3 to 2, and then that of a 4th, or of 4 to 3. And thus that of a 4th and 5th do together make an 8th, for $\frac{4}{3} \times \frac{3}{2} = \frac{4}{2} = \frac{2}{1} = 2$: Or the Proportion of 4 to 3, compounded with that of 3 to 2 is the ſame with that of 4 to 2 or 2 to 1, and conſequently the Difference of theſe two, which is that of a *Tone* or full Note, is that of 9 to 8; for $\frac{4}{3})\frac{3}{2}(= \frac{9}{8}$: Or if out of the Proportion of 3 to 2 you take that of 4 to 3, the Reſult is that of 9 to 8. Now according to this Computation 'tis plain, that an *Octave* is ſomething leſs than 6 *full Notes*; for as hath been demonſtrated by *Euclid*, and ſome others ſince, the Proportion of 9 to 8 being 6 times compounded is ſomething more than that of 2 to 1, for $\frac{9}{8} \times \frac{9}{8} \times \frac{9}{8} \times \frac{9}{8} \times \frac{9}{8} \times \frac{9}{8} = \frac{531441}{262144}$ which is more than $\frac{524288}{262144} = \frac{2}{1}$. And this being the Caſe they allowed to the *Diazeutick Tone*, *la, mi*, the full Proportion of 9 to 8, as the unalterable Difference between the *Fifth* and the *Fourth*. All the Difficulty was how the remaining Fourth, *viz. mi, fa, ſol, la*, ſhould be divided into three Parts, ſo as to anſwer pretty near the *Ariſtoxenians* two *Tones* and an half; and might all together make up the Proportion of 4 to 3, which is that of a *Diateſſaron* or *Fourth*.

Many Attempts were made to this Purpoſe, and according to theſe, they gave Names to the different Kinds of Muſick, *viz.* the *Diatonick*, *Chromatick*, and *Enharmonick*, with the ſeveral *Species* or leſſer Diſtinctions under theſe *Generals*.

The firſt was that of *Euclid*, (which obtained generally for many Ages) and which allows to *fa*, *ſol*, and to *ſol*, *la*, the full Proportion of 9 to 8 ; and therefore to *fa*, *ſol*, *la*, which we now call the *greater Third*, that of 81 to 64 ; for $\frac{9}{8} \times \frac{9}{8} = \frac{81}{64}$, and conſequently to that of *mi*, *fa* (which is the Remainder to a *Fourth*) that of 256 to 243 ; for $\frac{81}{64})\frac{4}{3}(\frac{256}{243}$, *i. e.* if out of the Proportion of 4 to 3, we take that of 81 to 64, the Reſult is that of 256 to 243. To this they gave the Name of λείμμα, that is, the Remainder (over and above two Tones.) But in common Diſcourſe, when we don't aim at ſpeaking exactly, nor deſire to be ſo underſtood, 'tis uſual to call it an *Hemitone* or *half Note*, as being very near it ; and the other two whole *Notes* : And this is what *Ptolemy* calls *Diatonum Ditonum*, (or the *Diatonick* Kind with two full Tones.) Againſt this it is objected, That the Numbers of 81 to 64, are too great for that of a *Ditone* or *greater Third* ; which is not harſh to the Ear, but is rather ſweeter than that of a ſingle Tone, whoſe Proportion is that of 9 to 8. And in that of 256 to 243 the Numbers are yet greater much ; whereas there are many Proportions (as $\frac{5}{4}$, $\frac{6}{5}$, $\frac{7}{8}$, $\frac{8}{7}$) in ſmaller Numbers than that of 9 to 8, of which in this Diviſion there is no Notice taken, and conſequently this Diviſion is not the moſt convenient.

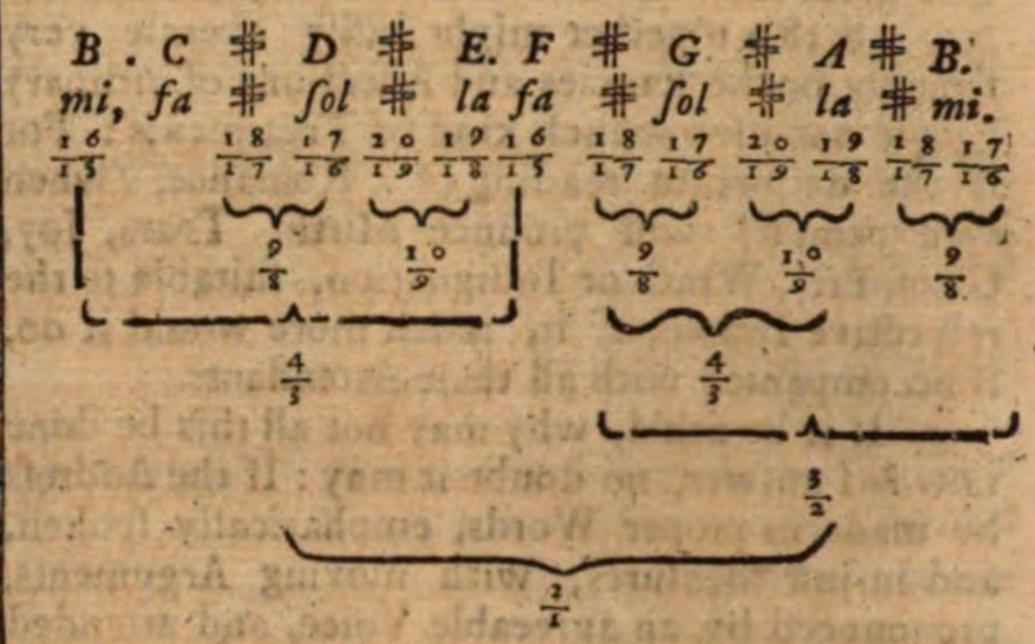
To rectify this, there is another Diviſion thought more convenient ; which is *Ptolemy*'s *Diatonum Intenſum*, of the *Diatonick* Kind, but more *Intenſe* or *Acute* than the other ; and this inſtead of two full Tones for *fa*, *ſol*, *la*, aſſigns what we now call a *Greater and a Leſſer Tone* ; and this ſeems to have been more followed by the nicer Muſicians of this and the laſt Age. To *fa*, *ſol*, they aſſign the Proportion of 9 to 8, which is their *greater Tone*, and to *ſol*, *la*, that of 10 to 9, which they call the *leſſer Tone* ; and therefore to *fa*, *la*, the *Ditone* or *greater Third*, that of 5 to 4 ; for $\frac{10}{9} \times \frac{9}{8} = \frac{10}{8} = \frac{5}{4}$, and conſequently to *mi*, *fa*, which is remaining of the *Fourth*, that of 16 to 15. for $\frac{5}{4})\frac{4}{3}(= \frac{16}{15}$ ; that is, if out of that of 4 to 3 you take that of 5 to 4, there remains that of 16 to 15.

Omitting to ſpeak of the other Ways of Diviſion, this $\frac{16}{15}$ is what we now call an *Hemitone* or *half Note* in *mi*, *fa* : $\frac{9}{8}$ is that of the *greater Tone* in *fa*, *ſol* ; and $\frac{10}{9}$ that of the *leſſer Tone* in *ſol*, *la*.

Only with this Addition, That each of theſe *Tones* is now, on Occaſion, by *Flats* and *Sharps* divided into *Hemitones* or *half Notes* ; which anſwers to what the *Greeks* called the *Change of Mood* ; and which is now done by removing *mi* to another *Key*, *viz.* $\frac{9}{8} = \frac{18}{16} = \frac{18}{17} \times \frac{17}{18}$ : and $\frac{10}{9} = \frac{20}{18} = \frac{20}{19} \times \frac{19}{20}$.

This by the Help of Flats and Sharps, as they are now called, (dividing each whole Note by its *greater* or *leſſer* into two *half Notes*, or ſuch as we call ſo.) The whole *Octave* is divided into 12 Parts or *Intervals*, contained in an Organ between 13 Pipes ; and theſe are commonly called *Hemitones* or *half Notes* : Not that each is preciſely an half Note, but ſomewhat near it, and ſo called. I ſay *by Flats and Sharps*, becauſe ſometimes one and ſometimes the other is uſed : As for Inſtance, a Flat in *D* or a Sharp in *C*, do either of them denote a midling Sound (tho' not preciſely in the middle) between *D* and *C*, flatter than *D*, and ſharper than *C*.

According to this, ſuppoſing *mi* to ſtand in *B fa B mi* (which is accounted its natural Place) the Sound of each Pipe is to bear theſe Proportions one to another, *viz.*




And ſo in each *Octave* ſucceſſively following : And if the Pipes in each *Octave* be fitted to Sounds in theſe Proportions of Gravity and Acuteneſs, it will be ſuppoſed according to this Hypotheſis, to be perfectly proportioned.

But inſtead of theſe ſucceſſive Proportions for each *Hemitone*, it hath been found neceſſary (if I do not miſtake the Practice) ſo to order the 13 Pipes containing the 12 Intervals or *Hemitones*, as that their Sounds, as to Gravity and Acuteneſs, ſhall be in continual Proportion (that is, each to its next following in one and the ſame Proportion) which altogether ſhall compleat that of the *Octave* or *Diapaſon*, or as 2 to 1, whereby it comes to paſs, that each Pipe doth not expreſs its *proper Sound*, but very near it, tho' ſomething varying from it : And this they call *Bearing*, which is ſomewhat of Imperfection in this noble Inſtrument the Organ, the Top of all.

It may be ask'd, Why may not the Pipes be ſo ordered as to have their Sounds in *juſt Proportion* as well as their Bearing ?

I anſwer, it might very well be ſo, if all Muſick were compoſed to the ſame Key, or as the *Greeks* call it, the ſame *Mode* ; as for Inſtance, if in all Compoſitions, *mi* were always in *B fa B mi*, then the Pipes might be ordered in ſuch Proportions as I have now deſign'd. But Muſical Compoſitions are made in great Variety of *Modes*, or with great Diverſity of the Pitch. *Mi*, is not always placed in *B fa B mi*, but ſometimes in *E la mi*, ſometimes in *A la mi re*, &c. And indeed there is no one of theſe *B* Pipes but may be made the Seat of *mi* ; and if they were exactly to any one of theſe Caſes, they would be quite out of Order for all the reſt. As for Inſtance. if *mi* be removed from *B fa B mi* (by a Flat in *b*) to *E la mi*, inſtead of the Proportions but now deſigned, they muſt be thus ordered.

| *B* | ♯. | *C* | ♯. | *D* | ♯. | *E.* | *F* | ♯. | *G* | ♯. | *A.* | *B.* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *fa* | ♯ | *ſol* | ♯ | *la* | ♯ | *mi* | *fa* | ♯ | *ſol* | ♯ | *la* | *fa.* |
| 18/17 | | 17/16 | | 20/19 | | 19/18 | 17/16 | | 18/17 | | 20/19 | 19/18 | 16/15 |

Where it is manifeſt, that the Removal of *mi* doth quite alter the whole *Series* of the Proportions. And the ſame would again happen if *mi* be removed from *E* to *A*, by another Flat in *E* : and again if removed from *A* to *D*, and ſo perpetually. But the *Hemitones* being made all equal, they do indifferently anſwer all the Poſitions of *mi* (tho' not exactly to any) yet nearer to ſome than to others ;

others; whence it is that the ſame Tune ſtands better in one Key than in another.

Nor can this ever be remedied, but only in Part, by making the Imperfection ſomething leſs by the Interpoſition of *quarter* or *half quarter Notes*, &c. for it hath been long ſince demonſtrated, that there is no ſuch thing as a *juſt Hemitone* practicable in Muſick (and the like holds for the Diviſion of a *Tone* into any other Number of equal Parts) for ſuppoſing the Proportion of a *Full Note* or *Tone* to be $\frac{9}{8}$ or as 9 to 8; that of the half Note muſt be, as $\sqrt{.}$ 9. to the $\sqrt{.}$ 8. that is, as 3 to the $\sqrt{.}$ 8. or 3 to $2\sqrt{.}$ 2. which are incommenſurable Quantities: and that of a Quarter Note will be as $\sqrt[4]{.}$ 9. to $\sqrt[4]{.}$ 8. which is yet more incommenſurable. And the like for any other Number of equal Parts; which therefore will never fall in with the Proportions of Number to Number.

So that this can never be perfectly adjuſted for all *Keys*, without ſomething of *Bearing*, by multiplying the Pipes. Unleſs for every Key, or for every different Place of *mi* there be a different Set of Pipes, of which this or that is to be uſed, according as (in the Compoſition) *mi* is ſuppoſed to be in this or that Place. Which vaſt Number of Pipes for every *Octave*, would greatly encreaſe the Charge, and after all, make the whole impracticable.

Authors of Note who have treated on this Subject of Muſick.

*Claudii Ptolemæi Harmonicorum Lib.* III. By Dr. *Wallis. Oxon.* 1682. 4*to.*
*Porphyrii Comment. in Lib.* 4. *Harm. C. Ptolemæi atque Manuelis Bryennii Comment. in* 3 *Libros Harmonicos ejuſdem Ptolemæi. (Qui ſoli reſtant ex Græcis Muſicæ Scriptoribus nondum Editi.) G. L. Cura J. Walliſii in Folio.*
*Syntagma Muſicæ*, Treating of Muſick Philoſophically, Mathematically, and Practically, by *J. Birchenſha*, Eſq;
*Muſica Speculativa des Mengoli. Bologna.* 1670. 4*to.*
*Philoſophical Eſſay of Muſick.* Lond. 1677. 4*to.*
*A Treatiſe of the Natural Grounds of Harmony.* By Dr. *Holder.* Lond. 1694. 8*vo.*
*An Eſſay to the Advancement of Muſick.* By *Tho. Salmon*, M. A. 1672. 8*vo.*
*Marci Meibomii Antiquæ Muſices Scriptores. G. L. Amſt.* 1652.
*Morley's Introduction to Muſick.*
*Des Cartes's Muſick.*
*Jo. Cochæi Tetrachordon Muſices.*
*Cleonidis Muſica. Fol.*
*Fabii Stapulenſis Elementa Muſices.*
*Salmon*'s Theory of Muſick in *Philoſ. Tranſ. N.* 302.

MUTUUM, in the Civil Law, is a *Loan* ſimply ſo called; or a *Contract* introduced by the Law of Nations, in which a Thing that conſiſts in Weight, (as ſuppoſe Bullion) in Number, as Money: or in Meaſure, as Corn, Wine, Oil, *&c.* is given to another upon Condition that he ſhall return another Thing of the ſame Quantity, Nature, and Value, upon Demand.

So that this is a Contract without Reward, and admits, properly ſpeaking, of no Recompence. And therefore where Uſe and Intereſt is agreed on, they ariſe from ſome diſtinct particular Argument, or by Cuſtom of the Country.



NAMATION, is the ſame as Diſtreyning or taking a Diſtreſs; and in *Scotland* 'tis uſed for Impounding.

NASALIS or *Rhinæus*, is a Pair of proper Muſcles belonging to the Cartilaginous Part of the Noſe; it ariſes fleſhy from the Extremity of the *Os Naſi* and adjacent Part of the *Os Maxillare*, and is inſerted into all the Cartilages of the *Alæ*; its Uſe is to open and dilate the Noſtrils, by putting that outwards.

NATIVO *habendo*, was a Writ that lay to the Sheriff, for a Lord, whoſe Villain claimed for his Inheritance, run from him, for the apprehending and reſtoring him to his Lord again.

NATURAL *Hiſtory*, is a Deſcription of any of the natural Products of the Earth, Water or Air, ſuch as Beaſts, Birds, Fiſhes, Metals, Minerals, Foſſiles, together with ſuch *Phænomena* as at any time appear in the Material World; ſuch as Meteors, *&c.*

Some Writers on this Subject are theſe:

*Plinii Hiſtoria Naturalis Dalechampii. Gen.* 1631.
*Joan. Euſebii Nierembergii Hiſtoria Naturæ.* Antw. 1635.
*Mart. Liſter Hiſtoria Conchyliorum*, Lond. 1685.
*Fr. Willoughbei Hiſtoria Piſcium.*
*Ornithologia (ejuſdem Authoris) ſive de Avibus.*
*Mouſettus de Inſectis.* Lond. 1634.
*Garneri Hiſtoria Animalium.*
*Gurnerus Rolfincius de Vegetabilibus.* Jenæ. 1670. 4*to.*
*Martyn Liſter's Hiſtoria Animalium Angliæ.*
*Fred. Lackmund. Admirand. Foſſilium Deſcriptiones.*
*Swammerdam's Hiſt. Generalis Inſectorum.*
*G. Piſonis de Re Naturali, &c. Indiæ Utriuſque.*
*J. Johnſton's Hiſtoria Naturalis.*
*Hiſtory of Animals by the Academy of Sciences.*
*Plot's Natural Hiſtory of* { *Oxfordſhire.* / *Staffordſhire.*
*Hiſtoria Naturalis de Terrante.*
*Merret's Pinax Rerum Naturalium Angliæ.*

NATURE. Beſides the three Senſes of this Word mentioned in Vol. I. it is ſometimes uſed for this vaſt Machine of the *Univerſe*, the wiſe Production of *Almighty God*, conſiſting of a great Number of *leſſer Machines*, every one of which is adjuſted by the ſame Wiſdom in Number, Weight and Meaſure.

*Laws of Nature*, ſignify thoſe Laws of Motion by which natural Bodies are governed in all their Actions upon one another, and which they inviolably obſerve in all the Changes that happen in the

the natural State of Things. An Account of these Laws see in Motion.

Sir *Isaac Newton* at the End of his excellent *Opticks*, (Lat. Edit.) observes, That *Universal Nature* is very *Simple* and *Uniform* in its Operations. All the Motions of the heavenly Bodies are caused by that *Attracting Force*, Impulse or Power which we call *Gravitation*; and which is mutual amongst all those Bodies. All the *lesser Motions* of the Particles or Corpuscles of Matter whereby Bodies act on one another, are effected also, by some *attracting* and *repelling Force*; which is mutual and reciprocal amongst them.

The *Vis inertiæ*, is a Principle *purely passive*, by which Bodies persist in their State of Rest or Motion, whereby they receive Motion from others equal or proportionable to the *moving Force*; and whereby they *resist* as much as they are *resisted*. But from this *Principle alone* there never could have been any such Thing as *Motion*, any where in the Universe. There is a Necessity of supposing some other Principle to be the Origin of Motion, and its Constitution too: For from the various Compositions of two Motions, 'tis plain that there cannot be always the same Quantity of Motion in the World, for if two Globes, connected together by a slender Thread, be supposed to revolve with an uniform Motion round their common Centre of Gravity; and at the same Time that Centre should move on Uniformity also in a Right Line coincident with the Plane of the *Globes* Orbits: Then will the *Summ* of the Motions of those two Globes, whenever they happen to be both in the Right Line described by the common Centre of Gravity, be *greater* than the *Summ* of their Motions can be, when they are in a Line at Right Angles to that. By which Instance 'tis apparent, *that Motion is producible and destructible.* But from the *Tenacity* and *Attrition* of the Particles of Fluid Bodies, and the Imbecility of the Elastick Force in solid Bodies, we may conclude, that the course of *Nature* tends more to the *Destruction* than the *Production* of Motion; and indeed it is continually decreasing, for Bodies that are either so perfectly *hard*, or throughly *soft*, as to have no *Elasticity*, cannot be reverberated back from one another, and from their Impenetrability only it would follow that their Motion would stop, and terminate. If therefore there were any such things as the *Imaginary Vortexes* of *Des Cartes*, their Motion must be continually decreasing, and at last must quite cease. Since therefore Motion is thus continually decreasing in the Universe, we must have Recourse to some *active Principles*, to increase and preserve it; *viz.* to such as the *Cause of Gravity* and *Fermentation*: By the former of which the Planets and Comets perpetually move in their Orbits, and Bodies by descending gain a great Velocity or large Quantity of Motion; and by the latter, the Heart and Blood of Animals is preserved in Motion and Warmth: The internal Parts of the Earth are perpetually getting Heat, many Bodies burn and shine, *Volcanoes* and *Earthquakes* are produced, and the Sun it self preserves his Light and Heat, and warms and cherishes all Things: For we find very little Motion in the World (except what is voluntary in free Agents) but what depends on these active Causes.

So that after well considering and understanding these Things, our admirable Author, (whose Piety and Goodness is as eminent as his profound Mathematick Learning and Penetration into Universal Nature) concludes, that our perfectly good, most wise, and Almighty Creator, did in the Beginning of the World, create Matter so as that its original Particles, from whence all corporeal Natures were to arise, were *solid*, *firm*, *impenetrable*, perfectly passive and moveable; and that they were made of such *Magnitudes* and *Figures*, and endued with such Properties, and in that Number and Quantity as was proportionable to the Space in which they were afterwards to move, in order to the most effectual obtaining of those Ends and Purposes for which they were created.

And these original primary Particles being perfectly solid, must be much more hard and firm than any Bodies that can be made out of them with Pores, hidden *Meatuses*, or Vacuities interspersed; that is, so perfectly hard and firm, that they can never be worn away or diminished; for 'tis not reasonable to suppose that there should be any Force or Power in the *ordinary Course* of Nature, that can divide *that* into more Parts, which God in the first *Creation* of Things, hath made *one*. As long therefore as these original Particles remain entire, there may for ever be Bodies made or composed of them; which shall have the same *Nature* and *Texture*: But if these can be broken, worn away, or diminished, then the Nature of corporeal Things which is dependent on these might be changed. Earth and Water composed of either such Particles as have been worn or broken, or of their Fragments, could not have at this Day, the same Nature and Texture, that original Earth and Water which was composed of these Particles when they were sound and entire. Wherefore that the Nature of Things should last, and their Natural Course continue the same; all the Changes made in Bodies must arise only from the various Separations, new Conjunctions and Motions of these original Particles. For mix'd or compounded Bodies are broken or destroyed, not by the breaking to Pieces of their solid original Particles, but by separating them one from another, and disposing them in those Places where they touch'd one another but in a little Part of their Surface. And these Original Particles, seem not only to have in them the *Vis Inertiæ* and all those *Passive Laws of Motion* which necessarily arise from thence; but receive also *Motion continually* from certain *Active Principles*; *viz.* such as *Gravity* the *Cause of Fermentation* and of the *Cohesion* of the Parts of *Matter*. And these *Principles* are not to be considered as *occult Qualities* which are feigned to arise from the *Specifick Forms* of Things, but as the *Universal Laws of Nature* by which Things themselves are formed. For that there are really *such Principles*; the various Phænomena of Nature do demonstrate, tho' what their *Causes* are hath not yet been explained: For to assert that the *several Species* of Things are endued with *Specifick Occult Qualities*, by which they have a certain Force or Power in acting, is in Reality to say Nothing. But from the Phænomena of Nature to derive two or three *general Principles of Motion*; and from thence to explain how the Properties and Actions of all Corporeal Things may be deduced from those Principles, would be a very *great Progress* in Natural Philosophy, although the Causes of those *Principles* should be yet undiscovered.

NAVAL *Architecture*. See *Shipping*.

NAVE, in Architecture, ſignifies the main Body of a Church,

NAVEL-STING. See *Umbelical Veſſels.*

NAVIGATION. Books on this Subject are;

Sir *Jonas Moor*, in 2 Vol in *Quarto.*
*Wright's Correct Errors in Navigation.*
*Norwood's Epitome of the Art of Navigation.*
*Sturmy's Mariners Magazine.*
*Seller's Practical Navigation.*
*Norwood's Syſtem of Navigation.* } *His Seaman's Practice.* — *Companion.*
*Phillips's Geometrical Seaman.*
*Colſon's Calendar.*
*Martin's Art of Navigation.*
*Perkin's Seaman's Tutor.*
*Eden's Art of Navigation.*
*Treſor de Navigation par M. Blondell.*
*Collin's Plain Scale new plained.*
*Jones's Navigation.*
*Newton's Idea of Navigation and Geography.*
*Atkinſon's Epitome of Navigation.*
*Hodgſon's Theory of Navigation demonſtrated.* 4*to.* 1707.

NEALING *of Steel*, is heating of it in the Fire to a *Blood-red-heat*, and then taking it out and letting it cool gently of it ſelf. This is done to make it ſofter, in order to engrave or punch upon it.

NEAR, at Sea, when the Conner commands, the Man at the Helm to ſet the Ship full to Leeward, his Word is *No-near*.

NEBULOUS-*Stars*, ſeen thro' good Teleſcopes appear to be Cluſters of ſmall Stars; as appears by the Obſervations of *Caſſini* and *Flamſtead*. See *Philoſ. Tranſ. N.* 123.

NECYDALUS, the ſame with *Nympha*, a Term uſed in the Natural Hiſtory of *Inſects*. See *Nympha*.

NEIFE, *Nativa*; is a Bond-woman, *An.* 1 *E.* 6. 3. and 9 *R.* 2. *cap.* 2. But if ſhe married a Freeman ſhe was thereby made free; and when once made free and diſcharged of all Bondage cannot be *Neife* after, without ſome ſpecial Act done by her; as Divorce or Confeſſion in a Court of Record. Nor ſhall a Free-woman be bound by taking a Villain to her Husband; but their Iſſue ſhall be Villains after their Father. There was alſo anciently a *Writ of Neifty*, whereby the Lord claim'd his *Neife*; but all this is now out of Doors.

NEWEL, in Architecture, is the upright Poſt that the Caſe of winding Stairs turns round about.

NITRE. See *Clark's Natural Hiſtory of Nitre. Lond.* 1670. in 8*vo.* Mr. *Boyle's Tract about the Redintegration of Salt Petre.*

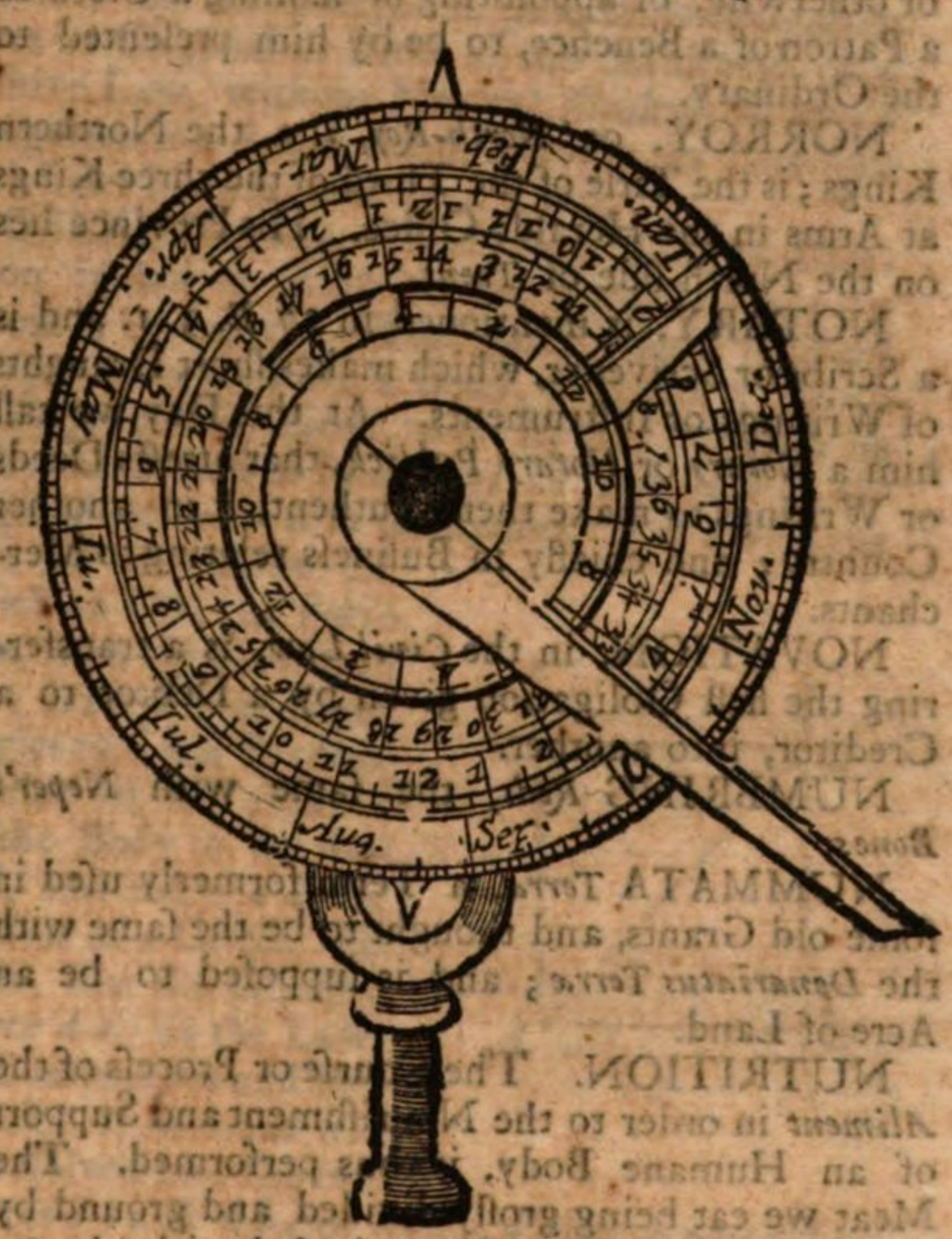
NOBLE; there hath not been any Piece of Gold (or Silver) of this Name coined with us ſince 9 *H.* 5. They were firſt coined by *E.* 3. 1344. The Noble contained 80 Pence; its half, which was then called *Obolus* 40 *d*, its 4th Part the *Quadrans* or *Farthing* in theſe Days 20 *d.*

NOCTURNAL. There are ſeveral Sorts of *Nocturnals*, of which ſome may be Projections of the Sphere; ſuch as the Hemiſpheres or Planiſpheres on the Plane of the Equinoctial; but the Seamen uſe only two, and the Manner of uſing either is the ſame. One of them is fitted for the Pole-Star and the firſt of the Guards of the Little Bear; and the other for the Pole-Star and the *Guards* or *Pointers* (as ſome call them) of the Great Bear.

The Inſtrument conſiſts of three Parts or Pieces; the largeſt of which hath a Handle to hold it by when you would *obſerve*; and oppoſite to the Handle there is a ſmall Tooth or Point, which (if it be made for the Little Bear) ſtands againſt the 25th of *April*; but if for the Great Bear, againſt the 17th of *February*; which are the Times of the Year when thoſe Stars come to the Meridian at 12 at Night. On this bigger Part or Piece then are two Circles deſcribed; the outermoſt hath the Months and their Days, and the innermoſt hath the 24 Hours of a Natural Day; on the backſide of this Piece alſo are the 32 Points of the Compaſs deſigned, and marked with their initial Letters.

The ſecond Part of the Nocturnal hath two Circles deſcribed on it; of which the outermoſt is divided into 29 ½ equal Parts, for the Days of the Moon's Age; and in the innermoſt into 24 Hours: And at the Beginning of the Days of the Moon's Age, and at XII, there is a Tooth to be ſet to the Day of the Months in the upper Part.

The third Part is an Index with a Fiducial Edge iſſuing from the Centre; and muſt be ſo long, that a good Part of it may extend beyond the outermoſt or biggeſt Piece. Theſe three Parts are ſo ordered, that by Means of a ſmall hollow Braſs Socket they are made to move about the Centre of the Inſtruments. See the Fig. annexed.




The Uſes of this Inſtrument are;

1. *To find the Hour of the Night.*

To do which, ſet the Tooth to the middle Part of the Day of the Month, and then turning the foreſide of the Inſtrument towards you, hold it up towards the North, and incline the upper Part toward you, till thro' the Hole in the Middle you can ſee the Pole-Star; there hold it faſt, and turn the long Index about, till by its Edge you can ſee either the *firſt of the Guards of the Little Bear*, or the *Pointers of the Great Bear*, (according as the Inſtrument is made) and then ſhall the Edge of the

the Index or Ruler, in the innermoſt Circle of the middle Part ſhew you the true Hour of the Night.

2. *To find on what Point of the Compaſs the Guards are.*

This will appear on the backſide of the Nocturnal, after you have found the Hour of the Night, as above; for the Index will be on the ſame Point of the Compaſs as the *Guards* really are.

3. *To find at what Hour the Moon will be full South on any Day of her Age.*

Seek the Moon's Age in the outermoſt Circle of the middle Piece, and then right againſt it in the innermoſt Piece, is the Hour required.

Thus if the Moon be 11 Days old, you will find ſhe will be on the Meridian at 8 Hours 48 min.

NODATED *Hyperbola*: So Sir *Iſ. Newton* calls a peculiar kind of Hyperbola, which by turning round decuſſates or croſſes it ſelf. See *Curves*.

NOMINATION; this Word as well by the Canoniſts as common Lawyers, is uſed for a Power that a Man hath by vertue of a Mannor or otherwiſe, of appointing or naming a Clerk to a Patron of a Benefice, to be by him preſented to the Ordinary.

NORROY, or *North-Roy*, *i. e.* the Northern Kings; is the Title of the Third of the three Kings at Arms in the Heralds-Office. His Province lies on the North-ſide of *Trent*.

NOTARY, is mentioned in 27 *E.* 3. 1. and is a Scribe or Scrivener, which makes ſhort Draughts of Writings or Inſtruments. At this Day we call him a *Notary* or *Notary Publick*, that atteſts Deeds or Writings to make them authentick in another Country; and chiefly in Buſineſs relating to Merchants.

NOVATION, in the *Civil Law*, is a transferring the firſt Obligation given by a Debtor to a Creditor, into another.

NUMBRING *Rods*, the ſame with *Neper's Bones*.

NUMMATA *Terræ*, a Term formerly uſed in ſome old Grants, and thought to be the ſame with the *Denariatus Terræ*; and is ſuppoſed to be an Acre of Land.

NUTRITION. The Courſe or Proceſs of the *Aliment* in order to the Nouriſhment and Support of an Humane Body, is thus performed. The Meat we eat being groſly divided and ground by the Teeth, is in that Action mingled with the *Saliva*, which helps to ferment and dilute it. Thence thro' the *Oeſophagus* or Gullet by the Conſtriction of its Fibres 'tis thruſt down into the Stomach; where being further ſoftened and ſwell'd by the Juices contained in the Glands of the Stomach, its Parts are farther broken and the intimate Coheſion of them deſtroyed, and they divided one from another, by the perpetual Motion of the Coats of the Stomach and by the Muſcles of the *Midrif* and *Abdomen*. By this Preſſure alſo of the Sides of the Stomach upon the contained Aliment, that is thruſt down into the Inteſtines; at its Entry into which it is mix'd with the Bile and Pancreatick Juice, the one to ſweeten, the other to dilute the Chyle. By the *Periſtaltick Vermicular* Motion of the Guts, (ariſing from the Alternate Action of their Spiral and Longitudinal Fibres) and by the Preſſure of the *Dyaphragm*, and the Muſcles of the *Abdomen*, the groſſer Parts of the Chyle are derived downwards to be thruſt out of the Body; while the finer are ſqueezed into the narrow Orifices of the *Lacteal Veins*, which opens into the Inteſtines; from whence in ſlender Channels they are carried into the Glands of the Meſentery; where they receive a fine thin *Lympha* from the *Lymphatick Ducts*, which further dilates it and ſcours its containing Veſſels; which Veſſels going from thoſe Meſenterick Glands unite into larger Channels, and thoſe into ſtill larger, and at laſt paſs directly into the common Receptacle of the Chyle; which is a kind of Baſon formed for it in the Union of theſe *Lacteal* and Lymphatick Veſſels. From thence in one Duct it aſcends into the *Thorax*, and ſometimes dividing about the Heart, it immediately unites again, and creeping along the Gullet, it paſſes on to the left *Subclavian Vein*, where in one or two Months it pours in its Contents, and there mixes with the poor Venal Blood returning from all Parts of the Body. And thus doth the Blood receive its Supply and Nouriſhment.

But if you take *Nutrition* in the Senſe which ſome do, of the Blood nouriſhing the ſeveral Parts of the Body: Then will that kind of Nutrition be performed by a *Secretory Duct* ariſing from the Termination of an Artery, and carrying a ſuitable Portion of the Blood to every Part to be nouriſhed; ſo that every Point of the Body muſt be the Termination of a *Secretory Duct* thro' which a proper Part of the Blood is brought in order to ſupply that Part of the Body.

NYMPHA, in ſuch Inſects as undergo a Tranſformation, is the very firſt Change of the *Eruca*, or of the *Vermiculus Prior*, or *Maggot*; or indeed, as *Swammerdam* hath proved (in his *Hiſt. Inſect. general.*) rather the Growth and Increaſe of the *Eruca*, whereby the Figures of the ſucceeding Animal is beginning to be expreſſed by the Explication of its Members, which before lay involved up in the *Eruca* (like a Plant in its Seed;) ſo that in Reality it is only the Animal under that imperfect Form is called the *Nympha*, the Word being taken from *Ariſtotle* in his *Hiſt. Anim. Lib.* v. *c.* 19. where he uſes it for the firſt Rudiment of an Inſect. This *Nympha* is ſometimes called *Chryſalis*, ſometimes *Aurelia*, and ſometimes *Necydalus*; all which Terms ſignify the ſame Thing.

O. The Seven *Antiphones* or Alternate Hymns of Seven Verſes, *&c.* ſung by the Choire in the Time of *Advent*, was formerly called *O*, from their Beginning with ſuch an Exclamation.

OATH, in the Law-Senſe, is an Affirmation or Denial by any Chriſtian of a Thing lawful and honeſt, before one or more that have Authority to give the ſame; for the Advancement of Truth and Right, calling Almighty God to witneſs that his Teſtimony is true. 'Tis called ſometime *his Corporal Oath*, becauſe he toucheth with his Hand ſome part of the Holy Scripture of the *New Teſtament*, and moſt uſually of the Four Goſpels (whence the Phraſe for lawful ſwearing is *Sacroſanctis Tactis Evangeliis.)*

OBEDIENTIA, was anciently uſed as a Term for Rent; but in the Common Law 'Tis taken for an Office, or for the Adminiſtration of an Office; and thereupon

OBEDIENTALES, is uſed in the Provincial Conſtitutions for thoſe that have the Execution of any Office under their Superiors.

OBIT, ſignifies an Office for the Dead or a Funeral Solemnity: The Anniverſary of any Perſon's Death was alſo called an *Obit*. And in Religious Houſes, *&c.* they had formerly an

OBITUARY, which was a Regiſter or Calendar wherein they enter'd the Obits or Obitual Days of their Founders or Benefactors.

OBLATA; were formerly Gifts made (tho' properly Offerings) to the King by any of his Subjects; and were ſo carefully taken Notice of by K. *John* and *Hen.* 3. that they were enter'd in the Fine Rolls under this Name of *Oblata*.

OBLATÆ; were the Conſecrated Wafers or Hoſts diſtributed to the Communicants in the Maſs or Sacrament of the Altar; and ſometimes the cuſtomary Treats in Religious Houſes have been called by this Name of *Oblatæ*.

OBLATIONS *of the Altar*, were cuſtomary Offerings from the Pariſhioners to their Prieſt, which were ſolemnly laid upon the Altar; of which the Maſs or Sacrament Offerings were uſually Three-pence at *Chriſtmas*, Two-pence at *Eaſter*, and a Penny at the two other principal Feaſts. The cuſtomary Dues alſo for *Sacramentalia* or Chriſtian Offices, were comprehended under this Title; and alſo all little Summs for ſaying Maſſes for the Souls of Perſons deceaſed.

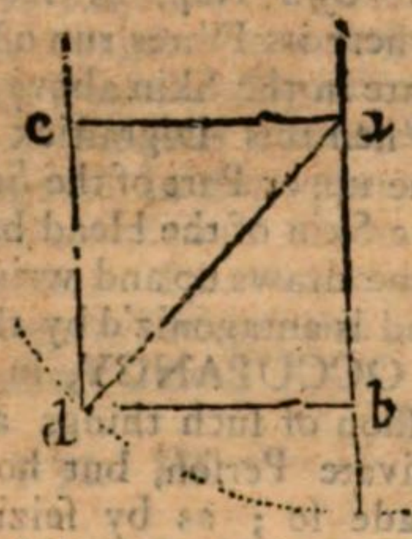
OBLATIONES *Funerales*, were the *Soul Scent* or Offerings to expiate the Omiſſions or Defaults of the Party deceaſed in paying Tythes or other Eccleſiaſtical Dues: At firſt this was an Oblation at the Funeral, and was often the beſt Horſe of the Defunct, led before the Corps, and delivered at the Church-Gate or Grave, for the Uſe of the Pariſh-Prieſt.

To this Cuſtom we owe the Original of Mortuaries. If the Corps were buried any where elſe, the Offerings were due to the Pariſh-Prieſt where the Party died.

At the Burial of the Dead, it was a Cuſtom for the ſurviving Friends to offer liberally at the Altar, for the pious Uſe of the Prieſt, and the good Eſtate of the Soul departed; and the Reliques of this ſuperſtitious Cuſtom do ſtill remain in *North-Wales*, where at the Rails of the Communion-Table, there is a Tablet or flat Board fixed, to receive the Money, which at moſt Funerals is offered by the ſurviving Friends, according to their own Ability and that of the Deceaſed. Dr. *Kennet's Gloſſary*.

OBLIGATION, by the Civilians, is defined to be a *Cauſe of Action*, and a legal Bond or Tie which compells by Action to give or to do according to the *Roman* Law. And they divide Obligations into *Natural*, *Civil*, and *Mix'd*: a *natural Obligation* is what ariſes only from meer natural Equity; and this they diſtinguiſh into *Effectual* and *Ineffectual*: The former of which, tho' there is not Ground enough for Action by the *Roman* Law, yet may bar by *Plea* and *Exception*; but the latter hath no Aſſiſtance from any poſitive Law, but conſiſts meerly in the Conſcience or Pleaſure of the Party. A pure *Civil Obligation* owes its Original or Birth to the Strictneſs of a poſitive Law, without Natural Equity. A *Mix'd Obligation* is a Legal Bond, having its Strength both from Natural and Civil Laws.

OBLIQUE *Force*, is that whoſe Line of Direction is not at Right Angles with the Body on whom it is impreſt. The *Ratio* which ſuch an *Oblique Force* to move a Body, bears to a *Direct* or *Perpendicular Force*, will by this Diagram be eaſily underſtood to be always as the *Sine of the Angle of Incidence is to the Radius*. Let *a b* be the Side of any Body on which an Oblique Force falls, with the Direction *d a*; draw *d c* at Right Angles to *d b*, a Perdendicular let fall from *d* to the Body to be moved, and make *a d* the Radius of a Circle. 'Tis plain, that the Oblique Force *d a*, by the Laws of Compoſition and Reſolution of Motions will be reſolved into the two Forces *d c* and *d b*; of which *d c* being parallel to *a b*, hath no Energy or Force to move that Body; and conſequently *d b* expreſſes all the Power of the Stroke or Impulſe upon the Body to be moved. But *d b* is the Right Sine of the Angle of Incidence *d a b*; wherefore the Oblique Force *d a*, to one falling perpendicularly is as the Sine of the Angle of Incidence to Radius. *Q. E. D.*




OBLIQUITY *of the Ecliptick*. 'Tis well known that the Plane of the Terreſtrial Equator is inclined to that of the Ecliptick in an Angle of 23 Degr. 30 Min. or rather more accurately 23°. 29′ And this Angle (allowing for a very ſmall Nutation of the Earth's Axis, which tho' neceſſarily deducible from the Principles of the *Newtonian* Aſtronomy, need not here be conſidered) hath always yet continued the ſame: As any one may find if they will on the two Solſtitial Days obſerve the Sun's Meridian Altitudes, and then freeing them from Refractions, Parallax, *&c.*

ſubtract the Winter from the Summer Altitude; for then half the Difference between them will be found to be 23°. 29′. the Quantity of the Angle of the Inclination or Obliquity of the Ecliptick to the Plane of the Equator.

OBOLUS, tho' now taken to ſignify our Half-penny, anciently ſignified the *Half Noble*. The Noble or *Floren* being called a *Penny*, and its quarter part a *Farthing*: And indeed in the old Hiſtories and Accounts of Coin, you are to underſtand by the Word *Denarius*, the whole Coin, be it *Angel*, *Rial*, &c. and by *Obolus* its half; and by *Quadrans* its fourth part.

OBSERVATION. The Seamen call an *Obſervation* the taking the Sun or any Stars Meridian Altitude, in order thereby to find their Latitude; and how they do this you will find under that Word: And they call finding the Latitude by the Name of *Working an Obſervation*.

OCCIPITO-*Frontalis*, is a Muſcle of the Skin of the *Occiput* and *Os Frontalis*, which is uſually called *Occipitalis*; it ariſes fleſhy from the tranſverſe Line of the *Occiput*, oppoſite to part of the ſuperior Termination of the *Maſtoidæus*, and part of the Beginning of the *Trapezius* next it, and then tendinous from the reſt of the Line backwards, ariſing after the ſame Manner on the other ſide; from thence it goes ſtrait up, and ſoon becoming all tendinous, it covers the two *Parietal Bones*, and the *Oſſa ſquammoſa* above the *Temporal Muſcles*, its outer Edge being faſtened to the *Os Jugale* on each Side. This broad Tendon near the *Coronal Suture* grows fleſhy, and deſcends with ſtreight Fibres as low as the *Muſculi Orbiculares*. It is inſerted into the Skin at the Eyebrows having ſent down between them a narrow fleſhy Slip or Elongation which is continued over the *Oſſa Naſi*, as far as its Cartilaginous Patts, where its Fibres run off on each Side, and terminate in the Skin above the *Muſculus Naſi proprius* When this Digraſtick Muſcle, which covers all the upper Part of the Scull like a Cap, acts, it pulls the Skin of the Head backwards, and at the ſame time draws up and wrinkles that of the Forehead, and is antagoniz'd by the *Corrugator*.

OCCUPANCY, in the Civil Law, is the Poſſeſſion of ſuch things as at preſent belong to no private Perſon, but however are capable to be made ſo; as by ſeizing or taking of Spoils in War, of things wild by Nature, as Birds and Beaſts for Game, &c. or by finding things before undiſcovered, or truly loſt, or loſt by their proper Owners.

OCCUPIERS *of Walling*, are certain annual Officers in the *Cheſhire* Salt-works, who ſee Right done between Lord and Tenant, and all Perſons concerned; they appoint alſo how many Houſes ſhall work at a Time, &c. and order a Cryer to proclaim the Time of kindling the Fires, &c. See *Salt*.

OCEAN, is the vaſt Collection or Union of all the Seas which compaſs round the whole Earth, and in which the two great Continents of *Europe*, *Aſia*, and *Africa* on one ſide of the Northern, and Southern *America* on the other, are but like two large Iſlands. This great and univerſal Ocean, is ſometimes by Geographers divided into 3 Parts; as 1. The *Atlantick* and *European Ocean*, lying between Part of *Europe Africa*, and *America*. 2. The *Indian Ocean*, lying between *Africa*, the *E. Indian* Iſlands, and *New Holland*. 3. The great *South Sea* or the *Pacifick Ocean*, which lies between the *Philippine Iſlands*, *China*, *Japan*, and *New Holland*, on the Weſt, and the Coaſt of *America* on the Eaſt. Sometimes alſo with Regard to *Europe*, they call that the *Hyperborean Ocean* which encloſes it on the North; and that which encloſes it on the Weſt, the *Weſtern Ocean*. That Sea which encloſes *Aſia* on the North and Eaſt is often called the *Tartarean*, and ſometimes the *Chineſe Ocean*; and on the South *Aſia* is bounded by three Seas, which are called the *Indian*, *Perſian*, and *Arabian Ocean*. Alſo the great Sea on the Eaſt of *Africa*, is called the *Oriental Ocean*, as is alſo that vaſt Sea which encloſes *America* on the Eaſt.

OCTAVES, in old *Engliſh* the *Uta's* were eight Days after any *eminent Feſtival*; and ſuch Feſtivals are enumerated in the Laws of *Edward* the Confeſſor.

OCTO *Tales*. See *Tales*.

ODIO and *Atia*, was an old Writ mentioned in the Statute of *Weſtminſter* 1. and made 3 *E.* 1. *cap.* 11. It was directed to the Sheriff, to enquire whether a Man committed to Priſon for a Suſpicion of Murder, be committed on juſt Cauſe, or only upon Malice: If the latter were the Cauſe, then another Writ came to the Sheriff to Bail him. But now this Courſe is taken away by 28 *E.* 3. *cap.* 9.

OECONOMICUS, was formerly uſed for the Executor of a laſt Will and Teſtament, as the Perſon who had the Oeconomy or Fiduciary Diſpoſal of the Deceaſed's Goods.

OFFERTORIUM, formerly was uſed for a Piece of Silk or fine Linnen, to receive and wrap up the Oblations or occaſional Offering in any Church.

OGEE, *Ogive*, and as it is often written O— G— is a ſort of Moulding in Architecture, conſiſting of a Round and a Hollow. *Vitruvius* makes it two quarter Circles. *Scamozzi* and ſome others, make the Arches flatter. 'Tis almoſt in the Form of an *S*, and is the ſame with what *Vitruvius* calls *Cima*. *Cima reverſa* is an O— G— with the Hollow downwards, as ſome define it.

OLERON *Laws*, are ſo called, becauſe made when King *Richard* I. was there (*i. e.* at *Oleron*, an Iſland in the Bay of *Aquitain* in *France*) they have Reſpect to Maritime Affairs.

OPACITY. Sir *Iſ. Newton*, *Opticks*, *Book* 2. ſhews that the *Opacity* of all Bodies ariſeth from the Multitude of Reflections cauſed in their Internal Parts: And he ſhews alſo, that between the Parts of the opake and coloured Bodies, there are many Spaces either empty or repleniſhed with Mediums of other Denſities; and he ſhews the true or principal Cauſe of *Opacity* to be this Diſcontinuity of their Parts; becauſe ſome opake Bodies become tranſparent by filling their Pores with any Subſtance of equal or almoſt equal Denſity with their Parts. Thus Paper dipp'd in Water or Oil, the *Oculus Mundi* Stone ſteep'd in Water, Linnen Cloth oil'd or varniſhed, and many other Subſtances ſoaked in ſuch Liquors as will intimately pervade their little Pores, become by that Means more tranſparent than otherwiſe; as on the contrary, the moſt tranſparent Subſtances may, by evacuating their Pores or ſeparating their Parts, be render'd ſufficiently opake; as Salts or wet Paper, or the *Oculus Mundi* Stone by being dried, Horn by being ſcrap'd, Glaſs by being pouder'd or flaw'd, Water by being form'd into ſmall Bubbles,

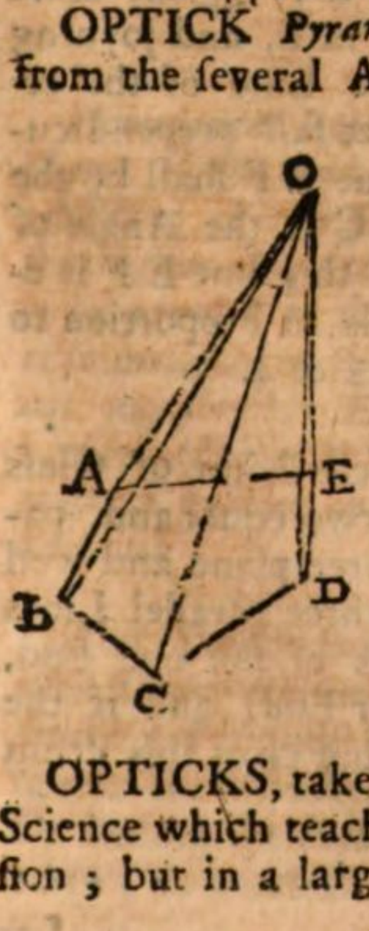
Bubbles either alone in the Form of Froth, or by ſhaking it together with Oil of Turpentine, or ſome other convenient Liquor with which it will not perfectly incorporate.

But however, to render Bodies opake and coloured, their Interſtices muſt not be leſs than of ſome definite Bigneſs; for the moſt *opacous* Bodies that are, if their Parts be ſubtilly divided (as when Metals are diſſolved in acid Menſtruums) become perfectly tranſparent. And on this ground it appears, why Water, Glaſs, Salt, and ſome Stones are tranſparent, for they are as full of Pores and Interſtices as the Bodies are; but yet their Parts and Interſtices are too ſmall to cauſe Reflections in their common Surfaces: Wherefore white Metals become opake not from their Denſity alone, but from their Parts being of ſuch a bigneſs as fits them to reflect the White of the firſt Order. And as he ſhews, that the White of the firſt Order is the ſtrongeſt which can be made by Plates of tranſparent Subſtances, ſo it ought to be ſtronger in the denſer Subſtances of Metals than in the rarer ones of Air, Water and Glaſs. And he thinks that metallick Subſtances of ſuch a Thickneſs as may fit them to reflect the White of the firſt Order, may by reaſon of their great Denſity reflect all the Light incident upon them, and ſo be as opake and ſplendent as 'tis poſſible for any Body to be. See *Colours*.

OPENING *of the Trenches*; is the firſt breaking Ground of the Beſiegers, in order to carry on their Attacks againſt the Town. The Difference between this and *carrying on the Trenches*, is, that *this* is only the Beginning of the Trench: It is begun by a ſmall Foſs or Ditch which the Pioneers make in the Night on their Knees, uſually about a Musket-ſhot from the Place, but if there be no hollow nor riſing Ground to favour them, they begin farther off. This ſmall Foſs is afterwards enlarged by the next Pioneers which come behind the firſt; and ſo 'tis dug deeper by Degrees till it be about 12 Foot broad and 5 Foot deep. The Earth that is dug out is thrown up as they go along, and ſerves them for a Parapet to ſave them from the Fire of the Town. The Place where the Trenches are opened, is called the End of the Trench.

OPPOSITE *Sections*. If a Cone be cut by a Plane through its Vertex, and afterwards by a ſecond Plane parallel to the former, this latter Plane produced through the oppoſite Cone, will there make the oppoſite Sections. See *Conick Sections*.

OPTICK *Pyramid*, is made by Rays coming from the ſeveral Angles of the ſuperficial Baſe of any Object, and united in a Point in the Eye of the Spectator. Thus if A B C D E be the Baſe of the Eye in O, the Optick Pyramid O A B C D E O. And when the Baſe is a Right-Line, as ſuppoſe A E or C D, then the Triangle O A E or O C D is called the




OPTICK *Triangle*, as the Angle A O E or C O D, is called the *Optick Angle*.

OPTICKS, taken properly and ſimply, is that Science which teaches the Properties of Direct Viſion; but in a larger Senſe it may comprehend the whole Doctrine of Light and Colours, and all the Phænomena of viſible Objects. In this large Senſe our incomparable Sir *Iſ. Newton* calls his Book of Light and Colours, *Opticks*; and from thence the following brief Introduction to this Science is taken.

## *DEFINITIONS.*

### DEFIN. I.

*By the Rays of Light I underſtand its leaſt Parts, and thoſe as well ſucceſſive in the ſame Lines as contemporary in ſeveral Lines.* For it is manifeſt that Light conſiſts of Parts both ſucceſſive and contemporary; becauſe in the ſame place you may ſtop that which comes one Moment, and let paſs that which comes preſently after; and in the ſame time you may ſtop it in any one place, and let it paſs in any other. For that Part of Light which is ſtopt cannot be the ſame with that which is let paſs. The leaſt Light, or part of Light, which may be ſtopt alone without the reſt of the Light, or propagated alone, or do or ſuffer any thing alone, which the reſt of the Light doth not or ſuffers not, I call a Ray of Light.

### DEFIN. II.

*Refrangibility of the Rays of Light, is their Diſpoſition to be refracted or turned out of their Way in paſſing out of one tranſparent Body or Medium into another. And a greater or leſs Refrangibility of Rays, is their Diſpoſition to be turned more or leſs out of their Way in like Incidences on the ſame Medium.* Mathematicians uſually conſider the Rays of Light to be Lines reaching from the luminous Body to the Body illuminated, and the Refraction of thoſe Rays to be the bending or breaking of thoſe Lines in their paſſing out of one Medium into another. And thus may Rays and Refractions be conſidered, if Light be propagated in an Inſtant. But by an Argument taken from the Æquations of the times of the Eclipſes of *Jupiter's Satellites* it ſeems that Light is propagated in time, ſpending in its paſſage from the Sun to us about ſeven Minutes of Time: And therefore I have choſen to define Rays and Refractions in ſuch general terms as may agree to Light in both Caſes.

### DEFIN. III.

*Reflexibility of Rays, is their Diſpoſition to be turned back into the ſame Medium from any other Medium upon whoſe Surface they fall. And Rays are more or leſs reflexible, which are turned back more or leſs eaſily.* As if Light paſs out of Glaſs into Air, and by being inclined more and more to the common Surface of the Glaſs and Air, begins at length to be totally reflected by that Surface; thoſe ſorts of Rays which at like Incidencies are reflected moſt copiouſly, or by inclining the Rays begin ſooneſt to be totally reflected, are moſt reflexible.

### DEFIN. IV.

*The Angle of Incidence, is that Angle which the Line deſcribed by the incident Rays contains with the Perpendicular to the reflecting or refracting Surface at the Point of* Incidence.

## DEFIN. V.

*The Angle of Reflexion or Refraction, is the Angle which the Line described by the reflected or refracted Ray contained with the Perpendicular to the reflecting or refracting Surface at the Point of Incidence.*

## DEFIN. VI.

*The Sines of Incidence, Reflexion, and Refraction, are the Sines of the Angles of Incidence, Reflexion, and Refraction.*

## DEFIN. VII.

*The Light whose Rays are all alike Refrangible, I call Simple, Homogeneal and Similar; and that whose Rays are some more Refrangible than others, I call Compound, Heterogeneal, and Dissimilar.* The former Light I call Homogeneal, not because I would affirm it so in all respects; but because the Rays which agree in Refrangibility, agree at least in all those their other Properties, which I consider in the following Discourse.

## DEFIN. VIII.

*The Colours of Homogeneal Lights, I call Primary, Homogeneal and Simple; and those of Heterogeneal Lights, Heterogeneal and Compound.* For these are always compounded of the Colours of Homogeneal Lights; as will appear in the following Discourse.

## AXIOMS.

### AX. I.

*The Angles of Incidence, Reflexion, and Refraction, lie in one and the same Plane.*

### AX. II.

*The Angle of Reflexion is equal to the Angle of Incidence.*

### AX. III.

*If the refracted Ray be returned directly back to the Point of Incidence, it shall be refracted into the Line before described by the Incident Ray.*

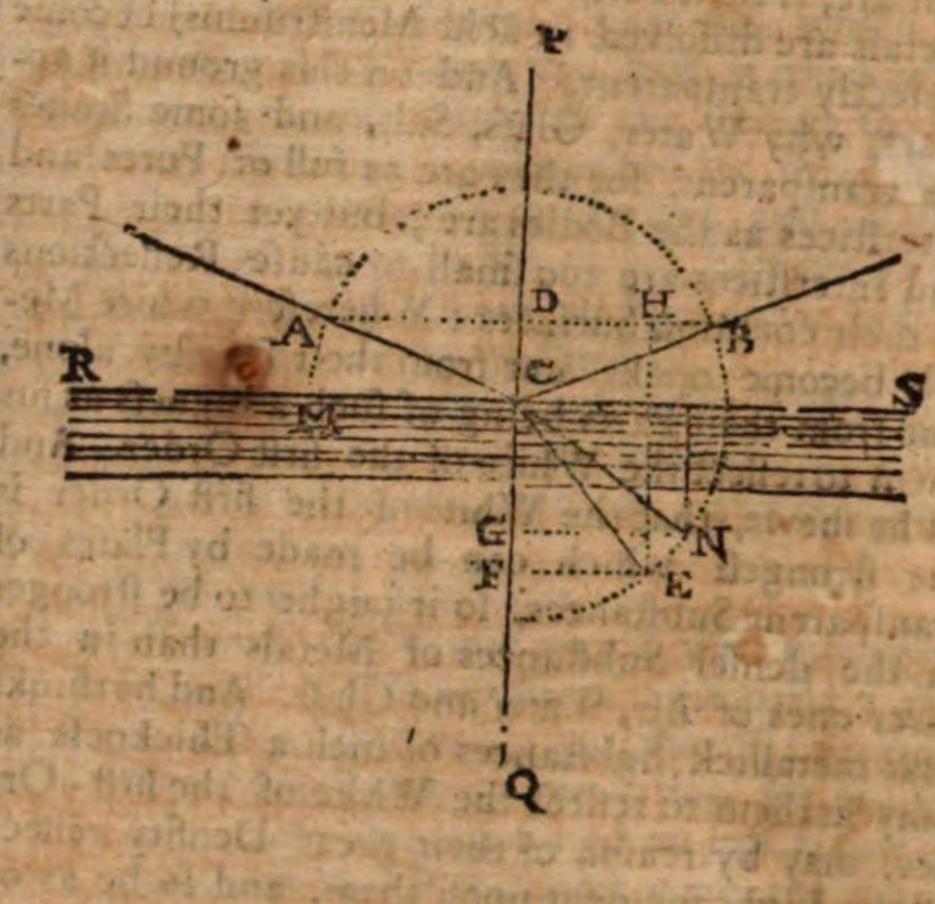
### AX. IV.

*Refraction out of the rarer Medium into the denser, is made towards the Perpendicular; that is, so that the Angle of Refraction be less than the Angle of Incidence.*

### AX. V.

*The Sine of Incidence is either accurately or very nearly in a given Ratio to the Sine of Refraction.*

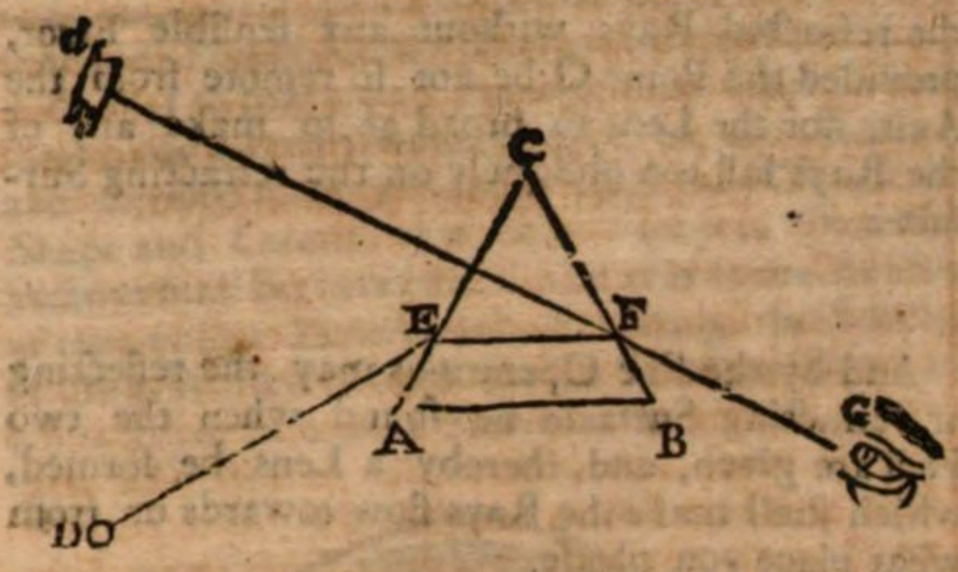
Whence if that Proportion be known in any one Inclination of the incident Ray, 'tis known in all the Inclinations, and thereby the Refraction in all Cases of Incidence on the same refracting Body may be determined. Thus if the Refraction be made out of Air into Water, the Sine of Incidence of the red Light is to the Sine of its Refraction as 4 to 3. If out of Air into Glass, the Sines are as 17 to 11. In Light of other Colours the Sines have other Proportions; but the Difference is so little, that it need seldom be considered.



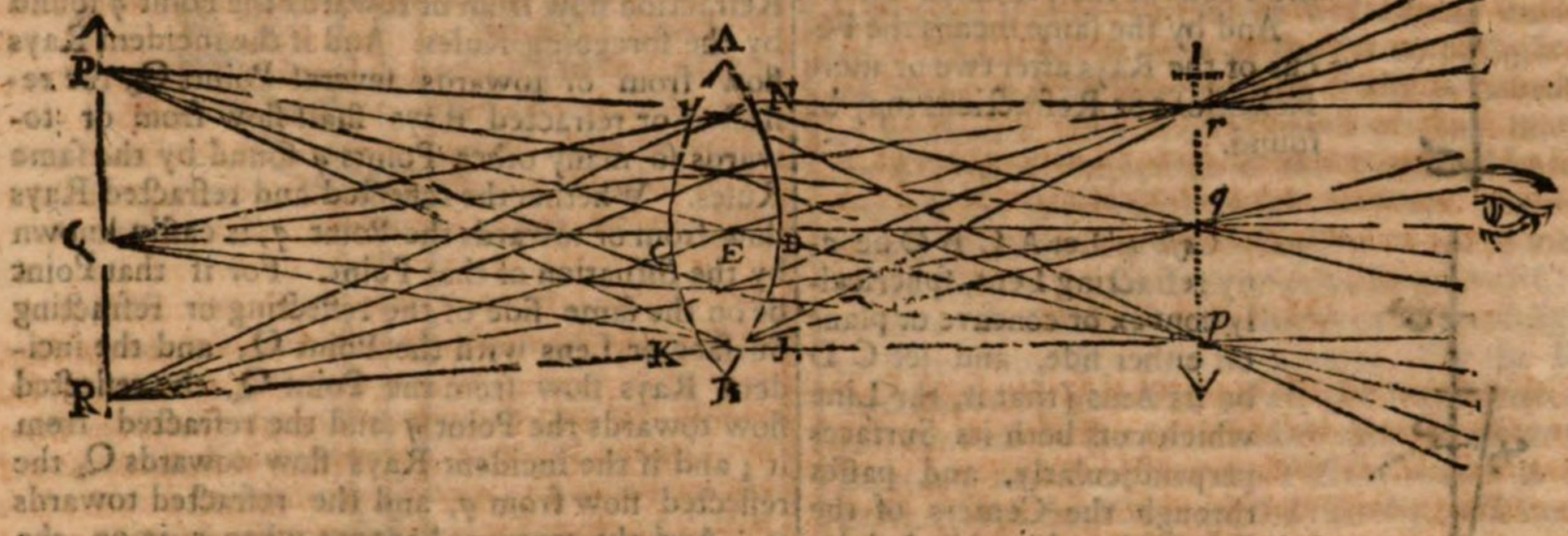

Suppose therefore, that R S represents the Surface of stagnating Water, and C is the point of Incidence in which any Ray coming in the Air from A in the Line A C is reflected or refracted, and I would know whether this Ray should go after Reflexion or Refraction: I erect upon the Surface of the Water from the point of Incidence the Perpendicular C P and produce it downwards to Q, and conclude by the first Axiom, that the Ray after Reflexion and Refraction, shall be found somewhere in the Plane of the Angle of Incidence A C P produced. I let fall therefore upon the Perpendicular C P the Sine of Incidence A D, and if the reflected Ray be desired, I produce A D to B, so that D B be equal to A D, and draw C B. For this Line C B shall be the reflected Ray; the Angle of Reflection B C P and its Sine B D being equal to the Angle and Sine of Incidence, as they ought to be by the second Axiom. But if the refracted Ray be desired, I produce A D to H, so that D H may be to A D as the Sine of Refraction to the Sine of Incidence, that is, as 3 to 4; and about the Center C and in the Plane A C P with the Radius C A describing a Circle A B E I draw parallel to the Perpendicular C P Q, the Line H E cutting the Circumference in E, and joyning C E, this Line C E shall be the Line of the refracted Ray. For if E F be let fall perpendicularly on the Line P Q, this Line E F shall be the Sine of Refraction of the Ray C E, the Angle of Refraction being E C Q; and this Sine E F is equal to D H, and consequently in Proportion to the Sine of Incidence A D as 3 to 4.

In like Manner, if there be a Prism of Glass (that is, a Glass bounded with two equal and parallel Triangular Ends, and three plane and well polished Sides, which meet in three parallel Lines running from the three Angles of the one End, to the three Angles of the other End) and if the Refraction of the Light in passing cross this Prism de desired.

Let




Let A B C represent a Plane cutting this Prism transversly to its three Parallel Lines or Edges there where the Light passeth through it, and let D E be the Ray incident upon the first side of the Prism A C where the Light goes into the Glass; And by putting the Proportion of the Sine of Incidence to the Sine of Refraction as 17 to 11 find E F the first refracted Ray. Then taking this Ray for the Incident Ray upon the second side of the Glass B C where Light goes out, find the next refracted Ray F G by putting the Proportion of the Sine of Incidence to the Sine of Refraction as 11 to 17. For if the Sine of Incidence out of Air into Glass be to the Sine of Refraction as 17 to 11, the Sine of Incidence out of Glass into Air must on the contrary be to the Sine of Refraction as 11 to 17, by the third Axiom.



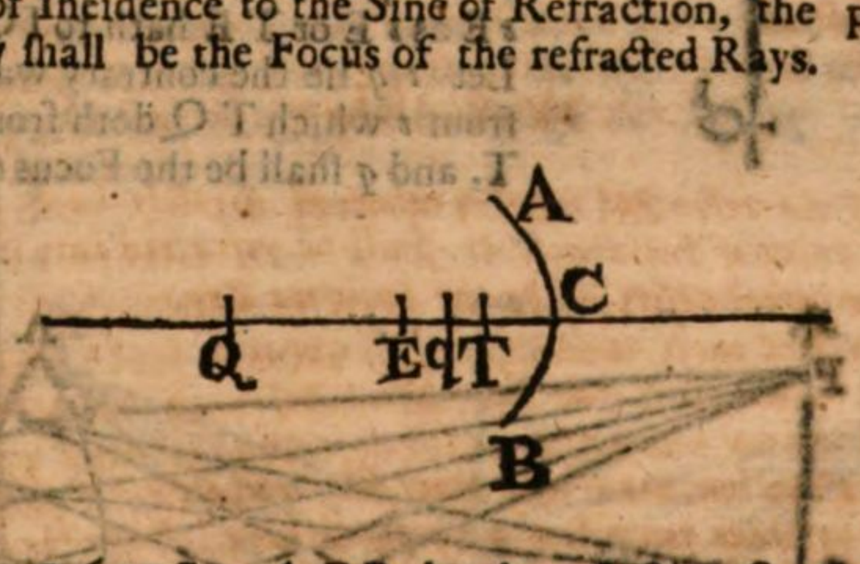

Much after the same Manner, if A C B D represent a Glass spherically convex on both Sides (usually called *Lens*, such as is a Burning-glass, or Spectacle-glass, or an Object-glass of a Telescope) and it be required to know how Light falling upon it from any lucid Point Q shall be refracted, let Q M represent a Ray falling upon any point M of its first spherical Surface A C B, and by erecting a Perpendicular to the Glass at the point M, find the first refracted Ray M N by the Proportion of the Sines 17 to 11. Let that Ray in going out of the Glass be incident upon N, and then find the second refracted Ray N *q* by the Proportion of the Sines 11 to 17. And after the same Manner may the Refraction be found when the *Lens* is convex on one side, and plane or concave on the other, or concave on both Sides.

## A X. VI.

*Homogeneal Rays which flow from several Points of any Object, and fall almost perpendicularly on any reflecting or refracting Plane or Spherical Surface, shall afterwards diverge from so many other Points, or be parallel to so many other Lines, or converge to so many other Points, either accurately or without any sensible Error. And the same thing will happen, if the Rays be reflected or refracted successively by two or three or more Plane or Spherical Surfaces.*

The Point from which Rays diverge, or to which they converge, may be called their *Focus*. And the Focus of the incident Rays being given, that of the refracted or reflected ones may be found by finding the Refraction of any two Rays, as above; or more readily thus.

*Cas.* 1. Let A C B be a reflecting or refracting Plane, and Q the Focus of the incident Rays, and Q *q* C a Perpendicular to that Plane. And if this Perpendicular be produced to *q*, so that *q* C be equal to Q C, the Point *q* shall be the Focus of the reflected Rays. Or if *q* C be taken on the same side of the Plane with Q C and in proportion to Q C as the Sine of Incidence to the Sine of Refraction, the point *q* shall be the Focus of the refracted Rays.




*Cas.* 2. Let A C B be the reflecting Surface of any Sphere whose Center is E. Bisect any Radius thereof (suppose E C) in T, and if in that Radius on the same Side the point T you take the Points Q and *q*, so that T Q, T E, and T *q* be continual proportionals, and the point Q be the Focus of the incident Rays, the point Q shall be the Focus of the reflected ones.

*Cas.* 3.

*Case* 3. Let B C B be the refracting Surface of any Sphere whose Center is E. In any Radius thereof E C produced both ways take E T and C *t* ſeverally in ſuch Proportion to that Radius as the leſſer of the Sines of Incidence and Refraction hath to the difference of thoſe Sines. And then if in the ſame Line you find any two Points Q and *q*, ſo that T Q be to E T as E *t* to *t q*, taking *t q* the contrary way from *t* which T Q lieth from T, and if the Point Q be the Focus of any incident Rays, the Point *q* ſhall be the Focus of the refracted ones.

And by the ſame means the Focus of the Rays after two or more Reflexions or Refractions may be found.

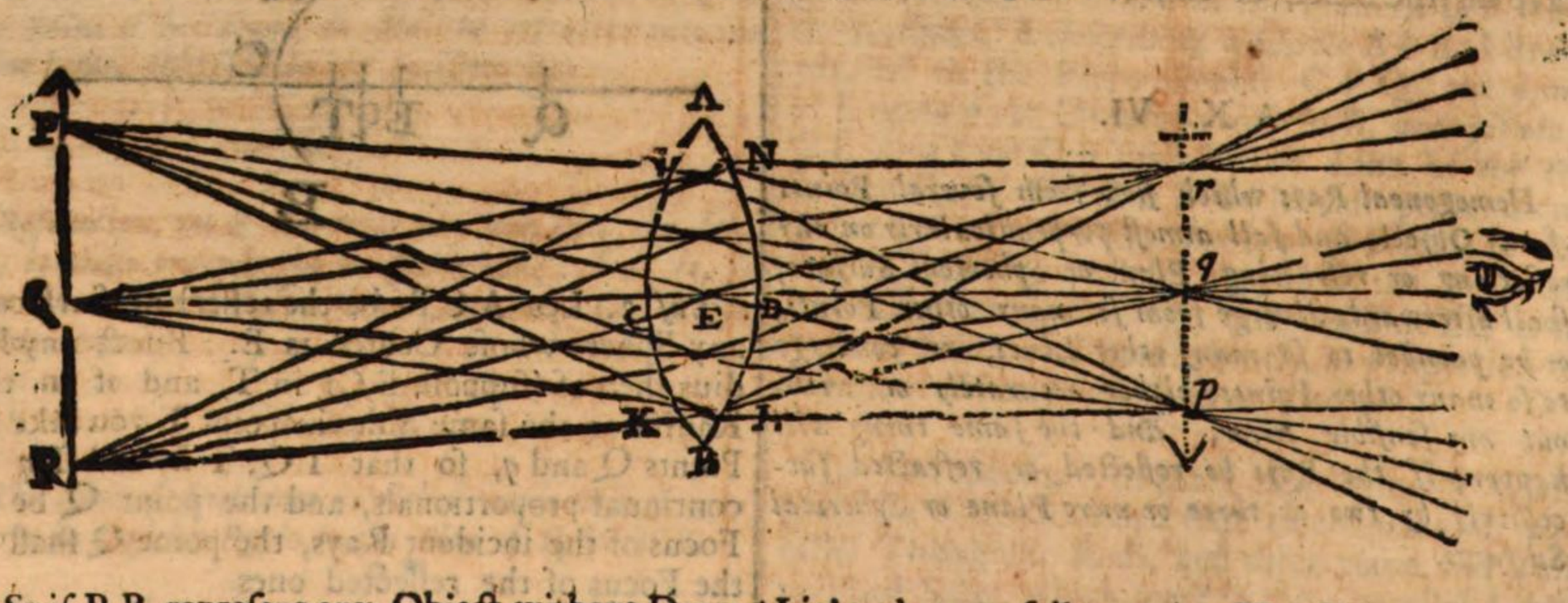
*Case* 4. Let A C B D be any refracting Lens, ſpherically convex or concave or plane on either ſide, and let C D be its Axis (that is, the Line which cuts both its Surfaces perpendicularly, and paſſes through the Centers of the Spheres,) and in this Axis let F and *f* be the Foci of the refracted Rays found as above, when the incident Rays on both ſides the *Lens* are parallel to the ſame Axis; and upon the Diameter F *f* biſected in E, deſcribe a Circle. Suppoſe now that any Point Q be the Focus of any incident Rays. Draw Q E cutting the ſaid Circle in T and *t*, and therein take *t q* in ſuch proportion to *t* E as *t* E or T E hath to T Q. Let *t q* lie the contrary way from *t* which T Q doth from T, and *q* ſhall be the Focus of the refracted Rays without any ſenſible Error, provided the Point Q be not ſo remote from the Axis, nor the Lens ſo broad as to make any of the Rays fall too obliquely on the refracting Surfaces.

And by the like Operations may the reflecting or refracting Surfaces be found when the two Foci are given, and thereby a Lens be formed, which ſhall make the Rays flow towards or from what place you pleaſe.

So then the Meaning of this Axiom is, that if Rays fall upon any plane or ſpherical Surface or Lens, and before their Incidence flow from or towards any Point Q, they ſhall after Reflection or Refraction flow from or towards the Point *q* found by the foregoing Rules. And if the incident Rays flow from or towards ſeveral Points Q, the reflected or refracted Rays ſhall flow from or towards ſo many other Points *q* found by the ſame Rules. Whether the reflected and refracted Rays flow from or towards the Point *q*, is eaſily known by the Situation of that Point. For if that Point be on the ſame ſide of the reflecting or refracting Surface or Lens with the Point Q, and the incident Rays flow from the Point Q, the reflected flow towards the Point *q* and the refracted from it; and if the incident Rays flow towards Q, the reflected flow from *q*, and the refracted towards it. And the contrary happens when *q* is on the other Side of that Surface.

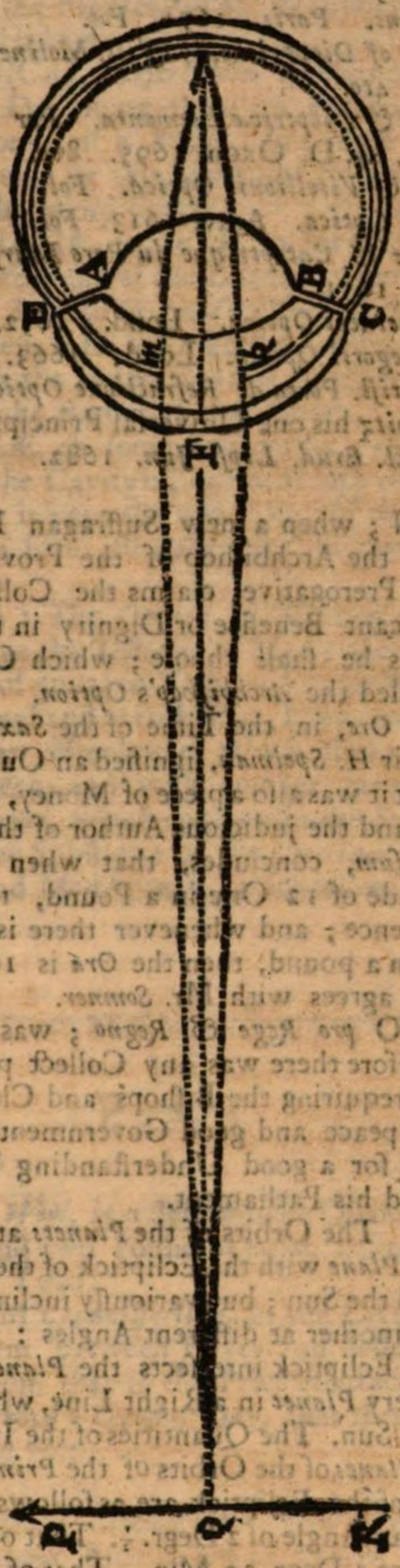
## AXIOM VII.

*Where-ever the Rays which come from all the Points of any Object meet again in ſo many Points after they have been made to converge by Reflexion or Refraction, there they will make a Picture of the Object upon any white Body on which they fall.*




So if P R repreſent any Object without Doors, and A B be a Lens placed at a Hole in the Window-ſhut of a dark Chamber, whereby the Rays that come from any Point Q of that Object are made to converge and meet again in the point *q*; and if a Sheet of white Paper be held at *q* for the Light there to fall upon it: The Picture of that Object P R will appear upon the Paper in its proper Shape and Colours. For as the Light which comes from the Point Q goes to the Point *q*, ſo the Light which comes from other points P and R of the Object, will go to ſo many other correſpondent

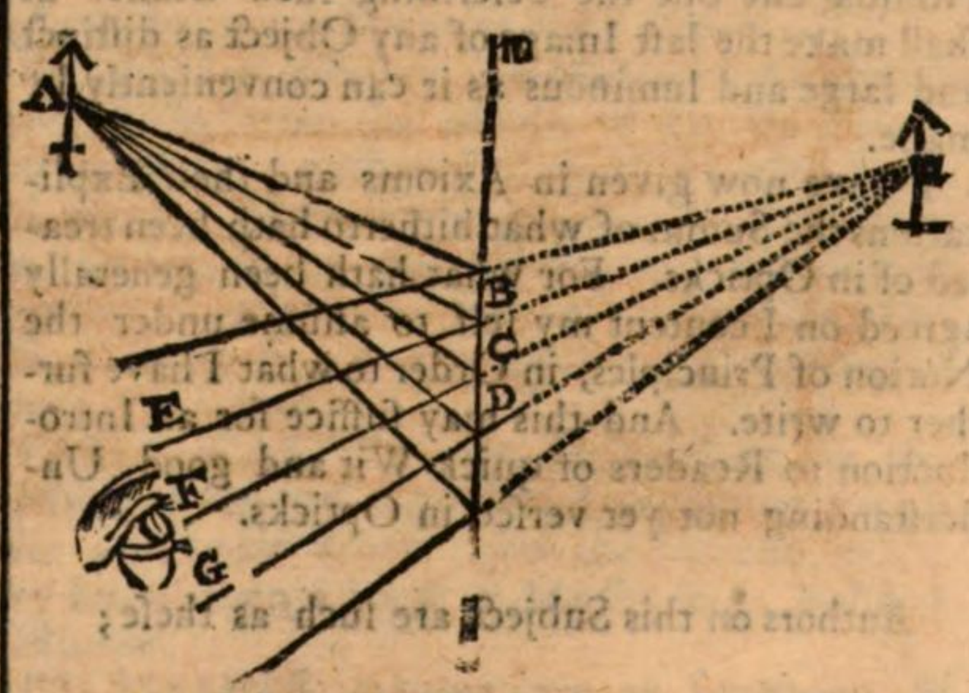
ſpondent Points *p* and *r* (as is manifeſt by the ſixth Axiom ;) ſo that every Point of the Object ſhall illuminate a correſpondent Point of the Picture, and thereby make a Picture like the Object in Shape and Colour, this only excepted that the Picture ſhall be inverted. And this is the Reaſon of that vulgar Experiment of caſting the Species of Objects from abroad upon a Wall or Sheet of white Paper in a dark Room.




In like manner when a Man views any Object P Q R, the Light which comes from the ſeveral Points of the Object is ſo refracted by the tranſparent Skins and Humours of the Eye, (that is, by the outward Coat E F G called the *Tunica Cornea*, and by the cryſtalline Humour A B which is beyond the Pupil *m k*) as to converge and meet again at ſo many Points in the Bottom of the Eye, and there to paint the Picture of the Object upon that Skin (called the *Tunica Retina*) with which the Bottom of the Eye is covered. For Anatomiſts, when they have taken off from the Bottom of the Eye that outward and moſt thick Coat called the *Dura Mater*, can then ſee through the thinner Coats the Pictures of Objects lively painted thereon. And theſe Pictures propagated by Motion along the Fibres of the Optick Nerves into the Brain, are the Cauſe of Viſion. For accordingly, as theſe Pictures are perfect or imperfect, the Object is ſeen perfectly or imperfectly. If the Eye be tinged with any Colour (as in the Diſeaſe of the *Jaundice*) ſo as to tinge the Pictures in the Bottom of the Eye with that Colour, then all Objects appear tinged with the ſame Colour. If the Humours of the Eye by old Age decay, ſo as by ſhrinking to make the *Cornea* and *Coat* of the *Cryſtalline Humour* grow flatter than before, the Light will not be refracted enough, and for Want of a ſufficient Refraction will not converge to the Bottom of the Eye, but to ſome Place beyond it, and by Conſequence paint in the Bottom of the Eye a confuſed Picture, and according to the Indiſtinctneſs of this Picture the Object will appear confuſed. This is the Reaſon of the Decay of Sight in old Men, and ſhews why their Sight is mended by Spectacles. For thoſe Convex-glaſſes ſupply the Defect of Plumpneſs in the Eye, and by encreaſing the Refraction, make the Rays converge ſooner, ſo as to convene diſtinctly at the Bottom of the Eye, if the Glaſs have a due Degree of Convexity. And the contrary happens in ſhort-ſighted Men whoſe Eyes are to plump. For the Refraction being now too great, the Rays converge and convene in the Eyes before they come at the Bottom ; and therefore the Picture made in the Bottom, and the Viſion cauſed thereby, will not be diſtinct, unleſs the Object be brought ſo near the Eye, as that the Place where the converging Rays convene may be removed to the Bottom, or that the Plumpneſs of the Eye be taken off, and the Refractions diminiſhed by a Concave-glaſs of a due Degree of Concavity ; or laſtly, that by Age the Eye grow flatter till it come to a due Figure : For ſhort-ſighted Men ſee remote Objects beſt in Old Age, and therefore they are accounted to have the moſt laſting Eyes.

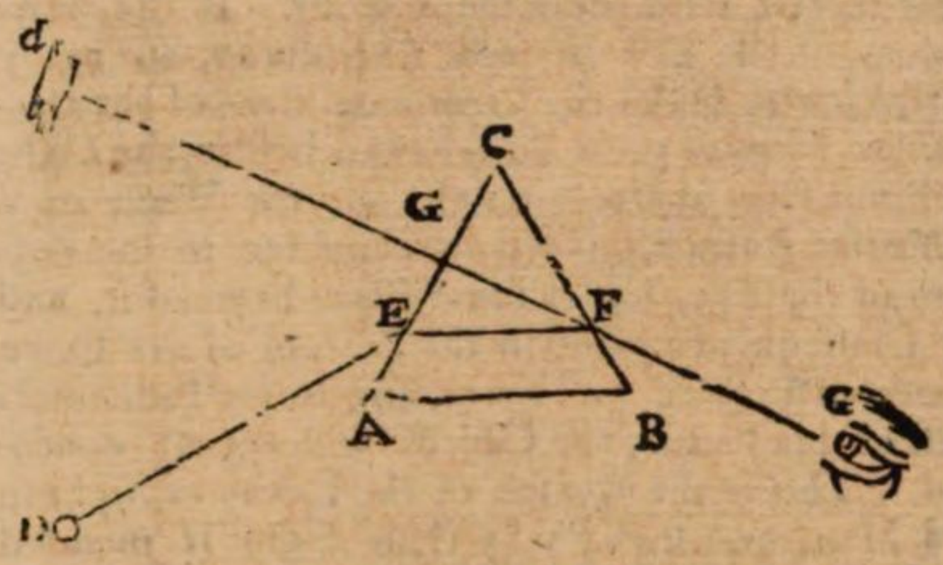
## A X. VIII.

*An Object ſeen by Reflection, or Refraction, appears in that Place from whence the Rays after their laſt Reflection or Refraction diverge in falling on the Spectator's Eye.*

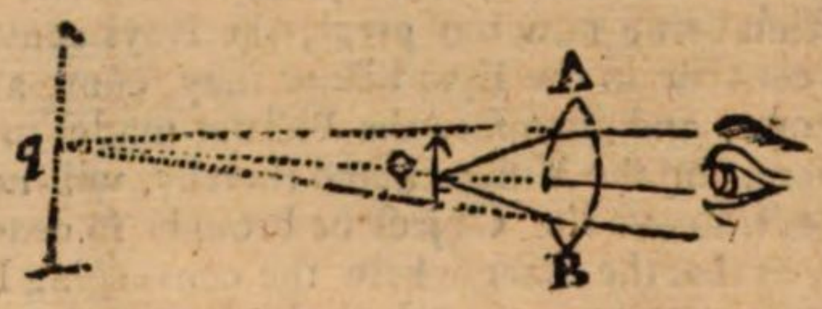



If the Object A be ſeen by Reflexion of a Looking-glaſs *m n*, it ſhall appear, not in its proper Place A, but behind the Glaſs at *a*, from whence any Rays A B, A C, A D, which flow from one and the ſame Point of the Object, do after their Reflexion

Reflection made in the Points B, C, D, diverge in going from the Glaſs to E, F, G, where they are incident on the Spectator's Eyes. For theſe Rays do make the ſame Picture in the Bottom of the Eyes as if they had come from the Object really placed at *a*, without the Interpoſition of the Looking-glaſs; and all Viſion is made according to the Place and Shape of that Picture.




In like Manner the Object D ſeen through a Priſm appears not in its proper place D, but is thence tranſlated to ſome other place *d* ſituated in the laſt refracted Ray F G drawn backward from F to *d*.




And ſo the Object Q ſeen through the Lens AB, appears at the Place *q* from whence the Rays diverge in paſſing from the Lens to the Eye. Now it is to be noted, that the Image of the Object at *q* is ſo much bigger or leſſer than the Object it ſelf at Q, as the Diſtance of the Image at *q* from the Lens A B is bigger or leſs than the Diſtance of the Object at Q from the ſame Lens. And if the Object be ſeen through two or more ſuch Convex or Concave-glaſſes, every Glaſs ſhall make a new Image, and the Object ſhall appear in the Place and of the Bigneſs of the laſt Image. Which Conſideration unfolds the Theory of Microſcopes and Teleſcopes. For that Theory conſiſts in almoſt Nothing elſe but the deſcribing ſuch Glaſſes as ſhall make the laſt Image of any Object as diſtinct and large and luminous as it can conveniently be made.

I have now given in Axioms and their Explications the Summ of what hitherto hath been treated of in Opticks. For what hath been generally agreed on I content my ſelf to aſſume under the Notion of Principles, in Order to what I have further to write. And this may ſuffice for an Introduction to Readers of quick Wit and good Underſtanding not yet verſed in Opticks.

Authors on this Subject are ſuch as theſe;

Sir *Iſ. Newton's Opticks*, Engl. *and* Lat.
*Phyſico-Matheſis de Lumine, Coloribus, & Iride. per Fr. Mar. Grimaldi.* Bononiæ. 1665. 4*to*.
*Cogitationes Phyſico-Mechanicæ de Natura Viſionis. Per* J. Ott. Schaphuſam. Heidelburgh. 1670. 4*to*.
*Synopſis Optica per Honorat. Fabrum*, Lugduni. 1667.
*L' Occhiale all' Occhio overo Dioptrica Practica. del Carlo Ant. Mancini.* Bolognæ. 1660. 4*to*.
*Lectiones* 18 *Cantabr. in Scholis Habitæ in quibus Opticorum Phenomenõn genuinæ Rationes inveſtigantur & exponuntur. Per D. Iſ. Barrow.* Lond. 1669. 4*to*.
*La Dioptrique Oculaire, par le Pere Cherubin D'Orleans. Paris.* 1671. *Fol.*
*A Treatiſe of Dioptricks, by Will. Molineux*, Eſq; *F. R. S.* 4*to*.
*Catoptricæ & Dioptricæ Elementa. Per* D. Gregorium, M. D. Oxon. 1695. 8*vo*.
*Alhazeni & Vitellionis Optica. Fol.*
*Aguillonii Optica.* Antv. 1613. *Fol.*
*L' Optique & Catoptrique du Pere Merſennes, a Paris.* 1651.
*Chriſt. Scheineri Optica.* Lond. 1652.
*Jacobi Gregorii Optica.* Lond. 1663.
*Joan. Baptiſt. Porta de Refractione Optices.* 15.
Mr. *Leibnitz* his one Univerſal Principle of *Opticks* in *Act. Erud. Lipſ. Jun.* 1682.

OPTION; when a new Suffragan Biſhop is conſecrated, the Archbiſhop of the Province, by a cuſtomary Prerogative, claims the Collation of the firſt vacant Benefice or Dignity in that See, according as he ſhall chooſe; which Choice is therefore called the *Archbiſhop's Option.*

ORA or *Ore*, in the Time of the *Saxons*, according to Sir *H. Spelman*, ſignified an Ounce, and he ſaith, that it was alſo a piece of Money, in value 16 pence; and the judicious Author of the *Chronicon Pretioſum*, concludes, that when we find Mention made of 12 Oræ in a Pound, then the *Ora* is 20 pence; and whenever there is ſaid to be 15 Oræ in a pound, then the *Ora* is 16 pence, in which he agrees with Mr. *Somner*.

ORANDO *pro Rege & Regno*; was a Writ formerly (before there was any Collect purpoſely appointed,) requiring the Biſhops and Clergy, to pray for the peace and good Government of the Realm, and for a good Underſtanding between the King and his Parliament.

ORBIT. The Orbits of the *Planets* are not all in the ſame *Plane* with the Ecliptick of the Earth's Orbit round the Sun; but variouſly inclined to it and to one another at different Angles: But the *Plane* of the Ecliptick interſects the *Plane* of the Orbit of every *Planet* in a Right Line, which paſſes thro' the Sun. The Quantities of the Inclinations of the *Planes* of the Orbits of the *Primary Planets* to that of the Ecliptick are as follows. That of *Saturn* is an Angle of 2 Degr. $\frac{1}{2}$. That of *Jupiter* is an Angle of 1 Degr. 20 Min. That of *Mars* is almoſt 2 Degr. *Venus* is a little more than 3 Deg. 20'. And that of *Mercury* is a little more than 7 Degr.

ORDEAL, was the old Judicial Cuſtom of proving the Guilt, or atteſting the Innocence of parties accuſed; chiefly by *Water* or *Hot Iron*. This *Ordeal* was ſimply call'd *Judicium*, in Oppoſition to *Bellum*, which was Duel or Combat Fight, the other cuſtomary purgation. Neither of theſe Trials were taken away by *William the Conquerour*, as Sir *W. Temple* aſſerts. *Ordeal* might be undergone by Servants or Deputies in the Cauſe and Name of their Maſters; eſpecially of thoſe Lords who were Biſhops and Eccleſiaſtical Men. Dr. *Kennett's*

*Kennet's Gloſſary at the End of his Parochial Antiquities.*

ORDINANCE *of the Foreſt*, is a Statute made about Foreſt Cauſes in the Thirty Fourth Year of *Edw.* I. See *Aſſize.*

ORDINATE *Figures* (in Geometry) are the ſame with Regular ones; that is, they are *Equilateral* and *Equiangular.*

ORDONANCE, in Painting or Sculpture, is the juſt and elegant Compoſition of the whole Piece by a proper, natural, and agreeable Diſpoſition of the Figures, ſo as to anſwer the Deſign of the Hiſtory.

ORGANICAL *Deſcription of Curves*, is the Method of Deſcribing them on a Plane by the Regular Motion of a Point. See ſome excellent ſhort Theorems for this, invented by Sir *Iſ. Newton*, under the Word *Curves.*

ORIGINALIA, is the Term for Records or Tranſcripts ſent out of the Chancery into the Lord Treaſurer's Remembrancer's Office in the Exchequer: Theſe are diſtinguiſhed from *Recordæ*, which ſignify the Judgments and Pleadings in Suits try'd before the Barons of that Court.

OSTINEÆ, ſo ſome Anatomiſts call the Entrance into the Cavity of, or the Mouth of the *Matrix*, where it joins the upper End of the *Vagina*, and makes a little Protuberance in the Form of Lips.

OVARIA: The *Ovaria* in Women are about half as big as the *Teſticles* in Men; their Surface is ſmooth and equal in Virgins, but in Women of Years unequal and wrinkled. They are covered with a *proper* Membrane, which ſticks cloſe to their Subſtance, and with another *common* from the *Peritonæum*, which covers alſo the Spermatick Veſſels. The Subſtance of the *Ovaria* is compoſed of Fibres and Membranes, which leave little Spaces, in which there are ſeveral ſmall Veſicles, round, full of Water, and which when boiled, harden like the Whites of Eggs; they have each of them two proper Membranes, on which there are ſeveral ſmall Twigs of Veins, Arteries and Nerves. Theſe Veſicles are called *Eggs.* The *Ovaria* have Nerves alſo from the Intercoſtals, and Lymphaticks, which diſcharge themſelves into the common Receptacle of the Chyle.

OVOLO or *Echinus*, in Architecture, is a part of the Ornaments or Mouldings of the Corniſh of a Pillar; which in the Tuſcan and Dorick Orders is turned like a *Scima* or *Cymatium*, and is ſubſtituted for the Support of the *Corona*; in the *Dorick Order* it uſually hath a ſlender *Regula* above it, and in the *Corinthian* both above and below too, where it is likewiſe carved and adorned with a broad *Welt* like a *Plinth.*

OUSTER *la main*, in a legal Senſe, denotes a Judgment given for him that ſued or traverſed a *Monſtrans le Droit*; and is indeed a Delivery out of the King's Hands; for when it appeareth on the Matter diſcuſſed, that the King hath no Right or Title to the Thing ſeized, then Judgment ſhall be given in the Chancery, that the King's Hand be *amoved*, and thereon an *Amoveas Manum* or *Ouſter la main* ſhall be awarded to the Eſcheator; which is as much as if Judgment were given that he ſhould have his Land again. Now, all Wardſhips, Liveries, Primier Seiſins, and *Ouſter la mains* are taken away by 12 *Car.* 2. *c.* 24.

OUTFANGETHEF, was a Privilege granted to ſome Lords of Mannors from the Crown, to try Foreigners or Strangers apprehended for Theft within their own Fee.

O YES, is a Corruption from the French *Oyez!* hear ye! being the Form uſed by our Criers in Courts, *&c.* to make Proclamation of any Thing.



PACK *of Wool*, is a determinate Quantity of 17 Stone and two Pound Weight, being a common Horſe Load.

PACTUM *Commiſſorium*, in the Civil Law, is an Agreement between Buyer and Seller, but on this Condition, that if the Price contracted for be not paid before a certain Day, that then the Bargain ſhall be void.

PAINTING. Books treating of this Art, and of the Eminent Artiſts, are as follow.

*An Idea of the Perfection of Painting: Originally written in French by* Rowland Treart, *Sieur* de Cambray, *and rendred Engliſh by* J. Evelyn, *Eſq*; *F. R. S.* Lond. 1668. 8*vo.*

*A General Idea of the Art of Painting, and a Relation of 7 Conferences held at* Paris *in the Academy Royal for the Improvements of the Arts of Painting and Sculpture.*

*Optique de Portraiture & Peinture, contenant la Perſpective Speculaire & Pratique Accomplic.* &c. *per Gregoire Huret de l' Academ. Royale de Peinture & Sculpture, a* Paris. 1670. *Fol.*

*Entretiens ſur les Vies & ſur les Ouvrages des plus Excellens Peintres Anciens & Modern, per M. Felibien.*

PALATO-*Salpingæus*, a Muſcle of the *Tuba Euſtachyana.* See *Muſculus Tubæ Novus.*

PALATO-*Staphilinus*, is a Muſcle of the *Uvula*, ariſing fleſhy from the middle of the *Os Palati*, near its juncture with its Fellow of the other Side, and running ſtrait forwards, it is inſerted near the Extremity of their duplicated glandulous Membrane called the *Gargareon*: Its Uſe is to pull it forwards and downwards. Dr. *Dowglas, Myogr. Comp. Spec.*

PALLIFICATION, in Architecture, is the *Pileing* the Ground-work, or ſtrengthning it with Piles or Timber driven into the Ground, when they build upon a *Moiſt* or *Marſhy Soil. Builders Dictionary.*

PALLISADES *turning*, are an Invention of Mr. *Coehorn's*, for in Otder to preſerve the Palliſades of the Parapet from the Beſiegers Shot; he orders them ſo, that as many of them as ſtand in the length of a Rod, or in about 10 Foot, turn up

and down like a Trap; ſo that they are not in Sight of the Enemy, but only juſt when they bring on their Attack; and yet are always ready to do the proper Service of Palliſades.

PALLS, *Pallia*, were Veſtures made of Lambs Wool (25. *H.* 8. 20.) about 8 Fingers broad, and with two Labells hanging down before and behind: Theſe the Pope gives or ſends to Archbiſhops and Metropolitans, who wear them about their Necks at the Altar above their Ornaments. We retain ſomething of the Figure of it, in what the Heralds call a *Croſs Pall.*

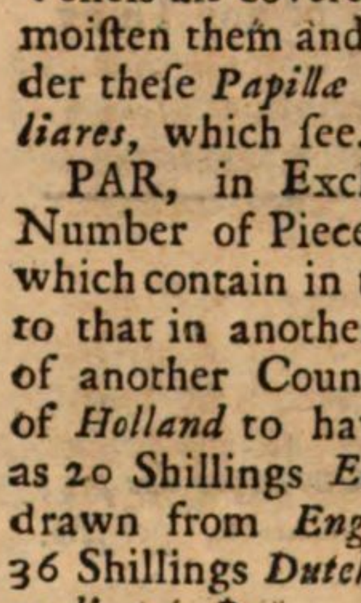
PANEL; ſome ſay is a little Part of any Thing; others, as *Spelman*, ſay it ſignifies a Schedule or little Page; which ſeems trueſt, for hence comes our Law Word to Empennel a Jury, *i. e.* to write the Names in a Pannel or Schedule of ſuch Jurors as the Sheriff returns to paſs upon any Trial.

PANNAGE, *Pannagium*; ſignified formerly both the running and feeding of Hogs within a Foreſt, and alſo the Price that was paid for their ſo running. *Pannagium Liberum*, or *Free Pannage*, was a Liberty of free running for Swine within the Limits of ſuch Foreſts or Woods; and was ſometimes a Privilege granted to ſome private Perſons, and to ſeveral Religious Houſes. If this Pannage were not duely paid, there was a *Proceſs* from the *Exchequer* and a *Deſtraint* by the *Sheriff*. The Title of *Pannage* was ſometimes alienated from the Pariſh Prieſt to the Appropriators. Dr. *Kennet's Paroch. Antiq.*

PAPILLÆ *Pyramidales*, are the Extremities of all the Nerves of the Skin, and ſerve more immediately for the Senſe of Feeding and Touching; about them there is a Web of Nerves and other Veſſels all covered with a Mucous Subſtance, to moiſten them and keep them in good Order. Under theſe *Papillæ Pyramidales* lie the *Glandulæ Miliares*, which ſee. See alſo the word *Skin.*

PAR, in Exchange of Money, is a certain Number of Pieces of the Coin of one Country, which contain in them an equal Quantity of Silver to that in another Number of Pieces of the Coin of another Country. *v. g.* Suppoſe 36 Shillings of *Holland* to have juſt as much Silver in them as 20 Shillings *Engliſh*; then Bills of Exchange drawn from *England* to *Holland* at the rate of 36 Shillings *Dutch* for each Pound Sterling *is according to Par.*

PARABOLA. To draw a Tangent to the *Parabola* in a Point aſſign'd.




Let the Point aſſigned be *M*, and the Parameter $=p$.

Then the Equation expreſſing the Nature of the Curve is $\boxed{px=yy}$

Suppoſe the Tangent found and all Things drawn as in the Figure,

'Tis required to determine the Subtangent *TO*; now the △'s *m R M* and *MOT* being ſimilar, let the former be noted with its proper Fluxionary Letters, and then this Proportion will ariſe;

$\dot{y} . \dot{x} :: y . \frac{\dot{x}y}{\dot{y}} (= OT)$. and the Equation of the Curve being $\boxed{px=yy}$ the Fluxion ($px=2y\dot{y}$ and dividing all by $p$; $\frac{2y\dot{y}}{p} = \dot{x}$. and ſubſtituting $\frac{2y\dot{y}}{p}$ inſtead of $\dot{x}$, in the Quantity $\frac{\dot{x}y}{\dot{y}} = OT$, you will find that $\frac{2yy}{p} =$ is alſo equal to *OT*. Then ſubſtituting $px$ inſtead of $yy$, you will have $\frac{2xp}{p}$ or $2x = OT$: That is, in the common *Parabola*, *The Subtangent is always = to twice the Abſciſſa.*

*N. B.* In any *Parabola* if the Parameter be ſuppoſed $= 1$. and $m$ be the Index of the Power of $y$, and a poſitive Number, whole or broken, then will $\boxed{y^m = x}$ expreſs the Nature of all *Parabola's*;

The Subtangent *TO* in the *Parabola* being equal to $2x$: and $\square MO = (yy) = px$. by Reaſon of the ſimilar Triangles *MOT* and *MOQ*: $OT (=2x) . y :: y . \frac{yy}{2x} = OQ$, and then putting for $yy$ its equal $px$ it will be $\frac{px}{2x} = OQ$ $\boxed{\text{or } \frac{p}{2} = OQ}$ which gives you a very temarkable Property of the common *Parabola*: *viz.* That the *Sub-normal*, as the Line *OQ* is called, is always equal to half the Parameter of the Axis, and conſeqnently a ſtanding Quantity.

Wherefore 'tis a very ready Way to draw a Tangent to the Parabola, to ſet off half $p$ from *O* the Foot of any Ordinate downwards in the Axis, and from *Q*, draw *MQ*: And to it at Right Angles *MT*: For that ſhall be the Tangent required.

PARABOLICK *Spiral.* See *Helicoid Parabola.*

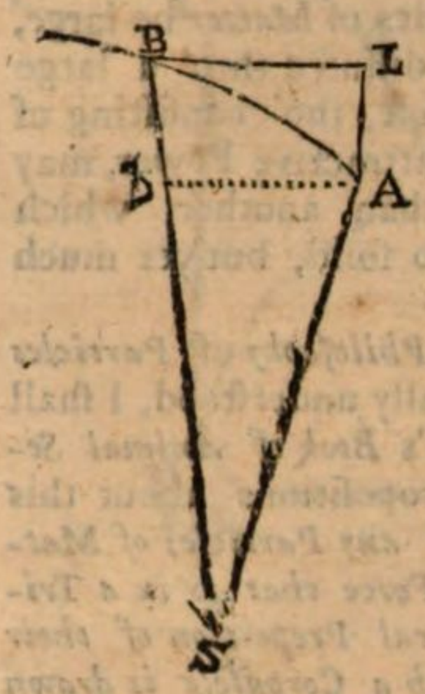
PARABOLOIDS, are Paraboliform Curves in Geometry; whoſe Ordinates are ſuppoſed to be in a Subtriplicate, Subquadruplicate, &c. Ratio of their reſpective *Abſciſſæ*; and putting $x$ for the Abſciſſa, $y$ for the Ordinate, and $p$ for the Parameter, the Equation for the *Cubical Paraboloid* will be $\boxed{ppx=y^3}$ In the Biquadrical Paraboloid, the Cube of the Parameter into the Abſciſſa is equal to the Biquadrate of the Ordinate; that is, $p^3x=y^4$: and ſo of other Paraboloids *ad infinitum.*

But there is alſo another Species of the *Paraboloids*; *v. gr.* 1. Suppoſe the Parameter multiply'd into the Square of the Abſciſſa to be equal to the Cube of the Ordinate; that is, $pxx=y^3$. Then the Curve is called a *Semicubical Paraboloid.* And,

2. When $px^3=y^4$. then 'tis called a *Semi-biquadratical Paraboloid.*

PARACENTRICK *Motion of Impetus*, is a Term in the New Aſtronomy, for ſo much as the Revolving Planet approaches nearer to, or recedes farther from the Sun, or Centre of Attraction.

Thus




Thus if a Planet in A move to B, then is S B—S A *bB*, the Paracentrick Motion of that Planet. *Hayes. p.* 293.

PARACENTRICK *Sollicitation of Gravity*, or *Levity* (which is all one with the *Vis Centripeta*) is in *Astronomy* expressed by the Line A L drawn from the Point A parallel to the Ray S B (infinitely near S A) until it intersect the Tangent B L.

PARADIGRAMMATICE, is the Art of making all sorts of Figures in *Plaister*. The Artists in this are called *Gypsochi*.

PARALLAX, in the *Leipsick* Acts for *October*, 1685, there is an Account of the *Cassinian Method* of finding the *Parallaxes* and *Distances* of the *Planets* from the Earth; practised at *Rome* by the Abbot *Fran. Blanchinus*.

PARALLAX *Diurnal* of the Sun. How to find it, see under *Sun* in this Vol.

PARALLEL *Sailing* in Navigation, is sailing under a Parallel of Latitude: of this there are but 3 Cases. 1. Given Departure and Distance. Required Latitude.

The Canon is, As Diff. of Longitude to Rad. :: so is Distance, to Cosine of the Latitude.

2. Given Diff. of Longitude between two places under the same Parallel; required their Distance.

The Canon is, As Rad. to Diff. Longitude : : so is the Cosine of Lat. to Distance.

3. Having the Distance between two places in the same Latitude, required their Difference of Longitude.

The Canon is, As the Co-sine of Lat. to Distance : : so is Rad. to Diff. Longitude.

PARASTÆ, in Architecture, are the same with *Pilasters*; the *Italians* call them *Membretti*.

PARCEL-*makers*, are two Officers in the Exchequer that make the parcels of the Escheators Accompts, wherein they charge them with every thing they have levied for the King's Use within the Time of their Office, and deliver the same to one of their Auditors of the Court, to make an Accompt with the Escheator thereof. See the *Practice of the Exchequer, p.* 99.

PARCELLING of the Seam of a Ship, is after it is caulked, to lay over it a narrow piece of Canvas, and then pouring on it hot *Pitch* and *Tar*.

PARGETING or *Parging*, is the Workmens Word for plaistering of Walls.

PARHELII and *Parhelia*, or such *Phænomena* as we call *Mock-Suns*, are the Representations of the Face or Figure of the *True Sun*, by way of Reflection in the Clouds.

PARLIAMENT, comes from *parler* to Speak, and *Ment*, Mind, in *Fr.* And the Writ which summons our *Parliament* runs, *ad consulendum*, &c. *de arduis Regni Negotiis.* And therefore signifies a solemn Conference of all the Estates of the Kingdom, summoned together by the King or Queen's Authority to treat of the weighty Affairs of the Realm. The ancient *Britains* seem to have had no such Assemblies; but that the *Saxons* had something like it, appears from King *Ina*'s Laws, who flourish'd *An.* 712. *W. the Conqueror* divided the Land amongst his Followers, in such manner, that every one should hold of him *in Capite*; and these distributed part thereof among their Friends and Servants; who for the same owed them *Suit* and *Service* in their Courts. The chief of these were called *Barons*, who thrice every Year assembled at the King's Court, *viz.* at *Christmas*, *Easter*, and *Whitsontide*: and then the King was wont to come amongst them in his Royal Robes, and with his Crown on his Head, to consult about the publick Affairs of the Kingdom. But some say, this ancient Custom was changed by *H.* 1. who in the 16th Year of his Reign, summoned the Commons to the great Council at *Salisbury*. *Cowell*'s *Interpreter*.

PARODICAL *Degrees in an Equation in Algebra*, are the several Regular Terms in a Quadratick, Cubick, Biquadratick Equation, &c. the Indexes of whose Powers ascend or descend orderly in an Arithmetical Progression, as $z \times 3z^2m + z^r = S$ is a *Cubick Equation* where no *Term* is *wanting*; but having all its *Parodick Degrees* the *Indexes* of the Terms regularly descending thus, 2, 3, 1, 0.

PARTICLES, are the very small parts of which any natural Body is supposed to be compounded; and these are often called the *constituent* or *component Particles of any Natural Body*. That these are almost infinitely small, the continual Effluvia which some Bodies do continually emit, and this without any sensible Diminution of their Bulk or Weight, as well as some other Experiments and Observations do plainly shew. But how to make any Conjecture at the several Sizes of these component Particles of Bodies, whether they are all equal in Bulk, or which are greater, and how much they are so, than others, is what *Philosophers* have hardly yet had *Data* or Discoveries enough to determine. But the wonderful Sir *Isaac Newton*, in his excellent Book of *Opticks*, hath opened a Door into this new World, and hath given some very good Rules whereby to guess at the Bigness of the Component Parts of Natural Bodies. For he having shewn in *Prop.* 5. *Book* 2. *Part* 3. That the transparent parts of all Bodies do most probably exhibit the same Colours with thin plates of Glass, or thin Bubbles of Water, and on the same Grounds; provided they are of the same Thickness and of the same Density with them. And since their Parts seem for the most part to have the same Density with Water or Glass, as by many Circumstances 'tis obvious to collect. To determine the Sizes of those Parts, you need only have Recourse to the Tables in the aforesaid Book for this purpose, in which the Thickness of Water or Glass exhibiting any Colour is express'd. Thus if it be desired to know the Diameter of a Corpuscle, which being of equal Density with Glass, shall reflect Green of the 3d Order, (as he distinguishes it) by looking into the Table, you will find that the Number $16\frac{1}{4}$ shews it to be $\frac{16}{1000000}$ parts of an Inch. In the general he proves also, *That the Parts of Bodies on which their Colours depend are denser than the Medium, which pervades their Interstices.* Prop. 6. B. 2. part 3.

He ſhews alſo at the End of his *Latin Opticks*, That the Component Particles of all Bodies muſt be hard or ſolid, or elſe *Fluid Bodies* could not *congeal*; which 'tis certain that *Water*, *Oyl*, *Vinegar*, and Spirit or Oyl of *Vitriol* will do by *Cold*; Quickſilver by the Fumes of Lead; Spirit of Nitre and Quickſilver together by diſſolving the Mercury, and then evaporating the *Flegm*: Spirit of Wine, or Urine, by firſt well dephlegmating them, and then mixing them together, and the Spirit of *Urine* and of *Salt*, by ſubliming them together to make *Sal Armoniack*. Nay, the very Particles or Rays of Light ſeems to be *hard Bodies*, otherwiſe they could not in their different Sides have different Properties, as he hath ſhewn that they have (ſee *Light*.) *Hardneſs* therefore ought to be accounted as the Property of all ſimple Matter in the Univerſe; for all Bodies which we know, are either hard, or may be made ſo. And if there are many hard Bodies, as we know is the Caſe of moſt, that have Pores interſperſed, or *Meatus* placed between their Particles; thoſe Particles themſelves that are devoid of any ſuch Vacuities muſt needs be much harder.

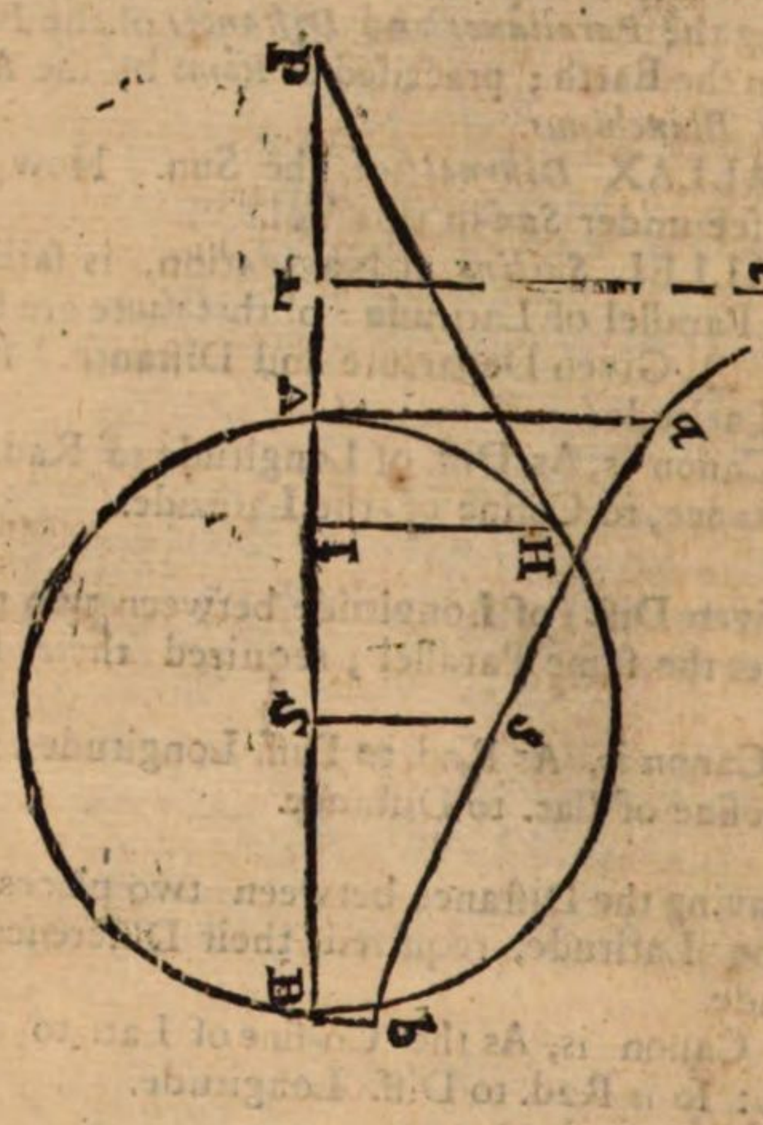
'Tis probable that the moſt ſmall Particles of Matter do attract one another, and adhere together with the greateſt Force; and that theſe may combine into larger Particles, whoſe attracting Force is weaker; and many of theſe latter cohering together may form yet greater Particles of Bodies, whoſe attracting Force ſhall be yet weaker. And ſo on by a continual Series, 'till you come to the greateſt of thoſe Particles, on which the *Chymical Operations*, and the *Colours* of Bodies depend (ſee *Attraction* and *Colour*) and theſe cohering into *Maſſes* may form Bodies of ſufficient *Magnitude* to become perceptible by Senſe.

It hath been diſcovered of late by the wonderful Sir *Iſaac Newton*, Mr. *J. Keil* of *Oxon*, and ſuch others as have proceeded on his Principles, *That there is a Power in Nature, by which each Particle of Matter attracts every other Particle with a Force that increaſeth in a greater Proportion than that by which the Squares of the Diſtance decreaſe*; viz *in a Reciprocal Triplicate, or Quadruplicate Ratio of the Diſtances*. For, were it not ſo, the Attraction of theſe ſmall Particles would not be much greater at the *Point* of *Contact*, than at ſome determinate Diſtance from it; as is evident in the Caſe of the *Gravity* of greater Bodies, whoſe power of Attraction is only reciprocally as the Square of the Diſtance; for we find that Bodies are of the ſame Weight, when at the Earth's Surface, or when at 100 Feet Diſtance. But when a little *Salt* is diſſolved in a large Quantity of Water, there is no Attraction of the Particles towards one another, till by evaporating part of the Water, they are brought within a due Diſtance; and then they preſently run towards one another, unite, and form Chryſtals, whoſe Parts have a ſtrong Coheſion. (See *Attraction* in this Vol.)

'Tis plain alſo, that the *attractive Force in theſe Particles is* (cæteris paribus) *proportionable to their Solidity*; for it muſt be compounded of the *Summs of all the Parts* of each Particle, and thoſe parts will be moſt numerous in ſuch Particles as are moſt ſolid; *i. e.* in ſuch as have feweſt and leaſt Pores or Interſtices between their Parts. For Particles or Corpuſcles may be ſo compounded, that the moſt ſolid and compact Particles may conſtitute the lighteſt Corpuſcle: That is, if the interſperſed Vacuities between the Particles of *Matter* be large, ſo that few of them may be diffuſed thro' a large Space. And ſuch a Corpuſcle, tho' conſiſting of Parts endued with a ſtrong attractive Power, may yet be ſpecifically lighter than another, which may conſiſt of Particles not ſo ſolid, but yet much cloſer put together.

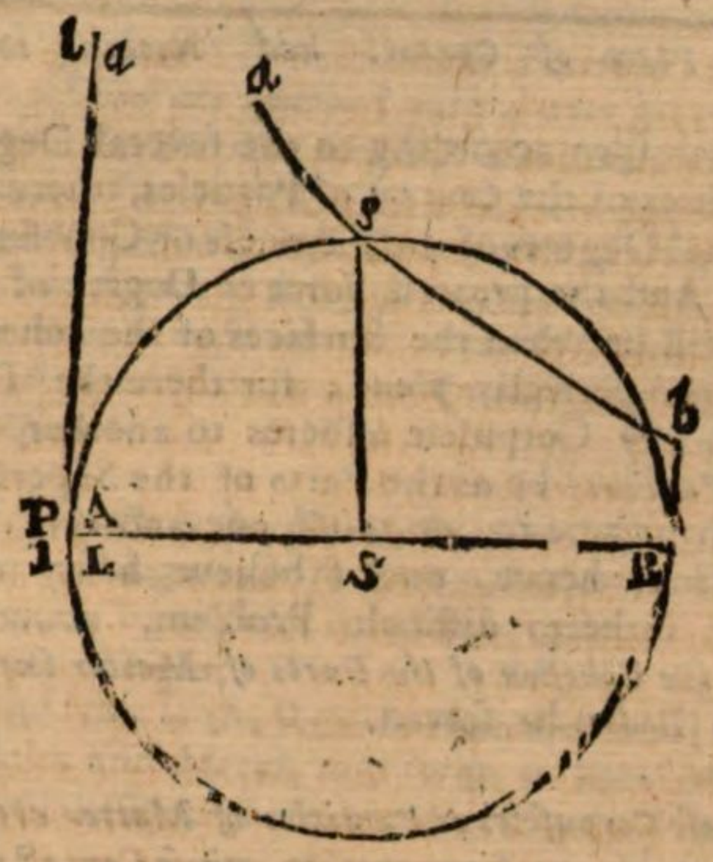
And becauſe this *Natural Philoſophy* of *Particles* is of the greateſt Uſe to be fully underſtood, I ſhall here give you (*from Dr.* Keil's *Book of Animal Secretion*, &c.) ſome further Propoſitions about this matter. I ſay then, *That if any Particles of Matter attract each other with a Force that is in a Triplicate or yet greater Reciprocal Proportion of their Diſtances: The Force by which a Corpuſcle is drawn to a Body, made up of ſuch attractive Particles, is infinitely greater at the Contact, or extreamly nearer it, than at any determined Diſtance from it.*

Suppoſe the Sphere *A H B* compoſed of Particles that attract any Particle, as *P*, with a Force reci-




procally proportionable to the Cubes of their Diſtances. Draw the Tangent *P H*, and from *H* let fall the *Perpendicular H I*: Biſſect *P I* in *L*, and raiſe the *Perpendiculars l L*, *A a*, *S s*, *B b*; and make *S s* = *S I*. Then with the Aſymptotes *L B*, *L l* thro' *s* deſcribe the Hyperbola *b s a*; and then the Area *a A B b* — ∏ 2 *A S* × *S I*; will repreſent the Attraction of the Corpuſcle *P* by *Prop.* 81. of Sir *Iſaac Newton*'s *Princip.* But when the Corpuſcle *P* comes to touch the Sphere in *A*, then the *Points P*, *L*, *A*, *I* and *H* will all coincide; and *A a* becomes the Aſymptote of the Hyperbola, and the *Area a A B b* becomes infinite; and the Rectangle 2 *A S* × *S I* being finite, the *Area a A B b* — 2 *A S* × *S I*, will be infinite; and conſequently the Force by which the Corpuſcle *P* is attracted by the Sphere, when it touches it in *A*, will be likewiſe infinite.

If




If the Sphere conſiſts of Particles that attract in a quadruplicate Proportion of their Diſtances reciprocally, the Force by which a Corpuſcle will be drawn to the Sphere will be $\frac{1}{PS^3 \times PI}$. But when the Corpuſcle comes to touch the Sphere, $PI$ becomes $=0$, snd conſequently whatever is divided by it becomes infinite, and therefore the attractive Force at the Point of Contact being proportional to $\frac{1}{PS^2 \times PI}$, will be infinite.

Prop. IV. *If a Body conſiſts of Particles attracting with a Force that is in a reciprocal Proportion to the Cubes of the Diſtances, or in a greater; and if this Force is not infinitely greater than the Force of Gravity at the Point of Contact, or extreamly near it, at any determined Diſtance from the Point of Contact, it muſt be infinitely leſs than the Force of Gravity.*

This is clear by the laſt Propoſition: For in that Caſe, the Force of Attraction in a Corpuſcle removed from the Contact is infinitely leſs than at the Contact, or extremely near it; but at the Contact it is not infinitely greater than the Force of Gravity by the Suppoſition: therefore the Force, by which a Particle removed at a determined Diſtance from the attracting Body is attracted, is infinitely leſs than the Force of Gravity.

Prop. V. *The Force, by which the Particles of Matter attract each other, when extremely near the Contact, is not infinitely greater than the Force of Gravity.*

This is evident; becauſe in the ſtrongeſt Coheſion of Particles touching one another, we find that the Weight of ſome Bodies will pull the Particles aſunder, tho' that Body may be prodigiouſly greater and heavier than the Particles united. Sir *Iſaac Newton* calculates from the Inflection of the Rays of Light, that this Force near the Contact is 10000 0000 0000 0000 greater than the Force of Gravity.

*Corol.* Particles removed at a determined Diſtance from the Body attracting, are not acted upon by it; becauſe this Force muſt then vaniſh, or which is the ſame Thing, be infinitely leſs than the Force of Gravity.

Prov. VI. *A large Particle attracts not more ſtrongly than a ſmall one at the ſame Solidity, but a Diverſity of Figures cauſes different Degrees of Attraction in Particles, that are otherwiſe the ſame.*

This attractive Power acts only on ſuch Particles as are extremely near; and therefore of a large Particle, the remoteſt parts conduce Nothing to Attraction: And for the ſame Reaſon the attractive Force varies, according as the Particles are Cones, Cylinders, Cubes, or Spheres: And, *cæteris paribus*, a Spherical Particle has the ſtrongeſt attractive Power.

Prop. VII. *If Particles ſwimming in a Fluid, attract one another more ſtrongly than they do the Particles of the Fluid, the Force, by which they come to each other, will be that by which their attractive Force, exceeds the attracting Force of the Fluid.*

For the Particles of the Fluid, that lie directly between the attracting Particles, being more preſſed than the other ambient Particles; they will from the Nature of Fluidity, with that Exceſs of Preſſure, drive the other Particles out of their Places, and make way for the attracting Particles to come together.

Prop. VIII. *If Particles ſwimming in a Fluid are more attracted by the Fluid, than by one another, they will recede from one another, with a Force that will be equal to the Difference of their mutual Attraction, and the Attraction of the Fluid.*

For the Ambient Particles of the Fluid attracting more ſtrongly, will with their Exceſs of Force draw the other Particles to themſelves and make them to recede from one another.

Prop. IX. *The Force, by which Particles attracting one another cohere, is greater,* cæteris paribus, *where the Contact is greater.*

For the Parts that are farther remov'd from the Contact, conduce Nothing to the Force of the Coheſion; and a greater Power muſt be requiſite to ſeparate two Particles, which cohere in two Points, than two Particles which cohere only in one Point, if the Degree of Coheſion be equal in each Point. Thus two poliſhed Marble-ſtones (ſuppoſe a Foot ſquare) adhere more ſtrongly than any other two Bodies of a Foot ſquare, which are not ſo ſolid, but have more Pores and Interſtices between their Parts, and which will not receive ſo good a poliſh, by which the parts come to a cloſe contact with one another.

Prop. X. *If the attracting Corpuſcles are elaſtick, they muſt neceſſarily produce an inteſtine Motion, greater or leſſer, according to the Degrees of their Elaſticity and attractive Forces.*

For after meeting they will fly from one another with the ſame Degree of Velocity (abating the Reſiſtance of the Medium) that they met together with; but when they approach other Particles in their Reſilition, their Velocity muſt increaſe, becauſe they are afreſh attracted, and therefore meeting a ſecond time, they will recede with a greater Velocity than they did at their firſt Concurſion: And ſo their Velocities will be increas'd by every Concurſion and Reſilition, which muſt neceſſarily produce a ſenſible inteſtine Motion; and the ſtronger their attractive Force, and the greater their Elaſticity, their Concurſions and Reſilitions will be the more ſenſible.

Prop. XI. *Particles attracting one another in a Fluid, moving either with a ſwift or ſlow progreſſive Motion, attract one another juſt the ſame, as if the Fluid was at reſt, if all the Particles move equally; but an unequal Velocity of the Particles does mightily diſturb their Attractions.*

The Particles do all by Hypotheſis move equally, and conſequently the progreſſive Motion of the Fluid does not alter their Diſtances, that is to ſay, it does not repel them from one another; and conſequently they muſt attract one another with the ſame Facility as if the Fluid was at reſt. But if ſome Particles move faſter than others, ſome muſt change their Poſition in Reſpect to each other, and thoſe parts, which by the force of Attraction would have come together, will by this unequal Motion be carried from one another. Thus Salts do not chriſtallize, nor the terreſtrial Particles of Urine attract one another, and unite, till the Water, in which they are diſſolved, is almoſt cold; and the inteſtine Motion of its Particles, cauſed by heat, is quieted.

Mr. *J. Keil* of *Oxford* in *Phil. Tranſact.* N. 315. advances theſe other Theorems about the ſmall Particles of Matter.

1. *That the leaſt Particle of Matter aſſignable, may ſo fill any large aſſigned Space, that the Diameters of the Pores, Interſtices, or Meatus between its Parts may be all leſs than any given Right Line; or, ſo that all the Parts of ſuch a Particle, ſhall be nearer to each other than any given Right Line.* See his *Lecture De Diviſibilitate Materiæ,* in his *Lectiones Phyſicæ.*

2. *Two Bodies may be aſſigned or given equal in Bulk, but yet any how unequal in Specifick Gravity, or in the Quantity of Matter in each; ſo that the Summs of the Pores or Meatus in each, ſhall be nearly equal.*

*V. gr.* Let there be a Cubick Inch of Gold and another of Air: Tho' the Quantity of Matter in the former may be 20000 Times as great as that in the latter: Yet the Vacuities in the Gold, may be to thoſe in the Air, as 999999 to 1000000; *i. e.* very nearly equal.

3. *Thoſe Particles which conſtitute Water, Air, or any other Fluid, (if they touch one another) are not abſolutely ſolid; but are compounded of other Particles, which do contain within them many Pores or Vacuities.*

And he thinks that ſuch Particles of Matter as are the *leaſt* of all others, and which are perfectly ſolid and devoid of all interſperſed Vacuities, may be called *The Firſt* or *Primary component Particles of Matter,* or *Particles of the firſt Compoſition.*

Such *Moleculæ* as are compounded by the Coaleſcence of any of theſe firſt Particles (only) may be called *Particles of the 2d Compoſition.* And ſuch *Moles* as are compounded of theſe ſecond *Moleculæ* by ſeveral of them coaleſcing together may be called *Particles of the third Compoſition*: And ſo on till you come to *Particles* out of which the *laſt Compoſition of Bodies is made,* and into which they are primarily diſſolved.

4. *If a Particle of Matter touch any Body, the Force with which it tends toward the Body, or by which it adheres to it, is proportionable to the Quantity of the Contact, for ſuch Particles as lie remote from the Place of Contact add Nothing to the Coheſion.*

And therefore according to the ſeveral Degrees or Quantities of the *Contact* of Particles, there will ariſe ſeveral Degrees of the Firmneſs or Coheſion of Bodies. And the greateſt Force or Degree of Coheſion, will be when the Surfaces of the cohering Particles are perfectly *plane*; for there the Force by which any Corpuſcle adheres to another, will (*cæteris Paribus*) be as the Parts of the Superficies which do adhere to, or touch one another.

And from hence, and I believe hence only, can that hitherto difficult Problem, about the *Cauſe of the Coheſion of the Parts of Matter in ſolid and firm Bodies* be ſolved.

5. *Thoſe Corpuſcles or Particles of Matter are moſt eaſily ſeparable one from another, whoſe Contacts with other Particles are feweſt and leaſt; as will be the Caſe of exceeding Particles of a Spherical Figure.*

And from hence, and hence only, can the True and Primary Reaſon of *Fluidity* ariſe.

6. *If the Texture of a Body be ſuch, that its Particles of the laſt Compoſition* (ſee *Prop.* 3.) *can be moved a little from their primary State of Coheſion or Contact by ſome external Force (ſuch as the Weight and Compreſſure, or the Stroke or Shock of ſome other Body.) But yet ſo as that the Particles of the Body don't by this Preſſure or Stroke, run into any new Contacts or Coheſions; Then, I ſay, they will recover again their former Contacts, by the Power of Attraction, or by a Force that will make them tend towards one another: And conſequently, ſuch a Body, will, after the Preſſure or Stroke, recover again its former Figure and Poſition of its Particles.*

And this is the Reaſon of the *Elaſticity* of Bodies.

7. *But if the Texture of a Body be ſuch, that when its Particles are by ſome external Force removed from their former Contacts and Coheſions, they go immediately into others of the ſame Degree; that Body cannot recover its former Figure and Poſition of Parts.*

And this is the Texture of ſuch Bodies as are *ſoft,* and herein the Reaſon of their *Softneſs* conſiſts.

8. *As Particles which are perfectly ſolid will attract one another the moſt ſtrongly; and as in all other Particles the Power of their Attraction is proportionable to their Denſity or Solidity; ſo that the attractive Forces of even Particles perfectly Denſe or Solid, depend much upon their Figures.*

For if a ſmall Particle of Matter be ſuppoſed to be formed into an indefinitely ſmall Plate or *Lamina,* of a Figure perfectly circular; and if another Particle of Matter be ſuppoſed to be in a Right Line paſſing thro' the Centre of that Plate, and at Right Angles to its Plane: Then if you ſuppoſe that Particle to be diſtant from the circular Plate a tenth Part of the Radius of that Circle; I ſay, the Force by which that Corpuſcle is attracted by the Plate is 30 Times leſs than if the attracting Matter had coaleſced into a Spherical Figure: So that the Virtue of the whole Particle had been diffuſed, as it were from one Phyſical Point.

But yet this circular Plate will more ſtrongly attract the Particle than any other Particle of the ſame Weight with it, that ſhall be formed into a long and ſlender Cylinder.

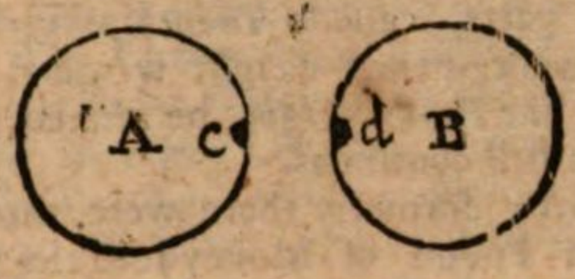
9. *Salts*

9. *Salts are Bodies, whose Particles of the laſt Compoſition are endowed with a very great attractive Force: But yet between thoſe Particles, there are very many Pores or Meatus, which are pervious to the Particles of the laſt Compoſition of Water; which aqueous Particles being ſtrongly attracted by the Saline ones, do ruſh towards them with an Impetuoſity, do disjoyn their mutual Contact, and diſſolve their Coheſion.*

10. *A Body ſpecifically heavier than Water, may have its Magnitude ſo diminiſhed, that it ſhall be ſuſpended by or ſwim in Water, and not deſcend by its own Weight.*

And this is the Reaſon that the ſmall Particles of Salts and Metals will ſwim in ſuch *Menſtruums* as will diſſolve thoſe Metals, &c.

10. *Greater Bodies attract one another with a leſs Force than leſſer ones do.*




For the Force with which the Bodies *A* and *B* attract one another, exerts it ſelf only in thoſe Particles which are near one to another, the remote ones having no ſuch Force; wherefore there is no greater attractive Force required to move the Bodies *A* and *B* towards one another, than to move *c* and *d*. But the Velocity of Bodies moved by the ſame Force, are reciprocally proportional to thoſe Bodies: Wherefore the Velocity by which *A* tends towards *B*, will be to the Velocity with which the Particle *c*, apart from the Body, tends towards *B*: : as the Particle *c* to the Body *A*; much leſs therefore is the Velocity of the Body, than that of *c* would be, if it were ſeparated from it.

From hence it comes to paſs, that the Motion of the *greater Bodies* is naturally ſo ſlow and gentle, that 'tis uſually impeded by an ambient Fluid or other Bodies round about them. But in *leſſer Bodies*, this attractive Force is very active and vigorous, and is the Cauſe of a great many noble Effects.

12. *Two Particles of Matter, tho' they do not touch, may yet come ſo near one to another, as that their mutual attractive Force ſhall much exceed the Force of Gravity.*

13. *If a Particle placed in a Fluid be equally attracted every where by all the ambient Particles of the Fluid, no Motion of the Particle will ariſe from thence: But if it be attracted by ſome Particles more, and by others leſs, it will move that way where the Attraction is greateſt, and the Motion produced will be anſwerable to the Inequality of the Attraction;* (i. e.) *it will be greater where there is a greater Inequality, and leſſer where there is leſs.*

14. *If a Body be placed in a Fluid, and its Particles do more attract the Particles of the Fluid, than the Particles of the Fluid do one another; and if there be alſo in that Body any* Pores or Meatus, *pervious to the Particles of the Fluid; then the Particles of the Fluid will ſoon diffuſe themſelves through thoſe* Meatus: *And if the Coheſion or Connection of the parts of the Body be not ſo ſtrong, but that it may be ſurmounted by the* Impetus *of the Particles of the Fluid ruſhing upon it, and every way into its Pores; there will ariſe from thence a Diſſolution of that Body.*

And from hence you may ſee the Reaſon of the Diſſolution of Bodies in *Menſtruums*: In order to which, Three Things are always neceſſary.

1. That the Particles of the Body to be diſſolved do more ſtrongly attract thoſe of the *Menſtruum*, than thoſe of the *Menſtruum* do one another.

2. That the Bodies have Pores pervious to the Particles of the *Menſtruum*.

3. That the Coheſion of the Conſtituent Particles of the Body be not ſo ſtrong, but that it may be broken by the violent Action of the Particles of the *Menſtruums* upon it.

15. *If Particles mutually attracting each other do alſo mutually touch one another, no Motion can ariſe; for they can come no nearer to each other: But if they are ſeparated from one another a very ſmall Diſtance, a Motion muſt ariſe from their mutual Attraction. Tho' if they are farther from one another than that they cannot attract one another more than they will the Particles of the Fluid in which they are, and ſo no Motion alſo will be produced.*

From theſe Principles all the *Phænomena* of *Fermentation*, and of all *Effervеſcences* do proceed. And from hence you may ſee the Reaſon why Oyl of *Vitriol* when mingled with a little Water, hath ſo great an *Effervеſcence* and *Ebullition*: For by the Infuſion of the Water, the Saline Particles are a little disjoined from their mutual Contact; but ſince they do much more attract one another than they do the Particles of the Water, and ſince they are not every way equally attracted, a conſiderable Motion muſt from thence ariſe.

And from hence alſo you may ſee the Reaſon why ſo great an Ebullition ariſes from putting Filings of Steel or Iron into the former Mixture of Oyl of *Vitriol* with a little Water; for the Particles of the Steel have a very great Degree of Elaſticity, and from thence a ſtrong Reflection muſt ariſe. And from hence alſo 'tis that ſome *Menſtruums* act with a greater Force, and will ſooner diſſolve Metals, when mingled with a little Water, than when pure and without ſuch Mixture.

16. *If the Particles which do mutually attract each other have no Elaſticity, then they are not reflected back from one another, but will form* Congeries, Moleculas, *Aggregates or Lumps of Particles; from whence what we call a* Coagulation *ariſes: And if theſe Lumps exceed in Specifick Gravity that of the Fluid, and are large enough, a* Precipitation *will ſucceed, Tho' a Precipitation may alſo ariſe from the ſpecifick Gravity of the* Menſtruum *in which the Particles ſwim, its being diminiſhed or increaſed.*

17. *If the Figure of Particles mutually attracting each other, when ſwimming in a Fluid be ſuch, that there is a greater attracting Force in ſome of their given Parts than in others, as alſo a greater Contact there; then thoſe Particles will coaleſce into Bodies having given Figures; and this way all* Chryſtallizations *ariſe; and you may by Geometry determine the Figures of the Component Particles from having the Figure of the Chryſtals given.*

18. *If*

18. *If between two Particles of a Fluid, another ſhall interpoſe, whoſe two oppoſite Faces or Sides have very great attractive Forces; this interpoſing Particle will glew or faſten the other two to its ſelf; and when this is done throughout the whole Fluid, that Fluid will be frozen or turned into Ice.*

19. *If a Body of ſome Bulk emit a large Quantity of Effluvia, and the Particles of ſuch Effluvia have a very great attracting Force, then will theſe Effluvia, when they come near any leſſer or lighter Body, by their attracting Force, ſurmount the Gravity of thoſe Bodies, and lift them up to the Bodies from whence they flow: And ſince the Effluvia are much more copious and thick at leſſer Diſtances from the emittent Body, than at greater; the light Body will be attracted by ſtill more and more denſe Effluvia, and at laſt be brought to adhere to the emittent Body.*

And this way moſt of the *Phænomena* of *Electricity* may be ſolved.

PARTING, is one of the Refiners Ways to ſeparate Gold and Silver; 'tis done by *Aqua fortis*, which how to make, and the whole Manner of the Operation, ſee under *Refining*.

PARTY *Jury*. See *Half Tongue*.

PASCHA *Clauſum*, is the Octaves of *Eaſter* or *Low-Sunday*, which cloſes or concludes that Solemnity; and *die (tali) poſt Paſchia Clauſum*, is a Date in ſome of our old Deeds; and the firſt Statute of *Weſtminſter* is ſaid to have been made *Landeſmain de la Cloſe de Paſche*, *i. e.* The *Munday* after *Eaſter-Week*.

PASNAGE, or *Pannage*, was anciently uſed in a double Senſe for the running or feeding of Swine within a Foreſt, and for the Price or Rate of it. If the *Paſnage* were not duly paid, there was a Proceſs from the Exchequer, and a Diſtreſs by the Sheriff. Dr. *Kennet*.

PASS, a Frame of Boards conſiſting of 2 or 3 Bottom Boards, and two Side ones, ſet ſlope-wiſe, thro' which the *Ore* ſlides down into the Coffer of the Stamping-Mill for the Tin-works, is called by the Workmen the *Paſs*.

PASSAGE, *Paſſagium*, 'twas a Tribute or Toll paid by Paſſengers or Travellers for the Repair or Maintenance of ſome Road or Paſſage.

PAVIMENTA *Teſſellata*. See *Teſſellata*.

PAY, the Seamen ſay, *Pay more Cable*, that is, let out more Cable; and *pay cheap*, that is, at the turning the Anchor out of the Boat, to turn it over-board faſter.

PECTEN, in Anatomy, is the ſame with the *Regio Pubis*, or lower part of the *Hypogaſtrium*.

PEDIMENT, in Architecture, is a Triangular Frame with Corniſh raiſed over the Front of a Houſe, and ſometimes over Doors, *&c.*

PEERS, in Architecture, are a kind of Pilaſters or Buttreſſes, for Support, Strength, and ſometimes Ornament.

PEERS, *Pares*, in our Common Law, are thoſe that are empannelled on an Inqueſt upon any Man for the convicting or clearing him of any Offence for which he is call'd in queſtion; and the Reaſon thereof is, becauſe 'tis the Courſe and Cuſtom of our Nation, that every one ſhall be tried by his *Peers* or Equals. The Word is uſed alſo for the Nobility of this Realm, and Lords of the Parliament, who tho' diſtinguiſhed as to degrees of Nobility, yet are *equal* in all publick Actions, as in Votes of Parliament, in paſſing Tryals on Noblemen.

PENNY, *Denarius*, was the firſt coined piece of Silver we have any account of; and for many Years the only one. In the Reign of *H.* 1. there were Half-pence. A Penny was ſo much the whole of the current Coin of the Kingdom, that *Denarius* ſignified the ſame thing with *Nummus* or Money. Dr. *Hicks* in his *Diſſertatio Epiſtolaris*, p. 109. ſaith, that the *Anglo-Saxons* had but *one* Silver Coin amongſt them, and that was a *Penny*; and *Cambden* and *Spelman*, and moſt of our good Antiquaries agree in this. The old *Penny* before 1279 was ſtruck with a double Croſs, ſo that it might eaſily be broken in the middle, or into four Quarters; and ſo made into *Half-pence* or *Farthings*, ſaith Mr. *Stow*; on which it was *then* ordered, that Half-pence and Farthings ſhould be made or coined round, as the *Penny* was before. The *Penny* was called *Sterling*, which ſee.

PENNY-*Weight*, formerly every Pound contained 12 Ounces, and each Ounce was divided inty 20 parts, called *Twenty-penny-weight*; for then Twenty-penny-weight weighed an Ounce: and tho' the *Penny-weight* be altered, the Denomination ſtill continues.

PENSA; formerly there were three ways of paying a Pound of Money into the Exchequer. 1. Payment of a *Pound de Numero*, which was juſt 20 Shillings in Tale. 2. Payment of *a Pound ad Scalum*, which was 6 *d.* over and above the 20 *s.* 3. *Ad Penſam*, which was paying the full Weight of 12 Ounces.

PENTECOSTALS, were, and are ſtill in ſome few Dioceſes, Whitſon-Contributions paid to the Biſhops, of which probably the firſt Occaſion were certain pious Oblations made to the Cathedral Church at *Pentecoſt* or *Whitſontide*. They were alſo made by the *Pariſhioners* to their *Pariſh Prieſt*, and ſometimes by inferior *Churches* or *Pariſhes* to their Mother-Church. Theſe *Pariſh Pentecoſtals* were called *Whitſon-Farthings*, and their Sum was divided into four parts, of which one went to the *Prieſt*, one to the *Poor*, one towards the Repair of the *Pariſh-Church*, and one to the *Biſhop*. See *Stephens of Procurations and Pentecoſtals*, and Dr. *Kennet's Parochial Antiquities in Gloſſary*.

PERCH, *Pertica*, is an *Engliſh* Meaſure of 16 Foot and a half in Length, called alſo a Pole and Rod. Forty ſuch Perches in Length, and four in Breadth, make what we call an *Acre of Ground*. This is the common *Statute-Perch*; but in ſome Counties in *England* its Length is different; as in *Staffordſhire* it is 24 Foot, in the Foreſt of *Sherwood* 25 Foot. In *Herefordſhire*, tho' a *Perch* of Walling be but 16½ Feet, yet a *Perch* of Ditching is 20 Feet: In the Foreſt of *Canke* 'tis 25; in the Foreſt of *Clarendon* 20. *Skene de verborum ſignificatione ſub. verb. Perticata Terræ*, ſaith, *Particata Terræ* is a Rood of Land. There are alſo ſome other Meaſures mentioned which are now out of uſe. He ſaith three Feet and one Inch make an *Elne*; ſix *Elnes* make a *Fall*; which he ſaith is the common lineal Meaſure. Six *Elnes* long and ſix broad make a *Square*, and *Superficial Fall* of Land meaſured; and 'tis to be underſtood, he ſaith, that a *Raip*, a *Rod* and a *Lineal Fall* of Meaſure, are all one; only a Rod is a *Staff* or *Pole* of Wood, and a *Raip* is made of *Tow* or *Hemp*. Alſo ten *Falls* in Length and four in Breadth make an Acre: This is the Meaſure of *Scotland*.

PERICARDIUM. Dr. *Keil* in *An. Secretion*, p. 32, 33. ſhews, that the Liquor in the *Pericardium* is the moſt fluid of any that is ſeparated from the Blood; becauſe the Particles of it *unite firſt*, and are *ſecreted firſt*; and thoſe Particles which unite firſt will have the greateſt attractive Force; and ſuch muſt have their Corpuſcles of a moſt ſpherical Figure, and muſt be moſt ſolid; ſo that their Contact will be the leaſt that can be.

PERIOPHTHALMIUM, is a thin Skin which Birds can draw over their Eyes to defend them, without ſhutting their Eye-lids. The ſame with the *Membrana Nictitans*.

PERISTERNA, in Anatomy, are the lateral parts of the *Thorax*,

PERITONÆUM: The external Surface of this ſoft thin *Membrane* is unequal where it adheres to the tranſverſe *Muſcles*; the internal is very ſmooth. It hath a Number of ſmall Glands which ſeparate a Liquor which ſupplies the Inteſtines, and facilitates their Motion; and when theſe Glands are obſtructed the *Peritonæum* grows thick, as in ſeveral Dropſies. The *Peritonæum* is a double *Membrane*, containing in its Duplicature the Umbilical Veſſels, the Bladder, Ureters, Kidneys, and Spermatick Veſſels, to all which it gives a Membrane, as alſo to the Liver, Spleen, Stomach, Inteſtines and Womb.

Its external *Lamina* hath two Productions, like to two Sheaths, which paſs thro' the Rings of the oblique and tranſverſe *Muſcles* in the *Groin*, for the paſſage of the Spermatick Veſſels in Men; and for the round Ligaments of the Womb in Women. Theſe Productions being come to the Teſticles in Men, dilate and form the *Tunica Vaginalis*. The Internal *Lamina*, which is very thin here, having accompanied the external Productions a little way, cleaves cloſe to the Spermatick Veſſels and round Ligaments of the Womb. The *Peritonæum* hath Veins and Arteries from the *Phrenicæ*, the Mammillary, the Epigaſtrick, and often from the Spermaticks. Its Nerves are of thoſe which are diſtributed in the *Muſcles* of the *Abdomen*; it hath likewiſe a few Lymphaticks which diſcharge themſelves into the *Iliack Glands*. By the Elaſticity of its Fibres it eaſily dilates and contracts in Reſpiration, and in Conceptions. If it breaks it cauſes a Rupture either in the Navel or Groin. Its Uſe is to contain the Bowels of the Abdomen, and to give to each of them an outer Coat.

PERMUTATION *of Quantities*. See *Variation* and *Combination*.

PERNANCY: Taking or receiving Tythes in Pernancy, is taking ſuch as are or may be paid in kind.

PERPETUAL *Motion*; by this Term ought to be meant an uninterrupted Communication of the ſame Degree of *Motion* from one part of Matter to another, in a Circle, (or ſuch like Curve returning into itſelf) ſo that the ſame Quantity of *Matter* ſhall return perpetually undiminiſhed upon the firſt Mover: And perhaps if Men had rightly underſtood that this is the true meaning of a perpetual Motion, abundance of Expence both of Money and Reputation might have been ſaved by the vain Pretenders to this piece of impoſſible *Mechaniſm*. For ſince by the ſecond Law of Nature or Motion, (ſee *Motion*) *The Changes made in the Motions of Bodies are always proportional to the impreſs'd moving Force, and are produced in the ſame Direction with it*, no *Motion* can be communicated to any Engine or *Machine* greater than that of the firſt Force impreſſed; and therefore ſince on our Earth, all *Motions* are performed in a Fluid which reſiſts them, it muſt of Neceſſity retard them; and conſequently a conſiderable Quantity of the *Motion* muſt be ſpent upon the reſiſting *Medium*; ſo that 'tis impoſſible the ſame Quantity of it can return undiminiſh'd on the firſt mover; which yet is abſolutely neceſſary for the Continuance of the ſame *Motion* perpetually. Beſides, in no *Engine* or *Machine* whatſoever, can all *Friction* be avoided, there being in Nature no ſuch thing as exact Smoothneſs or perfect Congruity: The manner of the Coheſion of the Parts of Bodies, the ſmall Proportion the ſolid matter bears to the Vacuities between them, and the Nature of thoſe conſtituent *Particles* not admitting it; wherefore this *Friction* will alſo ſenſibly in time diminiſh the impreſſed or communicated Force, ſo 'tis not poſſible the *Motion* can be perpetual; which Effect can indeed never follow, unleſs the communicated Force be ſo much greater than the generating Force, as to recompenſe the Diminution made therein by all theſe Cauſes, in order to the *Motion*'s returning undiminiſhed upon the firſt Mover. But *nil dat quod non habet*, the generating Force cannot communicate a greater Degree of *Motion*, that it hath it ſelf, and conſequently, the perpetual *Motion* is demonſtratively impoſſible.

Beſides, it being certain that a Body cannot move conſtantly in any Orbit with the ſame Degree of *Motion* from one ſingle Impulſe; ſince that Degree of *Motion* and *Velocity* ariſing from ſuch a ſingle Impulſe, muſt by that means continually decreaſe, and ſo at laſt be quite ſpent and extinct: From hence it will follow alſo, that there can be no perpetual *Motion* in any Engine from one ſingle Impulſe; for this *Motion*, that it may return again upon the firſt Mover, muſt be propagated in an Orbit; and conſequently muſt by Degrees ceaſe and ſtop.

Per *Quæ Servitia*, in Law, is a Writ Judicial iſſuing from the Note of a Fine, and lieth for Cogniſee of a Mannor, Seigniory, Chief Rent or other Services; to compel him that is a Tenant of the Land at the Time of the Note of the Fine levied, to attorn unto him.

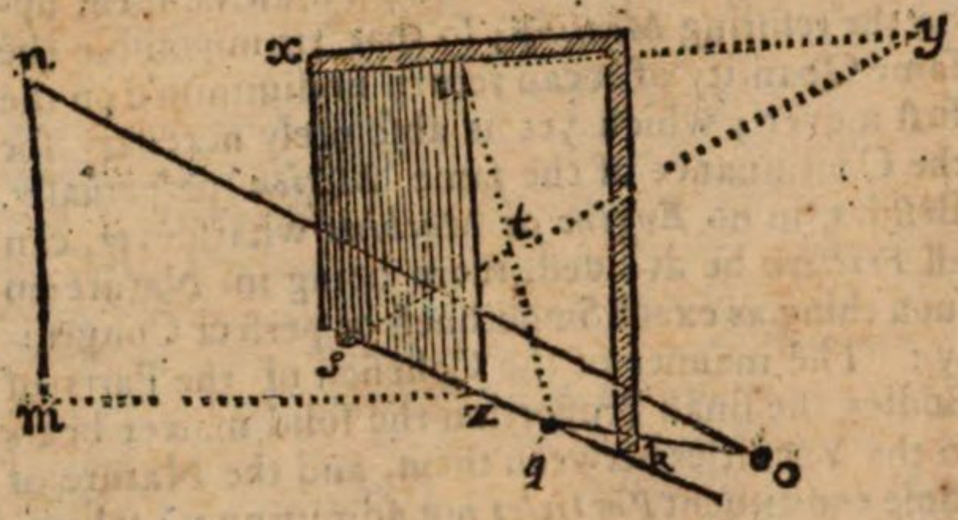
PERQUISITE, in the Law-ſenſe, is any thing gotten by a Perſon's own Induſtry, or purchaſed with his own Money, different from that which deſcends to him from his Father or Anceſtors.

PERQUISITES *of Court*, are ſuch Profits as grow to a Lord of a Mannor by Virtue of his Court-Baron, over and above the yearly certain Profits of his Land; as *Fines of Copyholds*, *Herriots*, *Amerciaments*, *Waifes*, *Strayes*, &c.

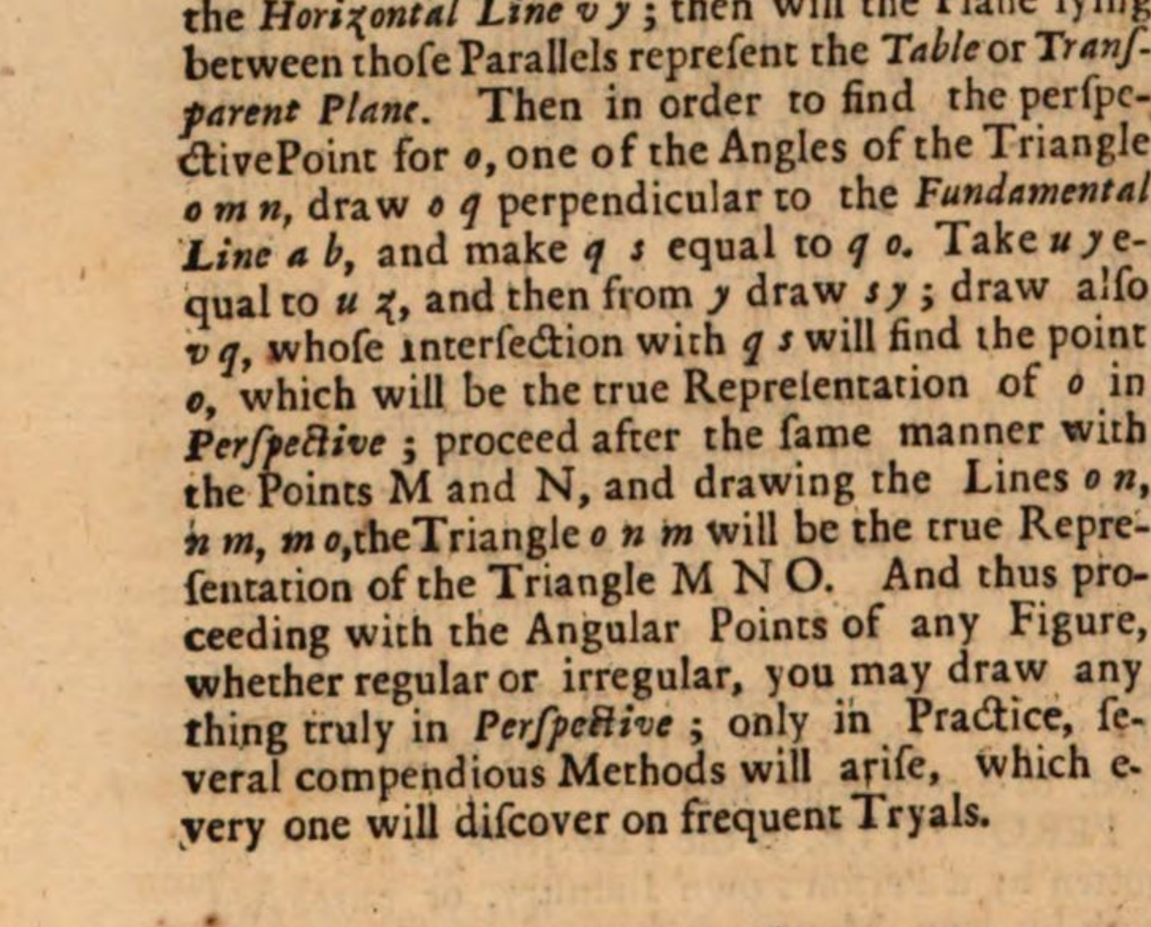
PERSONAL *Services*. See *Services*.

PERSPECTIVE: The Foundation or Ground of *Perſpective*, may be thus conceived. Suppoſe there be a Point, as *o*, which is ſeen by the Eye at *n* (whoſe Height above the Horizon is *n m*) thro' the *Glaſs* or tranſparent *Plane x z k*, which in *Perſpective* is called the *Table*: And it be required to find the true Repreſentation of this Point in *Perſpective*; from *m* the point of the Horizon perpendicularly under the Eye at *n* draw at Right Angles to *n m* (the height of the Eye) the Line *m z*; at *z* in the Table erect the *Perpendicular z u* equal to *n m*, and at Right Angles to it, from the Point *u*, draw alſo *u y* equal to *m z* the Diſtance of the Eye from the Table. From *o* let fall a Perpendicular to the Baſe of the Table, as *o q*.

and draw the Line *q u*. Take *q s* = to *q o*, draw *s y* cutting *u q* in the point *t*, so is *t* the point required.

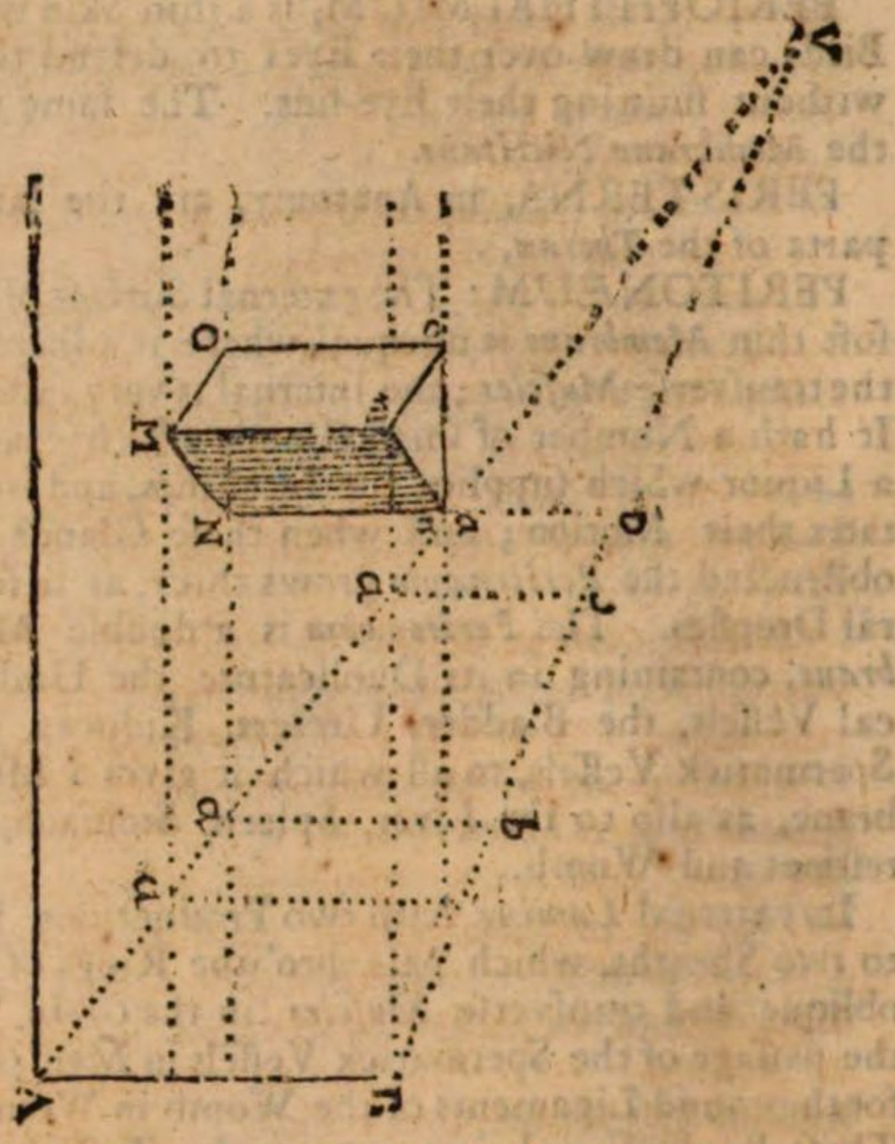



On this Foundation is the primary Rule of all *Perspective* built, and all its Practices establlshed, *v. gr.* Suppose an Equilateral Triangle (as *m n o*) or any other Geometrical Plane Figure were to be represented in *Perspective*. Between the Eye and the Triangle draw somewhere the Right-line *a b*, which they call the *Fundamental Line*; then draw *z v* representing the perpendicular Distance of the Eye above that Line, be it what it will, and thro' *v* draw, at Right Angles to *z u*, or parallel to *a b*, the *Horizontal Line v y*; then will the Plane lying between those Parallels represent the *Table* or *Transparent Plane*. Then in order to find the perspectivePoint for *o*, one of the Angles of the Triangle *o m n*, draw *o q* perpendicular to the *Fundamental Line a b*, and make *q s* equal to *q o*. Take *u y* equal to *u z*, and then from *y* draw *s y*; draw also *v q*, whose intersection with *q s* will find the point *o*, which will be the true Representation of *o* in *Perspective*; proceed after the same manner with the Points M and N, and drawing the Lines *o n*, *n m*, *m o*, the Triangle *o n m* will be the true Representation of the Triangle M N O. And thus proceeding with the Angular Points of any Figure, whether regular or irregular, you may draw any thing truly in *Perspective*; only in Practice, several compendious Methods will arise, which every one will discover on frequent Tryals.




And if the Scenographick Appearance of any Solid were to be represented, as suppose of a Triangular Prism whose Base is the Triangle *M N O* in the second Figure; you need only find the upper Surface of it after the same way as you found the lower or the Base, and then joining the corresponding Points by Right-Lines you will have the true Representation of the Solid in *Perspective*. So that the Work is the same as before, only you take a new *Fundamental Line*, as much higher than the former, as is the Altitude of that Solid whose Scenographick Representation you would delineate.

But there is yet a more commodious Way of doing this, as follows; Having found, as above, the Base, or *Ichnographick Plane m n o*;




Let Perpendiculars be erected to the *Fundamental Line*, from the three angular points, which will express the Altitudes of those Points. But because these Altitudes, tho' equal to one another in the Body or Solid it self, will appear unequal in the Scenographick View, for those that are further off will appear less, and the nearer, larger.

Their true proportionable Heights may be thus determined: Any where in the Fundamental Line let *A B* be erected perpendicularly equal to the true Altitude (or if the Figure hath different Altitudes, let them all be transferred into the Perpendicular *A B*) and from the points *A* and *B* (and from all the points of intermediate Altitudes, (if there be any such) draw Right Lines to the Eye point in *V*, or to any point in the Horizontal Line: Those Lines *A V* and *V B* will constitute a Triangle with *A B*, within which all the Points of Altitude will be contained. Thro' the points *o*, *n*, and *m*, draw parallels to the *Fundamental Line*, as you see, and from the points *a*, *a*, *a*, erect Perpendiculars to those Parallels, and where they intersect the two Lines *A V* and *B V*; as in the points *a*, *a*, *a*, and *b*, *b*, *b*, *&c.* they will determine the apparent Height of the Solid in that Scenographick Position to the Eye at *V*. And in practice these Parallels and Perpendiculars are to be easily described by the Help of a good *Drawing-Board* or *Table* fitted for this purpose, and others of this Nature.

Authors on this Subject of *Perspective*, are;

*Alberti Dureri Perspectiva, cum Fig.*
*Hansen Leucours Perspectiva*, in *High-Dutch*. *Ulm.* 1617. *Fol.*

*Henrick*

*Henrick Loutenſack Perſpectiva*, ditto. *Franck.* 1618.

*La Perſpective curieuſe de Niceron. à* Paris. 1663.

*La Perſpective avec la Raiſon des Umbres*, &c. *par Salamon de Cauſa.*

*Roger Bacon's Perſpective. Lat.*

*Joan. Cantuarienſis Archiepiſcopi Perſpectiva communis.*

*Luinganno de Glocchi, Perſpettiva practica.*

*Leada Regele delle Perſpettiva.*

*Verdmanni Friſii Perſpectiva.*

*The Jeſuits Perſpective*; or, *La Perſpective practique par un Religieux*, &c.

*Maxon's Practical Perſpective.*

*G. Ubaldi Perſpectivæ, Lib.* 6.

*La Perſpective ſpeculative & practique, par Mignon.*

*Lamii Perſpective.*

*Andreæ Alberti de Perſpectiva & Umbra, Lil.*

**PESA**, *Penſa, Piſa*; is a *Wey* or Weigh, or a certain Weight or Meaſure of Cheeſe and Wooll, containing formerly 256 Pounds.

**PESAGE**, is a Duty paid for weighing of Merchandize and other Wares, to a certain common Weigher, whom they called *Peſarius*.

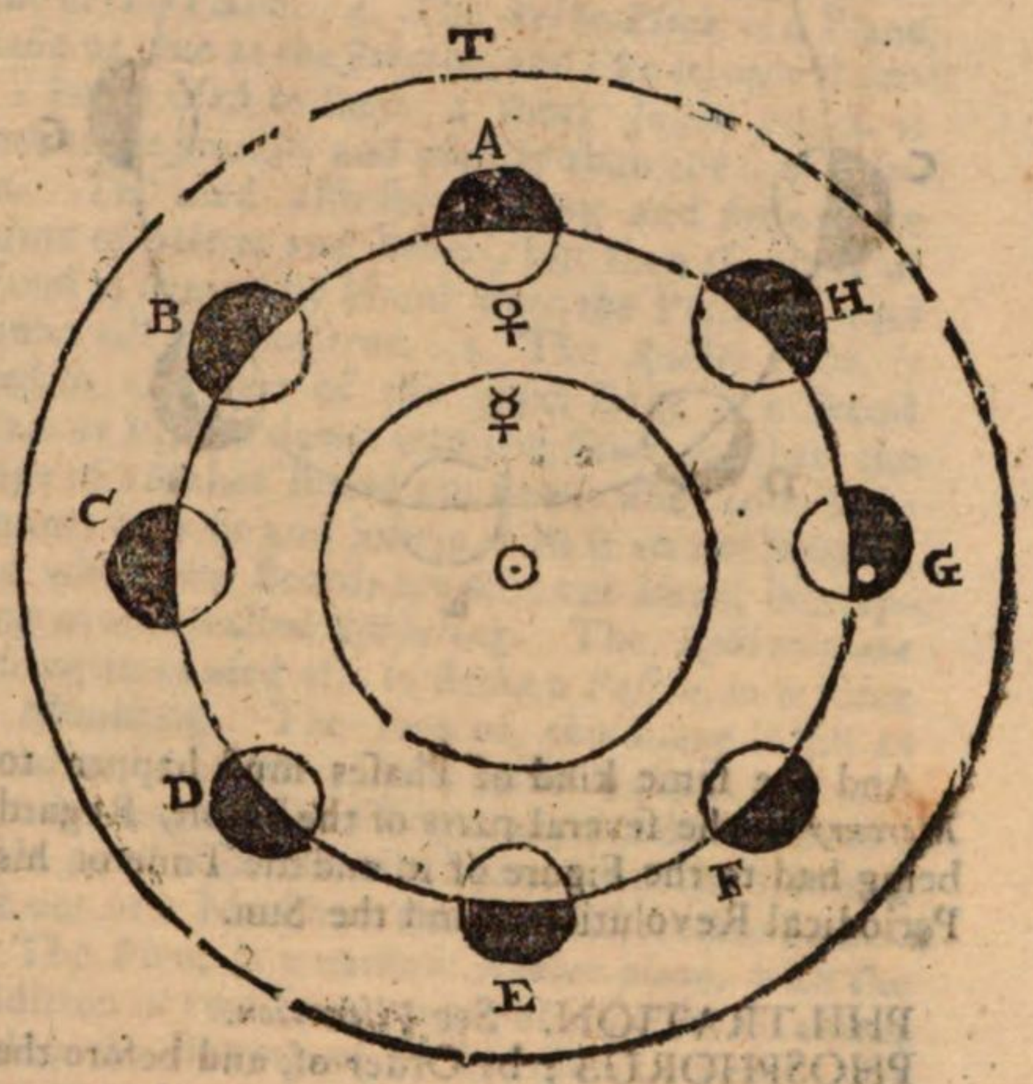
**PETER-*Pence***, called alſo *Hearth-pence*, *Rome Scot*, and in the North *Ream Pence*; was a Levy of a Penny on every Houſe wherein there were 30 Pence *vivæ pecuniæ*, to be collected and ſent to *Rome*: This at firſt tho' only a Contribution, at laſt paſs'd into a ſtanding Tax; one half of it went for Alms to the *Engliſh* School at *Rome*, and the other half to the Pope's Uſe.

It was at firſt given by King *Ina*, and confirm'd by *Offa* and *Ethelwolph*; eſtabliſhed by the Laws of *Canute*, *Edward the Confeſſor*, *William the Conquerour*, and *Henry* I. 'Twas collected by the Biſhops, who employed the Rural Deans and Archdeacons to receive it. The whole Summ was by Pope *Gregory* ſtated at 200 *l.* 26 *s.* In the Year 1365, King *Edward* the Third firſt forbad the Payment of this Duty to the Pope; but the Cuſtom ſoon returned again, and continued till the Reign of *Henry* the Eighth, when *Polydore Virgil* was employed here as the Pope's Receiver-General. No Place nor Religious Houſe was exempt from this Impoſition, but only the Abby of St. *Albans*.

**PETIT-*Sergeanty*** : To hold Lands or Tenements in *Petit-Sergeanty*, is to hold them of the Crown, by yielding the Sovereign a Knife, Buckler, Arrow, or a Bow without a String, or other like Service at the Will of the firſt Feoffer; and there belongs neither Ward, Marriage nor Relief: No one can hold Land in Grand or Petit-Sergeanty, but of the Crown. See *Stat. of Car.* 2. c. 24.

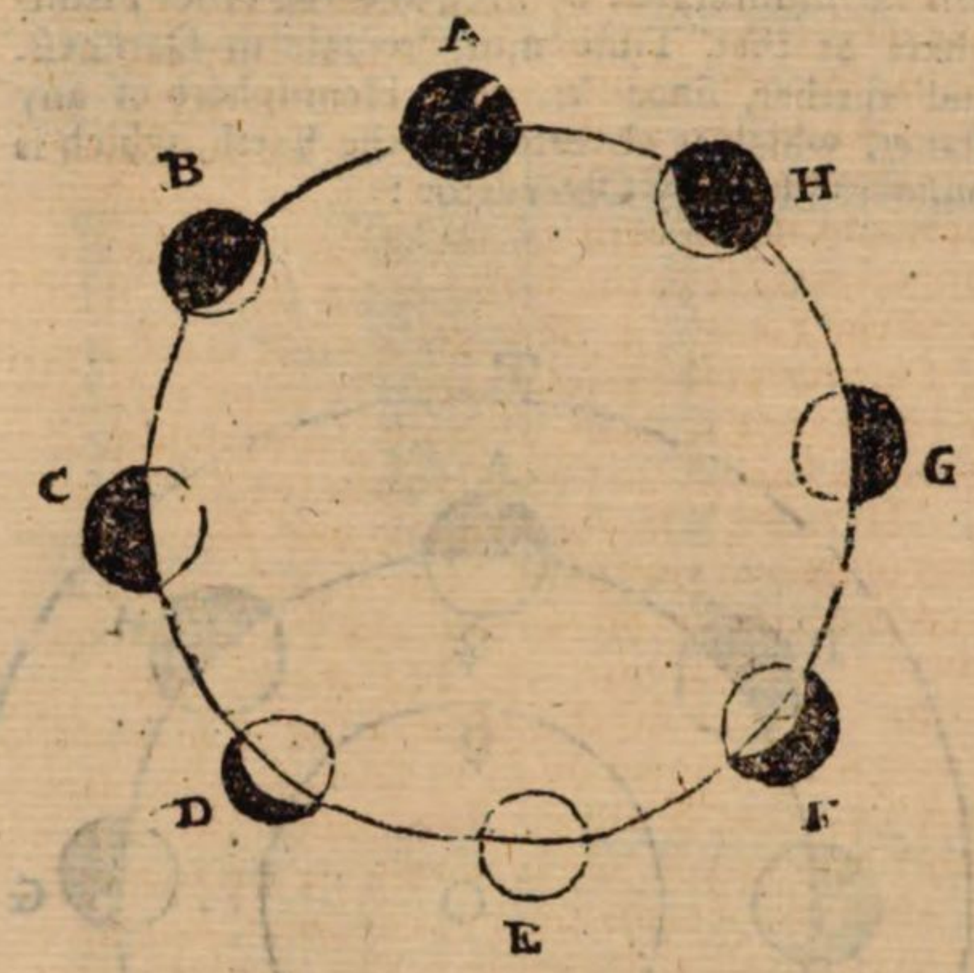
**PHALANX**, among the *Macedonians*, was an oblong ſquare cloſe Battle of Pikemen, conſiſting of 16 File, and 500 in Front, as *Polybius* ſaith; and the Soldiers ſtood ſo cloſe together, that the Pikes of the 5th Rank extended 3 Foot beyond the Front of the Battle.

**PHASES** *of the Planets*: Since all the Planets as well as the Earth are ſpherical, opake, and ſcabrous Bodies, they muſt reflect every way the Sun's Rays which fall upon them; and it will follow alſo from hence, that one half of every Planet, or that Hemiſphere which is turned towards the Sun, will be illuminated by him, and the other Hemiſphere at that Time muſt remain in Darkneſs. And further, ſince 'tis that Hemiſphere of any Planet, which is obverted to the Earth, which is conſidered by any Obſervator:




The eight little Circles repreſent the different Phaſes of *Venus*, as they will appear to an Eye placed in T on the Earth, while ſhe moves round in her Orbit A C E G about the Sun. It will be plain then, that when *Venus* is in A, and the Earth at T; ſhe being then moſt retrograde, (ſee the Word *Direct* in this Vol.) will leaſt of all appear to us, becauſe her obſcure Hemiſphere is entirely obverted towards us. And if ſhe happen to be then in either of the Nodes, *i. e.* in the Plane of the Ecliptick, ſhe will appear like a Spot in the Body of the Sun.

But when ſhe gets further to B (the Eye being ſtill ſuppoſed to be in T) ſhe will ſtill be retrograde, but ſome ſmall part of her illuminated Disk will be viſible; and ſhe will appear with illuminated Horns which will be turned from the Sun, or towards the Weſt. When ſhe comes to C, one half of her illuminated Disk will be viſible to an Eye in T, and then ſhe will appear like an Half-Moon; in D ſhe will be gibbous, and in E at full. And the ſame Phaſes ſhe will put on as ſhe moves in the other Semicircle from E to A again, only the illuminated Horns will be turned a contrary Way; as appears by the ſecond Figure, where all the ſeveral Phaſes are delineated.




And the ſame kind of Phaſes muſt happen to *Mercury* in the ſeveral parts of the Orbit, Regard being had to the Figure of it, and the Time of his Periodical Revolution round the Sun.

PHILTRATION. See *Filtration.*

PHOSPHORUS; by Order of, and before the *Royal Society* at *London*, Mr. *Hawksbee* made ſeveral Experiments on the *Phoſphorus*, about its Production and Propagation of Light *in vacuo*; and it plainly appeared from them, that the removing the common Air did very ſenſibly encreaſe its Light. And by the Experiments made by the ſame Perſon on the *Mercurial Phoſphorus*, and mentioned in *Phil. Tranſ. N.* 303. it is alſo manifeſt, that tho' *Mercury* when ſtrongly agitated in the common Air would exhibit in a darkned Room ſome Sparks of Light, yet that a very ſenſible and eminent Degree of it might be produced by ſhaking it in proper Glaſſes *in Vacuo.*

*Bernouli*, Profeſſor of Math. at *Groningen*, made an eaſy portable *Mercurial Phoſphorus* after this Manner: In a clean neat Viol he included about five or ſix Ounces of well purified clean Quickſilver; and then evacuating the Viol of Air by applying to an Air-Pump, it would, when ſhook ſtrongly in the Dark, appear all bright and luminous, ſo as that one might diſtinguiſh the Faces of the Spectators.

PHYSICKS, or Natural Philoſophy. The moſt eminent Books on this Subject which will give the Reader a true and uſeful Knowledge of Nature, are theſe:

Sir *Iſ. Newton's Principia Philoſoph. Naturalis Mathematica.*
*Ejuſdem Optice: ſive de Lumine & Coloribus.*
*Borellus de Motionibus à Gravitate pendentibus.*
*—De vi percuſſionis.*
*Wallis Mechanicks, ſive Liber de Motu Tractatus Geometricus.*
*Hon. Fabri Dialogi Phyſici.* Lugd. Galliarum. 1669. 8vo.
Mr. *Boyle's Phyſical Pieces.*
*Keil's Introductio ad Veram Phyſicam.*
*Ditton's Laws of Nature and Motion.*
*Cheyne's Philoſophical Principles of Natural Religion.*
All Dr. *Hook's* Tracts printed while he was living, and his *Opera Poſthuma.*
*Philoſoph. Tranſactions.*
And *Collections.*
*Acta Eruditorum Lipſiæ.*
*Collegium Experimentale ſive Curioſum, in quo primaria hujus ſeculi Inventa & Experimenta Phyſico-Mathematica inveniuntur* 2 Vol. 4to.
*Eſſays of Natural Experiments made in the* Academy del Cimento, *Engliſh'd by Mr.* Waller, 1684. 4to.
*Ray's Wiſdom of God in the Works of the Creation,* Laſt Edit. with 3 *Phyſ. Diſcourſes.*
*Woodward's Natural Hiſtory of the Earth.*
*Bohun, of Winds.*
*De Reſiſtentia Solidorum,* by *Alex. Marchettus,* Florentiæ. 1665. 4to.
*Hypotheſis Phyſico-Nova G. G. Leibnitz.* Lond. 1671. 12mo. See *N.* 74. of *Phil. Tranſ.*
*Horologium Oſcillatorium Chriſtop. Hugenii,* Paris, *Fol.* 1673.
*Traite de la Percuſſion ou Choque de Corps per M. Mariotte a* Paris 1673. 12mo.
*Traite de Mouvements des Eaux & des autres Corps Fluides par Feu. par M. Mariotte.* Paris 1686. 8vo.
*Pardies Local Motion,* Engl.
*Exegeſis Phyſico-Math. de momentis Gravium.*
*Whiſton's Theory of the Earth.*
*Gallilæi Dialogi de Mechanica & Motu Locali.*
*—de Syſtemate Mundi.*
*Sinclari Ars nova & magna Gravitatis & Levitatis.*
*Dee de Præſtantioribus quibuſdam Naturæ Virtutibus.* 4to Lond. 1558.
*Miſcellanea Curioſa Germanica,* in 8 Vol. 4to.
*Phyſico-Matheſis de Lumine, Coloribus, & de Iridi. per Grimaldi.*

PIAZZA's, or as our Vulgar frequently call them *Piaches*, are in the *Italian* the ſame as our Cloyſters.

PICAGE, from the Latin *Pica*, was a Cuſtom or Duty paid at Fairs and Markets for breaking the Ground and pitching up of Stalls and Standings; and this Profit of Picage was uſually given or granted in Charters for holding a Fair or Market.

PIEDROIT, in Architecture, is a Square Pillar which is partly within the Wall. *Bulid. Dict.*

PILÆ, in Architecture, and their *Quadra's* and Tables (as we yet ſee them in ancient Altars and Monuments) were imploy'd for Inſcriptions; but if ſhorter and more maſſy, they ſerve for Arches of Bridges and for Buttreſſes to ſolid Work. *Evelyn's Parallel.*

PINK, is a Veſſel uſed at Sea maſted and rigged like other Ships, but only ſhe is built with a *round Stern*, the Bends and Ribs compaſſing ſo as that her Sides buldge out very much; wherefore theſe Pinks are difficult to be boarded, and alſo are made to carry greater Burdens than others. They are often uſed for Store-Ships, and Hoſpital-Ships, in the Fleet.

PINNACE, is a ſmall Veſſel, with a *Square Stern*, going with Sails and Oars, and carrying three Maſts; and is uſed as a Scout for Intelligence, and for Landing of Men, &c. alſo one of the Boats belonging to a great Man of War, which ſerves to carry the Officers to and from the Shoar, is called the *Pinnace.*

PISCI-

PISCIVOROUS *Animals*, are ſuch as feed on Fiſh. See *Birds*.

PITCH, is a Word uſed by Architects and Builders in theſe Senſes. Sometime *Paving* is called *Pitching*: But uſually they underſtand by it the Angle which a Gable-end, and conſequently the whole Roof of a Building is ſet to. If the Length of each *Rafter* be $\frac{3}{4}$ of the Breadth of the Building, then they ſay that Roof is of a *True Pitch*: But if the Rafters are longer, they ſay 'tis a *high* or *ſharp pitch'd Roof*; if ſhorter, they call it a *low* or *flat pitch'd Roof*.

PLACE *Apparent of a Planet*, is a point in the Starry Heaven which is found by a Right-Line paſſing from the *Spectator's* Eye on the Earth's Surface, and terminated at the other End amongſt the fixed Stars. In the Figure under the Word *Parallax* in Vol. I. If *A* be the Centre of the Earth, and *B* a point on its Surface; let ☾ repreſent the Moon, then will *G* be her true and *H* her apparent Place in the Starry Heaven.

PLACE *True of a Planet*, in Aſtronomy, is that point amongſt the fix'd Stars which is found by imagining a Right Line to be drawn from the Earth's Centre thro' the Planet, and terminated at the other End in the Starry Heaven.

PLACE *Geometrick*. The Ancients called their *Locus* or Place, ἀναλυόμενον, i. e. *Reſolutus*, and the Order of their Writings about it, according to *Pappus*, is this, (1.) *Euclidis Datorum, Lib.* 1. (2.) *Apollonii* λόγου ἀναλομῆς, or *de Rationis Sectione, Libri* 2. (3.) The ſame Author's χωρίου ἀναλομῆς, of the *Section of a Space*, 2 Books. (4.) His two Books of *Tactiones* (ἐπαφῶν.) (5.) *Euclide* his 3 Books of *Poriſmata*. (6.) *Apollonius* his νεύσεων, or of *Inclinations*, Book 2. (7.) The ſame Writer's two Books of *Loca plana*, τόπων ἐπιπέδων. (8.) His eight Books of *Conicks*. (9.) *Ariſtæus* his five Books τόπων στερεῶν, or of *Solid Places*. (10.) *Euclide* his two Books of *Places ad Superficiem*. (11.) *Eratoſthenes*'s two Books *de Mediętatibus*. Of all which only *Euclid*'s *Data*, and four Books of *Apollonius* his *Conicks*, are left now in Being.

See alſo *J. Craig's Tractatus Mathematicus de Fig. Curvilinearum Quadraturis*; & *de Locis Geometricis*. Lond. 1693. 4to.

PLANE, is an Inſtrument uſed in *Joinery*, to make Boards plane, try, and ſmooth, or in order to joint or frame them together, &c. Theſe are of ſeveral Names and Sorts according to the ſeveral Uſes; as, 1. The *Fore-plane*, which is a long Plane, and uſed firſt of all before either *Smooth-plane* or *Jointer*. The Edge of the Iron of this *Plane* is not ground ſtreight, but riſing with a Convex Arch in the middle of it, that its Edge may bear to be ſet the *Ranker*, for its Uſe is to take off the Irregularities of the Stuff as ſoon as may be, in order to prepare it for the *Smoothing-plane*, or *Jointer*. If the *Stuff* be *free* and *frowy*, that is, even tempered all over, you may then ſet the Plane ſo *rank* as that you may take off a Shaving of the Thickneſs of an old Shilling; but if it be hard or curling, you can't take off one thicker than an old Groat. 2. The *Smoothing-plane*, is a ſhort ſmall Plane, whoſe Iron is ſet very fine, and its uſe is to take off the Irregularities of the *Fore-plane*, or thoſe which it hath left. 3. The *Jointer* is a Plane longer than the Fore-plane, and hath its *Sole* perfectly ſtrait from End to End; it comes after the Fore-plane and Smoothing-plane, and is deſign'd to ſhoot an Edge of a Board perfectly ſtreight in order to jointing, as alſo Boards of any Thickneſs; for 'tis uſed to *Try*, as they call it, that is, ſmooth Tables with, whether large or ſmall; wherefore its Iron muſt be ſet very fine, little above an Hair's breadth above the Sole of the Plane, and the length of the Edge of it exactly ſtrait, or parallel to the Plane of the Sole or Bottom of the Plane. 4. The *Strike-Block* is a Plane made as true as the *Jointer*, and like it, only ſhorter; being uſed to ſhoot a ſhort Joint, which it doth more handily and readily than the *long Jointer*. 'Tis uſed alſo for framing and fitting the Joints of *Mitres* and *Bevels*, but then the piece of Wood is drawn by Hand over the Plane ſeveral Times till 'tis ſhot true. 5. The *Rabbet Plate* is uſed to cut part of the upper Edge of a Board ſtrait or ſquare down into the Stuff, ſo that the Edge of another Board cut down after the ſame manner may fit and join in with it on the Square; and when two Boards are thus cut away, this lapping over is called *Rabbeting*. The *Rabbet-plane* is ſometimes uſed alſo to ſtrike a *Paſcia*, in a piece of Moulding. The Iron of this Plane is full as broad as the Stock is thick (uſually about an Inch) that the Angles of the Edge may cut down exactly ſtrait; and it delivers its Shavings at the Side and not out of a Mouth at the Top, like other Planes. 6. The *Plow*, is a narrow *Rabbet-plane*, with the Addition of two Staves with Shoulders to them, and on the Bottom of the Shoulders a Fence: Its uſe is to plow a narrow ſquare *Groove* on the Edge of any Board, of any proper Depth. 7. *Mouldingplanes*, of which are ſeveral kinds, as the Round Plane, the Hollow, the O— G—, the Snipes Bill, &c. and theſe of ſeveral Sizes, as from half an Inch to an Inch and half. When theſe Planes are uſed on ſoft Wood, as Deal, Pear-Tree, Maple, &c. the Iron is ſet to an Angle of 45 Degr. with the Sole or Baſe of the Plane; but if it be very hard Wood, as Box, Ebony, Lignum Vitæ, &c. it is ſet to 80 Deg. and ſometimes quite upright. There is alſo ſome difference in the grinding of the *Baſil* or the Slope of the Edge of the Iron of the Plane; for in working on hard Wood this is ground to an Angle of about 18 or 20 Deg. but in ſoft Wood, not to one above 12 Degrees; for the more acute the *Baſil* is, the better and ſmoother the Iron cuts, but the more obtuſe and thicker it is, the ſtronger is the Edge to cut upon hard Work.

PLANE *of the Projection*, in the Aſtronomical Perſpective, or Stereographick Projection, is a Plane which paſſes thro' the Centre of the Sphere, the being ſuppoſed the Pole of or in a Point in the Axis of that Plane, and 90 Degr. above it or the Surface of the Sphere; thus, if the Eye be in the Zenith or Nadir Points, the Horizon will be a Plane on which the Circles of the Sphere may be projected Stereographically: And from hence it will follow, that all great Circles of the Sphere paſſing thro' the Eye-point, muſt be at Right Angles to the Plane of the Projection, becauſe they paſs thro' its Poles. See *Spherick Geometry*, or *Projection* in Vol. I.

PLANETS. The Motions of the ſix Primary Planets round the Sun is ſo adjuſted, that the Square of the Times of their peroidical Revolutions are as the Cubes of their Diſtances from the Sun: And the ſame thing is found by all Aſtronomers to be true, with Regard to the Motions of the *Secondary Planets* or *Satellites* round their primary ones. *Greg. Aſtron. p.* 26, 27.

The

The Forces with which the *Primary Planets* are continually drawn from a Rectilineal Motion, and by that Means are retained in their Orbits, are reciprocally as the Squares of their Distances from the Centre of the Sun. *Id. p.* 33.

The Forces with which the *Secondary Planets* are retained in their Orbits, are reciprocally as the Squares of their Distances from the Centres of their Primary Planets about whom they revolve. *p.* 34.

The *Nodes* and *Apsides* of all the Planetary Orbits are at rest and do not move progressively. *p.* 55.

The Planets and Comits are retained in their Orbits by the Force of Gravity; the same Law prevailing thro' all the Solar System. *p.* 57.

If a Primary Planet revolving round the Sun as its Centre carry round with him a Satellite which revolves also round the Planet; the Motion of this Satellite will be *accelerated* all the while it is moving from the Quadratures to the Syzygies, and *retarded* all the while it is moving from the Syzigies to the Quadratures: So that it will move *faster* near either its Conjunction or Opposition, and *slower* near the Quadratures. The Figure of its Orbit will also be more *Curvilineal* in the Quadratures than in the Syzygies, and consequently the Satellite will be or recede farther from the Primary Planet, in the Quadratures than in the Syzygies, so as that the Orbit will be an Ellipsis, whose Centre is the Primary Planet, and whose greater Axis lies at Right Angles to a Line drawn from the Sun; and the lesser Axis is coincident with that Line. This Dr. *Gregory* demonstrates in his *Astron. p.* 282, *&c.*

But if the Orbit of the Satellite Planet, instead of being a Circle be an *Ellipsis*, in whose *Focus* the Primary Planet is supposed to be placed, then will the greater Axis of this Elliptical Orbit, twice advance forward, *viz.* in the 2 Quadratures, and twice recede backward, *viz.* in the 2 Syzygies, of every Revolution of the Satellite round the Planet. *p.* 298.

In each Revolution of the Satellite round the Planet the *Apsides* will, for the most part, advance more forwards than they recede backwards, and by the Excess of this Progression, will move *in Consequentia*.

PLASTICE, or the *Plastick Art*, is the Art of making Figures of Men, Birds, Beasts, Fishes, Planets, *&c.* in Clay, *&c.* The Workmen are called *Plastæ*. It differs from Carving, because here the Figures are made by *Addition* usually, but in Carving always by *Subtraction* of what is superfluous. It is now with us chiefly used in Fretwork Ceilings; but the *Italians* apply it to the Mantlings of Chimneys with great Figures.

PLAY. The Laws of Chance or the Proportion of Hazard in Play or Gaming is a Thing Mathematically computable, *&c.* For tho' it be usually very uncertain in any Game depending on Chance, who shall win; yet it may, in most Cases, be determined who hath the better of the lay, and what Advantage one hath above the other; (which if Gentlemen knew and considered, they would not, perhaps, venture their Money with Sharpers, and such Wretches as make it their whole Business to *know* and *remember* the Odds in Gaming, as well as to practice most infamous Ways of Cheating by false Dice, slight of Hand, *&c.* But, I proceed to an easy Instance; tho' whether a Man shall throw 6 with one Die the first time be uncertain, yet how much it is against him, or how improbable that he doth not, may easily be determined. So likewise if another and I play at Tables or Back-Gammon, 3 up, and I am the first one; tho' it be uncertain, and can't be determined Mathematically who shall win; yet by those Principles I can demonstrate what the Advantage is on my Side, and how much the Value of my Expectation or Chance exceeds his.

A vast Variety of Questions about these Things will arise in Play, amongst two or more Gamesters; in Order to the Determination of which, this must be premised as a Principle.

*That the Value of any one's Chance or Expectation of Winning, is what would purchase the like Chance, Advantage or Expectation in a just or equal Game.*

Thus if a Person should, unknown to me, hide in one Hand 7 *s.* and in the other 3 *s.* tho' it be impossible for me to be certain which Number is in which Hand; yet I'm sure 'tis an Advantage to me to have the Choice of which Hand I will take; and (as I shall shew below) this Advantage is worth five Shillings.

In order to which, I lay down this Proposition.

*Proposition* I.

Where there is an equal Chance for $a=3$ *s.* and $b=7$ *s.* the Value of my Expectation is $\frac{a+b}{2}$; or half the Summ of $a$ and $b$.

To investigate the truth of which Proposition; suppose I would seek what the value of my Expectation is in this Case, let it in the Analytick way of Enquiry, be called $x$.

Then, by the general Axiom or Principle, If I had $x$, I were able in a fair and equal Game to purchase such an Expectation again.

Suppose therefore I play with another on these Terms, that each of us shall Stake down $x$, and that the Winner shall give $a$ to the Loser: I say this is just and fair, and that I have an equal Chance, either to get $a$, if I lose the Game, or to have $2x-a$ (that is, both the Stakes, subducting $a$) if I win. Now to make it an equal Game, this $2x-a$ must be $=b$, wherefore transposing $a$ and dividing by 2, you will have this Equation $x=\frac{a+b}{2}$, which gives $x$ sought.

Thus in Numbers, If I have an equal Chance of getting 3 *s.* or 7 *s.* then by this Proposition my Expectation or Interest is worth 5 *s.* and 'tis certain, that having 5 *s.* I may have the same Chance; for if I play with another, and each of us Stake 5 *s.* with this Condition, that the Gainer shall pay the Loser 3 *s.* This is an equal Way of Gaming; and 'tis plain, That I have an equal Chance to get or receive 3 *s.* if I lose, or 7 *s.* if I win.

That is, if a Man will give me the Choice of 7 *s.* in one of his Hands, and 3 *s.* in the other, 'tis as good as giving me 5 *s.*

*Proposition* II.

Where there it an equal Chance of $a$, $b$, or $c$, the value of my Expectation is $\frac{a+b+c}{3}$, or one third of the Sum of $a$, $b$, and $c$.

Let $x$ (as before) be the Value of my Expectation; then must $x$ be such, that I can purchase with it the same Expectation in a just and equal Game. Suppose the Conditions of the Game were, that of three Gamesters each of us stake down $x$, and I agree with one of them, to give him $b$ if I win, and he doth the same by me; with the other I agree to give $c$, if I win; and he doth the same with me: I say, this is fair and equal Play; for here I have an equal Chance to get $b$, if the first win, $c$ if the second win; or $3x-b-c$ (that is, all the Stakes, deducting $b$ and $c$) if I win my self. Now to make the Game equal, $3x-b-c$ must be equal to $a$, wherefore $x=\frac{a+b+c}{3}$. And so on; if there had been an equal Chance for four Things as $a+b+c+d$, the Value of my Expectation will be $x=\frac{a+b+c+d}{4}$, &c.

*Proposition* III.

Let the Number of Chances by which 13 ($=a$) may happen to me, be $p=3$, and the Number of Chances by which $b=8$, falls to me be $q=2$, and supposing all the Chances to happen with an equal Facility; then, I say, the Value of my Expectation is $\frac{pa+qb}{p+q}$; that is, in Words, The Quotient arising from the Summ of the Products of both the Numbers $a$ and $b$, when multiply'd into their Respective Chances $p$ and $q$, and then divided by the Summ of those two Chances. To prove which,

Suppose as before my Expectation to be $x$: If I have $x$, I shall be able to purchase with it the same Expectation again in an equal Game. For this I may take in as many Persons to play with me as make up the Number of $p+q$; of which every one must stake $x$, Therefore the whole Stake will be $px+qx$, and every one plays with equal hopes of winning.

With as many of my Fellow-Gamesters as the Number $q$ stands for, I bargain one by one, that which of them soever wins shall give me $b$; and if I win, I will do so by them. Then with the rest of the Gamesters, whose Number is $p-1$ (that is, all the remaining Gamesters but those expreſt by $q$, and my self) I bargain, that whoever of them gains the Stakes shall give me $a$, and I agree to do so by them, if I win. 'Tis plain, that this is fair Play, no Man being injured. And in this Case I have $q$, Expectation to gain $b$; and $p-1$ Expectation to win $a$: And 1 Expectation (*viz.* If I win my self) to gain $px+qx-bq-ap+a$; for if I win I must give $b$ to each of the $q$ Gamesters, and $a$ to each of the $p-1$ Players; which makes $bq+pa-a$; if therefore $qx+bx-ba-ap+a$ were equal to $a$, I should have $p$ Expectations of $a$; (since just now I had $p-1$ Expectations of it) and $q$ Expectations of $b$; and so I should come just to my first Expectation; wherefore putting $px+qx-bq-ap+a=a$. By Reduction $x=\frac{ap+bq}{p+q}$. Q. E. F.

In Numbers, If I have 3 Chances for 13, and 2 Chances for 8, I say by this Rule my Expectation is worth 11.

For $13\times3=39$. and $8\times2=16$. and $39+16=55$, and $55-^{a}5=11$.

And if I have 11, I can easily shew that I may come to this Expectation: For, suppose I play with 4 others, each of which, as well as I, stakes 11; with two of these I bargain, that whoever of us wins shall give the others 8 a-piece; and then with the other 2, I agree, that the Winner shall give to the 2 Losers of us 13 a-piece. Then 'tis plain, I have 2 Expectations to get 8, and 3 Expectations to get 13 (*viz.* if either I or any of the other two win) for in this Case I gain all the Stakes which make 55; out of which I must give the first two 8 a-piece, and the other two 18 a-piece, and so there remains 13 for my self.

To apply these things to the ordinary Cases of Play.

1. Suppose he that come first to Three be *up*, or *wins the Stake* between two Gamesters: And let me be *two* and he but *one*; *Query*, What is my Advantage? Or, if we leave off Play, what is my just Share of the Stakes?

The first Consideration here is, how much each of us wants to be up; as suppose we play 3 up, and he be 1 and I 2; or if we play, first come to 20, and he be 18 and I 19 Games; in both these Cases he wants 2 of being up and I want but one, The Question is, what Advantage I have of the Lay? or what Proportion or the Stakes is due to me if we should now leave off.

To find which, let us see what would happen if the Game went on: If I get the next Game, or End, I am up, and win the Stakes; which suppose you call $a=8$, but if he win 2, then he will be up as well as I, and so both our Lots are equal; and if we should then divide, each of our Shares will be $\frac{a}{2}$ or $\frac{1}{2}a$.

But before we play that Game, if I am two and he but one, the Hazard, which of us shall win that Game, being equal, I have an equal Chance to get the whole Stake or the half; that is, $a$ or $\frac{a}{2}$; for if I win the Game I have $a$, and if he win, my just share of the Stake is $\frac{1}{2}a$.

Since therefore, before I begin this Game, I have an equal Chance to gain $a$ or $\frac{1}{2}a$, the Value of my Expectation (by *Prop.* I.) is half the Sum of both those Chances (*i. e.*) $\frac{a+\frac{1}{2}a}{2}=\frac{3}{4}a=6$. Now if I have $\frac{3}{4}a$ due to me as my Share, he can have but $\frac{1}{4}a$ due to him as his Proportion, so that if we play'd for 8 Pieces, and would draw Stakes when I am two and he but one, and if three be up, I must have 6 Pieces and he but 2 Pieces, and the Odds on my side is *Three to One*.

Another way thus; in

*Case* 1. The Deficiencies being 3; the Sett must be up in two Ends; wherefore take the Members of the 2d Power of $a+b$, and distribute them thus: Because $A$ wants but one of up, let all the Members, where there is one $a$ or more, with their *Unciæ* be collected for $A$, and all where there's two $b$'s (or $bb$ and above) for $B$.

For

| For *A*. | For *B*. |
|---|---|
| 1 *aa* | 1 *bb* |
| 2 *ab* | |
| 3 | 1 |

Wherefore *A*'s odds to *B* is 3 to 1.

Or by ſimple Subtraction only, Let the Stake of each be 32 *s.* then if *A* wins the next Game he is up and hath the whole or 64 Shillings; but if *B* wins it, their Shares will be equal. *A* there might have ſaid, If *B* will leave off let him give me the 32 Shillings. which I am ſure of, tho' he ſhould win the next Game; and ſince he will not venture for the other 32 *s.* let us divide it fairly between us; ſo *A* muſt have 16 *s.* more, which will make his Share in the whole 48 Shillings, and he muſt have only 16 Shillings.

'Tis the ſame odds, *i. e.* 3 to 1, that a Man throws not Pile twice together with one Piece, as that he throws two Piles the firſt throw with two Pieces.

For reckoning each Face of the Piece of Money for a Chance, like the Face of a Dye, 'tis plain, of the 4 Chances on the two Pieces, there is only *two Piles* for him, whereas there is 2 Croſſes, one Pile and one Croſs, and one Croſs and one Pile againſt him; each Piece having two Faces) that is, there is one for him and 3 againſt him.

*Caſe* 2. Suppoſe I want but one Game of up, and my Fellow-Player 3.

I conſider the State of our Caſe, if either my ſelf or he gain the next Game. If I win it I am up, and ſo have the Stake *a*; if he win it, he will then want two of being up, as I want but one. And then I ſhall be in the ſame State as was ſuppoſed in the Caſe before this; and my Share of the Stakes, if we ſhould divide fairly, is $\frac{3}{4}a$; wherefore before I threw I had an equal Chance for *a* or $\frac{3}{4}a$, and therefore (by *Propoſition* I.) my Expectation is worth $\frac{a+\frac{3}{4}a=\frac{7}{8}a}{2}$: But if my Proportion of Expectation be $\frac{7}{8}a$, his can be but $\frac{1}{8}a$; and therefore my Odds is as 7 to 1.

Otherwiſe thus,

The Deficiencies being 4, the Sett muſt be up at 3 Games End: Then take the Members of the third Power of $A+B$ and diſtribute them thus:

| For *A*, | For *B*, |
|---|---|
| $1a^3$ | $1b^3$ |
| $3aab$ | |
| $3abb$ | |
| 7 | 1 |

Wherefore the Odds is as 7 to 1.

Here alſo by common Subtraction 'tis plain; That if *A* wins the Game he hath 64 *s.* but if *B* wins it, they are in the Condition mentioned in *Caſe* 1. That is, there is then 48 *s.* due to *A*; wherefore he might ſay, Give me that 48 *s.* that is due to me (for I'm ſure of it whether I win or loſe the next Game) and if you will leave off and not hazard the other 16 *s.* let us divide them equally; give me 8 *s.* more, which makes my Share 64 *s.* leaving yours but 8 *s.* wherefore *A*'s Advantage was 7 to 1.

*Caſe* 3. By this Method of Calculation you will find, that if I want but one of being up and he 4, the Odds on my Side is 15 to 1.

*Caſe* 4. Suppoſe I want 2 and he 3 Games of being up.

Then if I win the next, I ſhall want but one and he three. This State of the Sett is worth $\frac{7}{8}a$ by the laſt *Caſe*; but if he win, then each of us will want 2, and ſo our Chance is equal, and there is $\frac{1}{2}a$ due to each of us; wherefore I have an equal Chance to gain $\frac{7}{8}a$ or $\frac{1}{2}a$: But $\frac{\frac{7}{8}a+\frac{1}{2}a}{2}=\frac{11}{16}a$. wherefore, if we were to divide the Stakes juſtly, there is eleven 16ths due to me, and conſequently but 5 Sixteenths due to him; wherefore I muſt have eleven parts of the Stake, and he but five.

Otherwiſe thus;

Let *A* want 2 of up, and *B* want 3.

The Deficiencies 2+3 being 5, the Sett muſt be up in one Game leſs; *viz.* 4.

I take therefore the 4th Power of the Binomial $A+B$, *viz.* $a^4+4a^3b+6a^2b^2+4b^3a+b^4$, and diſtribute it thus;

Let all the Members where there are two *a*'s be collected for *A*, and all thoſe where there are three *b*'s for *B*.

| *A*. | *B*. |
|---|---|
| $1a^4$. | $4b^3a$ |
| $4a^3b$ | $1b^4$ |
| $6a^2b^2$ | |
| 11 | 5 |

Then adding all the *Unciæ* in each Collection together they will give the Chances and ſhew the Odds of *A*'s winning or being up before *B*, to be as 11 to 5.

And ſo on Univerſally.

As in *Caſe* the next, where *A* wants two and *B* wants four of up.

The Deficiencies being 6, the Sett will be up in one Game leſs, *viz.* 5. Taking therefore the *Unciæ* of the 5th Power of $a+b$ you will have

| for *A*. | for *B* only |
|---|---|
| $1a^5$ | $1b^5$ |
| $5a^4b$ | $5ab^4$ |
| $10a^3b$ | |
| $10a^2b$ | |
| in all 26. | in all 6. |

Wherefore the Odds is 26 to 6, or 13 to 3.

This Method by the *Uncia* of a *Binomial* was communicated to me by the Honourable *Francis Roberts*, Eſq;

*Caſe* 5. Suppoſe I want 2 and he 4.

If I win next I ſhall want but one and he will ſtill want four; but if I loſe the nextGame, I ſhall want 2 and he 3; wherefore by *Caſe* 3, 4. I have an equal hazard of gaining $\frac{11}{16}$ or $\frac{5}{16}$, and this by *Prop.* I. is worth $\frac{13}{16}a$; wherefore his Share is but $\frac{3}{16}a$, and therefore the Odds on my Side is 13 to 3.

*N. B.* Wherefore he that wants but 2 of up, when the other wants 4, is in a better State than he who wants but one when the other wants but two (as in *Caſe* 1. for his Expectation then is but $\frac{3}{4}$ or $\frac{12}{16}a$, whereas now 'tis $\frac{13}{16}a$.

To carry this a little farther, Suppoſe 3 Men at play, and let the firſt and ſecond want but one Game of up; and the third want two.

To find the value of the Share of the firſt (in Caſe of a Diviſion of the Stakes) you muſt conſider what will happen if either he or any of the two other gain the firſt Game. If the firſt win he gets the Stake *a*, if the ſecond win the firſt hath Nothing; but if the third win, each would want a Game; ſo that $\frac{1}{3}a$ is each Man's Share:

Where-

Wherefore the first Man hath one Expectation to gain $a$, one to get nothing, and one for $\frac{1}{3}a$; which by *Prop.* II. is $\frac{a+0+\frac{1}{3}a}{3}=\frac{4}{9}a$. But the second Man's Expectation was as good as that of the first, for he wanted also but one of up; wherefore his also is $\frac{4}{9}$ of $a$: But $\frac{4}{9}a+\frac{4}{9}a=\frac{8}{9}a$, and consequently the Third's Share can be but $\frac{1}{9}a$; wherefore the Stakes being divided into 9 parts, the two first Men must have 4 a-piece, and the third must have one.

And after this manner you may proceed with any Number of Players; of which some want more and some less of the Setts of Games. If you go about to investigate any one's Share, you must consider what would be due to him, if either he or any one Gamester should win the next Game; and then, *adding all their Shares, and dividing the Sum by the Number of the Gamesters, the Quotient will be the Share you seek.*

*Proposition* IV. *Problem.*

To find at how many Throws one may undertake to throw 6 with one Dye?

*Case* 1. If I undertake to throw six the *first time* tis plain there is but one Chance for me and 5 against me. Let the Stake therefore be $a$, then shall I have one Expectation to gain $a$, and 5 to gain Nothing; wherefore by *Prop.* II. $\frac{a+5 \text{ nothing,}}{6}$ (for 5 times Nothing is Nothing) $=\frac{1}{6}a$, is the Value of that Expectation, and consequently my Antagonist must have $\frac{5}{6}a$; wherefore he ought to lay me 5 to 1.

*Case* 2. If I undertake to throw 6 at 2 Throws with one Dye, my Chance may thus be found;

If I throw 6 the first time, I have my Stake; if I do not, I have but one throw remaining; which (by *Case* 1.) is $=\frac{1}{6}a$; wherefore there are five Chances for my gaining $\frac{1}{6}a$, and but one for $a$; which (by *Prop.* II.) $=\frac{a+\frac{5}{6}a}{6}=\frac{11}{36}a$, the Chances against me then give my Fellow Gamester $\frac{25}{36}a$, and consequently, that I don't throw 6 at two Throws, is 25 to 11.

*Case* 3. By the same Method of Calculation you will find that I don't throw 6 at three times is 125 to 91, a little more than 4 to 3.

*Case* 4. That I do throw it at 4 times is 671 to 625, a little more than an even Wager.

*Case* 5. That I do it at 5 times, is 4651 to 3125, *viz.* almost 3 to 2.

*Case* 6. That I do it at 6 times, is 31031 to 15625, almost 2 to 1.

The Solution of this Problem and of the following one I had also from the Honourable *Fr. Roberts*, Esq; Thus,

In how many times, with a single Dye, may one undertake to cast Six?

The Chances of one Dye being 6, I make 6 the Numerator of a Fraction, and the Chances against my throwing 6 being 5, I make that the Denominator; and by Consequence, the *Denominator subducted from the Numerator leaves the Chances which are for me.*

Now I say, that the Number of Throws requir'd must be the Index of that Power of $\frac{6}{5}$, which makes the Numerator at least double to the Denominator; for by that Means the Chances against me being subducted, a *Majority* will remain for me.

| Throws | makes it | | $6\times\frac{6}{5}\times\frac{6}{5}\times\frac{6}{5}\times\frac{6}{5}$ | |
|---|---|---|---|---|
| 1 | | 5 agst. me. | 1 for me | |
| 2 | | 25 | 11 | that is 36—25 |
| 3 | | 125 | 91 | 216—125 |
| 4 | | 625 | 671 | 1296—625 |

Wherefore at 4 Throws I have something the Advantage: And so you may proceed on as far as you please.

*Problems* of this Nature are very expeditiously solved by the *Logarithms*, as in this Example.

In how many times, with six Dice, may one undertake to throw all Sixes?

All the Chances on 6 Dice being the 6th Power of 6; that is, 46656, let $x$ be the Number of Throws required.

| | | |
|---|---|---|
| $x2$ | 1 | $46556^x$ ———> 46655 2. that is, this Fraction when raised up to the Power of $x$ must have its Numerator above double of the Denominator; or by the *Logarithms.* |
| | 2 | $0.00000931x > 0.30103000$. |
| | 3 | Wherefore dividing one by the other, it will follow, that $x > 32334$. |
| | 4 | And consequently $x=32335$. |

Now without the Logarithms, (which solve this in a few Minutes) a Man's Life would scarce serve to go thro' the Operation; for $\frac{46656}{46655}$ must be raised up to the 32335th Power, which would make a Row of Figures almost a Quarter of a Mile in Length.

*Proposition* V. *Problem.*

To find at how many times one may throw 12 with only two Dice.

*Case.* 1. 'Tis plain, the first Throw, the Castor hath but one Way to throw it, and 35 Throws to miss it; wherefore by *Prop.* II. his Expectation is but $\frac{1}{36}a$.

*Case* 2. He that undertakes it at twice, if he throw 12 the first time gains $a$; if not, he hath but one Throw more for it; and that is worth but $\frac{1}{36}a$, by the former Case; wherefore there is but one Chance for him for 12 at the first Throw, and 35 Chances against him: So that he hath 1 Chance for $a$ and 35 for $\frac{1}{36}a$, which by *Prop.* II. is worth $\frac{71}{1296}a$, and there will be against him $\frac{1225}{1296}a$. which is above 16 to 1.

Omitting then the Chances of doing it at three Throws, let us find the Hazark or Odds of doing it at 4 Throws.

If he that undertakes to throw 12 at 4 Throws do it the first or second Throw, then he hath $a$; if not, there remains two other Throws against him;

him; which by the former Case are worth $\frac{71}{1296}a$.

But for the same Reason in his two first Throws, he hath 71 Chances for *a*, against 1225 Chances which will lose it; wherefore at first he hath 71 Chances for *a*, and 1225 which give him $\frac{71}{1296}a$; which by the 2d *Proposition* is worth $\frac{1500625}{1679610}a$.

And thus if you pursue all the Cases (saith the ingenious Author of the Laws of Chance, *p.* 38, 39.) you will find that he that undertakes to throw 12 with two Dice at 24 Throws, has some Disadvantage of the Lay, as he that engages to do it at 25, hath some Advantage.

*Proposition* VI.

After the same manner may be found, that you may undertake to throw two Sixes at ten Throws of one Dye, or with one Throw of ten Dice.

*Proposition* VII.

If I play with another but one Throw with two Dice, so that if 7 comes up I win the Stake, if 10 he gains it; what is the Odds, and how much of the Stakes would belong to me if we draw?

Of the 36 Chances on the two Dice, there are 6 which will give me 7, 3 which give me 10, and consequently 27 other Chances which give me neither, and which equals the Game; in which Case there is due to each of us $\frac{1}{2}a$; but if none of the 27 should happen, I have 6 Chances to gain *a* and 3 by which I may get Nothing; which, by *Prop.* II. is $\frac{2}{3}a$ in Value. So I have 27 Chances for half *a* and 9 Chances for $\frac{2}{3}a$, which (by *Prop.* II.) $= \frac{13}{24}a$ for me, and $\frac{11}{24}a$ for him.

Prop. VIII.

If I were playing with another, *by turns*, with two Dice, so that if I throw 7 I win, and if he throw 6 he wins, and he hath the first Throw; What is the Proportion of my Hazard to his?

Suppose I call the Value of my Hazard *x*, then if the Stakes be *a*, his Hazard will be $a-x$.

Then whenever 'tis his Turn to throw, my Hazard is *x*; but when it is my Turn, the Value of my Hazard is greater.

Suppose I then call it *y*. Now because of 36 Throws on two Dice, there are 5 which will give him 6, and 31 which bring it again to my turn to throw; I have 5 Chances for nothing and 31 for *y*, which (by *Prop.* III.) is worth $\frac{31}{36}y$. But at first I supposed my Hazzard to be *x*, wherefore $\frac{31}{36}y = x$, wherefore $\frac{36}{31}x = y$. I supposed likewise when it was my Turn to throw, that the Value of my Hazard was *y*: But then I have 6 Chances which give me 7, and consequently the Stake; and 30 which give my Antagonist the Dice; that is, make my Hazard worth *x*. So I have 6 Chances for *a*, and 30 for *x*; which by *Prop.* 3. is worth $\frac{6a+30x}{36}$, but by the Supposition, that is $= y = \frac{36}{31}x$, and therefore $\frac{6a+30x}{36} = \frac{36}{31}x$; and by Reduction $x = \frac{31}{61}a$, which is the Value of my Hazard; wherefore his must be $\frac{30}{61}a$, and consequently my Chance to his is as 31 to 30.

In the Book above-mentioned, called *The Laws of Chance*, you will find the Advantages and Disadvantages of the several Chances at *Hazard*, *Raffling*, *Whist*, &c. this Way computed.

*Proposition* IX. *Probl.*

*To find in any Number of Games the Value of the First.*

Suppose *A* and *B* play so that he that wins the first 9 Games shall have the Stakes, and *A* hath won one of the 9 already; if they leave off, how much of *B*'s Money is due to *A*.

To find this, take the first 8 even Numbers, 2, 4, 6, 8, 10, 12, 14, 16, and multiply them continually, that is, the first by the second, and then the Product arising thence multiply by the third, &c. Take also the first 8 odd Numbers, and do so by them. The Product of the even Numbers will be a Denominator, and that of the odd ones a Numerator of a Fraction; which Fraction will express the Quantity of *B*'s Money due to *A* on his winning the first of the 9 Games.

Suppose only 4 Games up, of which *A* is one: Take the three first even Numbers, as 2, 4, 6, and multiply them continually, they will make 48; the three first Numbers 1, 3, 5, so multiply'd make 15: Therefore there is due in this Case to *A*, $\frac{15}{48}$, or $\frac{5}{16}$ of *B*'s Money; wherefore, if each had staked 16 Shillings, there would be a Crown due to *A* besides his own Stake of 16 Shillings.

*Proposition* X. *Probl.*

*To find the Value of his Hazard who undertakes at the First Throw to cast Doublets with any assigned Number of Dice.*

In two Dice, 'tis plain, that to avoid *Doublets*, every one of the *Six* different Throws of the first Dye, can only be combined with *Five* of the Second; because one of the Six is of the same kind, and therefore will make Doublets.

For the same Reason, the 30 Throws of 2 Dice which are not Doublets, can only be combined with four Throws of a third Dye, and with but 3 Throws of a fourth Dye.

Wherefore in General this will be the *Series*.

$$\frac{6\times5\times4\times3\times2\times1\times0, \&c.}{6\times6\times6\times6\times6\times6\times6, \&c.}$$

The Under *Series* is the Summ of all the Chances; and the Upper, the Number of Changes against him who undertakes to throw Doublets.

Each *Series* must be continued to so many Terms, as are the Number of Dice. *V. gr.* If one should undertake to throw Doublets, the first Throw with four Dice, his Adversary's Hazard is $\frac{5\times5\times4\times3}{6\times6\times6\times6} = \frac{360}{1296} = \frac{5}{18}$, and he hath $\frac{13}{18}$: So that 'tis 13 to 5 that he throws Doublets the first time with 4 Dice.

In

In Seven Dice, 'tis eaſie to ſee the Chances againſt the Undertaker are nothing, becauſe then there muſt neceſſarily be Doublets.

*Propoſition* XI.

If I have $p$ Chances for $a$; $q$ Chances for $b$; and $r$ Chances for $c$: I ſay, my Expectation is worth $\frac{ap+bq+cr}{p+q+r}$, that is, in Numbers, ſuppoſing $p=2$. $a=3$. $q=4$. $5=b$. $1=r$. $c=9$; the Value of my Hazard is $\frac{2\times3+4\times5+1\times9}{7}=5$. For call my Expectation $x$, then $x$ muſt be ſuch, as having it, I am able to purchaſe as good a Hazard again, in a juſt and equal Game. Suppoſe the Law of the Play were this, that I playing with ſo many others, as with my ſelf, make up the Number $p+q+r$; with as many of them as the Number $p$ repreſents, I make this Bargain, that whoever wins ſhall give me $a$, and I will do ſo to each if I win: With thoſe repreſented by the Number $q$, I bargain to have $b$ if any of them win, and to give $b$ to each of them if I win my ſelf; and with the reſt of the Players, whoſe Number is $r-1$, I agree to give or to receive $c$ after the ſame Manner. Now all being in an equal Probability to gain, I have $p$ Chances to get $a$, $q$ Chances for $b$, and $r-1$ Chances to get $c$, and one Chance, *i. e.* when I win my ſelf, to get $px+qx+rx-ap-bq-rc+c$. which if it be ſuppoſed equal to $c$ then I have $p$ Chances for $a$, $q$ Chances for $b$, and $r$ Chances for $c$ (for juſt now I had $r-1$ Chances for it) therefore if $px+qx-rx-ap-bq-rc+c=c$: Then is $x=\frac{ap+bq+cr}{p+q+r}$ as it ought to be.

By this Theorem all the Chances at *Hazzard* may eaſily be calculated. Vid. *Laws of Chance*, *p.* 87.

PLEAS *of the Sword. Placita ad Gladium.* In 2 *H.* 3. *Ranulph* the 3d. Earl of *Cheſter* granted to his Barons of *Cheſhire* an ample Charter of Liberties; *Exceptis Placitis ad Gladium ſuum pertinentibus.* The Reaſon of which was, that *William* the Conqueror gave the Earldom of *Cheſter* to his Kinſman *Hugh* (commonly called *Lupus*) Anceſtor to this Earl *Ranulph*, *Tenere ita Libere per Gladium, ſicut ipſe Rex Willhelmus tenuit Angliam per Coronam.* And conſonant hereunto, in all Indictments for Felony, Murder, *&c.* in that County Palatine, the Form was anciently, *Contra Pacem Domini Comitis, Gladium & Dignitates ſuas.*

PLEBANIA, *Eccleſia plebanianis*, is a Mother-Church which hath one or more ſubordinate Chapels.

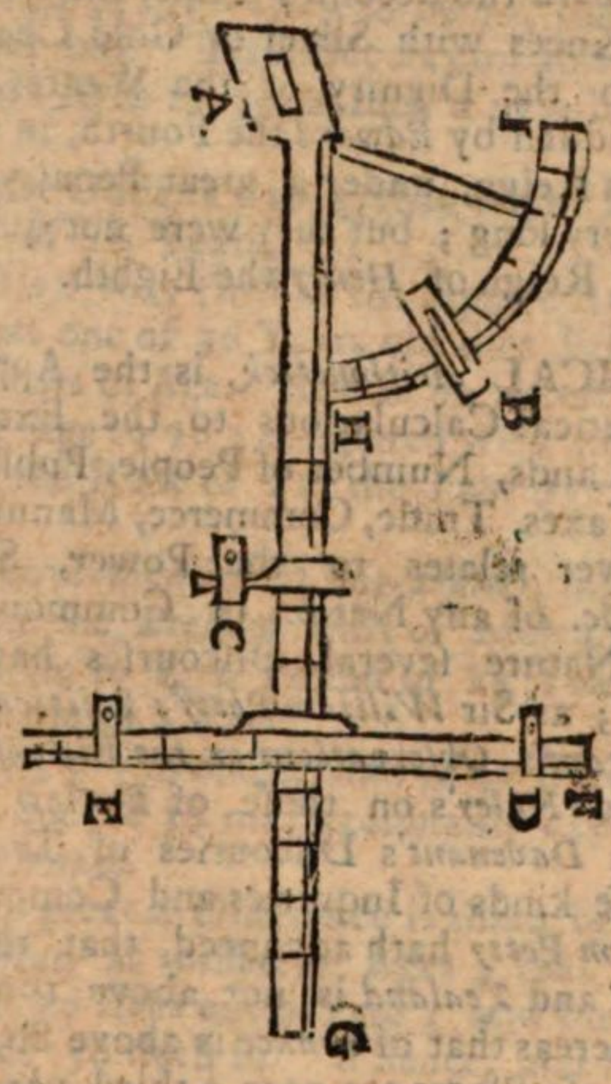
PLEBANUS, was ſometimes the Title of a Rural Dean, becauſe the Deanaries were formerly affixed to the *Plebaniæ*, or chief *Mother Churches* within ſuch a Diſtrict, which at firſt was uſually Ten Pariſhes. Sometimes it ſeems to have been uſed for a Pariſh-Prieſt of ſuch a large Mother-Church as was exempt from the Juriſdiction of the Ordinary, and therefore he had the Authority of a Rural Dean committed to him by the Archbiſhop, to whom the Church was immediately ſubject.

PLEBISCITUM, in the *Roman* Law, was whatever was enacted by the Common People, at the Requeſt of the Tribune, or ſome other plebeian Magiſtrate.

PLEURA, is a double Membrane, which covers all the inward Cavity of the *Thorax*; it ariſes from the *Vertebræ* of the Back, and aſcends on each ſide upon the Ribs, to the middle of the *Sternum.* It is fixed to the *Perioſteum* of the Ribs, and to the internal intercoſtal Muſcles, and it covers the Midriff. Its Side towards the Cavity is ſmooth and equal, but that which is fixed to the Ribs is rough.

PLOW, an ancient Inſtrument, tho' now not much uſed at Sea, mentioned in the former Volume; and its Deſcription is thus given by Sir *Jonas Moor* in his Navigation.

There is firſt, a *Staff*, as A L G, on which a ſmall Arch, as H I, and a Croſs, as E F, are fitted together with three Vanes, as A an Horizontal Vane, B a Shade Vane, and C a Sight Vane, which is moveable upon the *Staff*.




In order to make an Obſervation of the *Sun's* Altitude with this Inſtrument, you muſt fit on the Horizon-Vane, and then you may place the Shade Vane to any Degree of Altitude in the Diviſions of the Arch, ſo it exceed not the Altitude to be obſerved, nor be above 10 Degrees (which a little Practice will ſoon enable you to gueſs readily at:) for in both theſe Caſes the Diviſions on the *Staff* are deficient. Then put on the Sight-Vane, hold up the Inſtrument, and turn the Back of the Arch to the Sun, and move the Sight-Vane on the *Staff* backwards and forwards, till the Shade of the upper Edge of the Shade-Vane fall on the upper part of the Slit of the Horizon-Vane; and that at the ſame time, looking thro' the Sight-Vane, you can ſee the Horizon thro' the Horizon-Vane; for then will the Summ of the Degrees on the Arch and on the Staff be the Altitude, allowing for the Height above the Horizon and for Refraction. For the Height above the Horizon they uſually allow 6 or 8 Inches.

PLOW-*Land*, *Carucata*, was formerly as much arable Land as one Plow could plough up in one Year:

Year. This in the Beginning of the Reign of *Rich.* I. was accounted at 60 Acres; and in the 9th of *Rich.* I. 100 Acres is allowed for a Plow-Land. And this Measure was very different according to Time and Place.

PNEUMATICAL *Experiments*, are such as are made in the exhausted Receiver of the Air Pump, in order to discover the several Properties of the Air and its Influence on other Bodies. Of these you may find great Variety in Mr. *Boyle*'s Works, and in the *Philosophical Transactions*; and those made with great Accuracy and Care.

PNEUMONICA *Vena*. See *Vena Pneumonica*, in this Vol.

POCKET *of Wooll*, is the Quantity of half a *Sack*. 3 *Instit. Fol.* 96.

POINTS *of the Compass*. See *Compass* and *Rhumbs*.

POLEINE, was a kind of Shoe with a picked Point turned up at the Toe: These first came into Fashion in the Reign of *William Rufus*, and by degrees came to be of that excessive Length, that in *Richard* the Second's Time, they were ty'd up to the Knees with Silver or Gold Chains, according to the Dignity of the Wearer. They were forbidden by *Edward* the Fourth, in the fifth Year of his Reign, under a great Penalty, to be worn so very long; but they were not quite disused till the Reign of *Henry* the Eighth.

POLITICAL *Arithmetick*, is the Application of Arithmetical Calculations to the Extent and Value of Lands, Number of People, Publick Revenues, Taxes, Trade, Commerce, Manufactures, or whatever relates to the Power, Strength, Riches, *&c.* of any Nation or Common-wealth. Of this Nature several Discourses have been published; as Sir *William Petty's Political Arithmetick*, *Grant*'s *Observations on the Bills of Mortality*; Capt. *Haley*'s on those of *Breslaw* in *Silesia*; Dr. *Davenant*'s Discourses of Trade, *&c.* From these kinds of Inquiries and Computations, Sir *William Petty* hath advanced, that the Land of *Holland* and *Zealand* is not above 1000000 of Acres, whereas that of *France* is above 80,000000, and yet those Places are near a third part as rich and as strong. That the Rents of Lands in *Holland* to those of *France*, are about 7 or 8 to 1. That the People of *Amsterdam* are $\frac{2}{3}$ of those of *Paris*, or *London*, which don't differ, he saith, above a 20th part from one another. That the Value of the Shipping of *Europe* is about 2 Millions of Tuns; of which the *English* have 500000, the *Dutch* 900000, the *French* 100000, the *Hamburghers*, *Danes*, *Swedes*, and *Dantzickers*, have 250000, and *Spain*, *Portugal*, and *Italy*, &c. about as much. The Value of the Goods exported from *France* into all the Parts is supposed Quadruple to what is sent into *England* alone, and consequently in all about 5000000. What is exported out of *Holland* into *England*, is worth 2000000; and what is exported thence into all the World, is 18000000. The Money yearly raised by the *French* King (in Peace) is about $6\frac{1}{2}$ Millions Sterling; and all *Holland* and *Zealand* pay about 2100000 *l.* and all the Provinces together about 3000000. That the People of *England* are about 6000000; their Expence at 7 *l. per Annum* a Head, 42000000. The Rent of the Lands about 8 Millions, and the Profits of the Personal Estate as much. The Profits of all the Labour of the People 26000000. In *Ireland* the People amount to about 12 Hundred Thousand. The Corn spent in *England*, at 5 *s.* per Bushel Wheat, and half a Crown Barley, is worth Ten Millions *per Annum*. The Navy of *England* (then) required 36000 Men to man it; other Trade of Shipping about 48000 Men to manage it. In *France*, to manage the Shipping Trade, he reckons then but 15000 Men. The whole People of *France* he accounts about 13000000 and an half; and those of *England*, *Scotland*, and *Ireland*, all together, to be 9 Millions and an half. In the King of *England*'s Dominions are about 20000 Church-men; and in *France* above 270000. In our whole Dominions above 40000 Seamen, in *France* not above 10000. In *England*, *Scotland*, and *Ireland*, and all other Dominions belonging to us, there was then about 60000 Tun of Shipping; which is worth about 4 Millions and a half of Money. The Sea-Line round *England*, *Scotland* and *Ireland*, and the adjacent Islands, is about 3800 Miles.

In the whole World about 300,000000 of People, and not above 80 Millions with whom the *English* and *Dutch* have Commerce. The Value of the Commodities traded for in the whole, not above 45000000. The Manufactures of *England* in the whole, exported from *England*, amount to about 5000000 *per Ann.* Lead, Tin, and Coals, 500000 *l. per Ann.* The Value of the *French* Commodities (then) brought into *England*, did not exceed 1200000 *l. per Ann.* The whole Cash of *England* in current Money was then about 6000000 *l.* and at 6000000 of Souls, allowing each to spend 7 *l. per Ann.* the whole Expence will be 42000000, that is, about 800000 *l.* a Week. The Rent of Houses in *England* was then about 4000000 *l. per Annum.*

Dr. *Davenant* also in his Discourses on the publick Revenues and Balance of Trade of *England*, shews the great Use of Political Arithmetick in all the Considerations about the Revenues and the Management of our Trade; he gives some good Reasons why Sir *William Petty's* Number above-mentioned are not entirely to be rely'd upon, and therefore advanced others of his own, which are founded upon and supported by the Observations of the ingenious and industrious Mr. *Gregory King*. Some of the Particulars of which, that are most useful, are these: That the Land of *England* is 39 Millions of Acres. The Number of People, according to this Account, is *now* about 5545000 Souls, they increasing about 9000 every Year, Allowances being made for Plagues, *&c.* Wars, Shipping, and the Plantations. The People of *London* he reckons at 530000. Those in the other Cities and Market Towns in *England*, at 870,000, and those in the Villages and Hamlets at 4100000. The yearly Rent of the Land he accounts to be 10,000000. That of the Houses and Buildings 2,000000 *l. per Ann.* The Produce of all kinds of Grain he reckons to be worth 9,075000 *l.* in a Year of moderate Plenty. The Rent of the Corn Land annually 2,000000 *l.* and the neat Produce above 9,000000. The Rent of the Pasture Meadows, Woods, Forests, Commons, Heaths, *&c.* 7,000000. The Annual Produce by Cattle, in Butter, Cheese, and Milk, he thinks, is about 2,500000. The Value of the Wooll yearly shorn, about 2,000000: Of Horses yearly bred, about 250000. Of the Flesh yearly spent as Food, about

bout 3,350000. Of the Tallow and Hides about 600000. Of the Hay yearly consumed by Horses, about 1,300000; of Hay consumed by other Cattle, 1,000000.

Of the Timber yearly felled for Building 500000 *l.* Of the Wood yearly spent in Firing, *&c.* about 500,000 *l.* The Land of *England* to its Inhabitants is now about $7\frac{1}{4}$ Acres *per* Head. The Value of the Wheat, Rye and Barley necessary for the Sustenance of *England* amounts to at least 6,000000 of Pounds Sterling *per An.* The Value of the Woollen Manufacture made here is about 8,000000 *l. per Ann.* and our Exports of all Finds of the Wollen Manufacture do amount to above 2,000000 *l. per An.* The annual Income of *England* on which the whole People live and subsist, and out of which Taxes of all kinds are paid, is now since the War about 43,000000 *l.* That of *France* 81,000000, and that of *Holland* 18,250000 *l. &c,*

The Ingenious Capt. *Halley,* Geometry Professor in *Oxon,* hath made a very exact Estimate of the Degrees of the Mortality of Mankind, drawn from curious Tables of the Births and Burials at the City of *Breslaw,* the Capital of *Silesia,* with an Attempt to ascertain the Price of Annuities upon Lives from thence. This is Published in *Philos. Transf. N.* And in the *Miscellanea Curiosa,* Vol. I. From a Table which he hath there calculated he derives the following Uses. 1. To find the Proportion of Men able to bear Arms in any Multitude; which he reckons from 18 to 56 Years old; and accounts about $\frac{1}{4}$ of the whole. 2. To shew the differing Degrees of *Mortality* (or rather of *Vitality*) in all Ages; by which Means he finds the Odds there is, that any Person of any Age doth not die in a Year's Time, or before he attain such an Age. 3. To shew at what Number of Years, 'tis an even Lay that a Person of any Age shall die; and finds for Instance, that in an even Lay, that a Man of 30 Years of Age lives between 27 and 28 Years. 4. To regulate the Price of Insurance upon Lives: And, 5. The Valuation of Annuities on Lives. 6. How to value two or three Lives after the same Manner. And from the whole he makes two very good Observations. 1. How unjustly we complain of the Shortness of our Lives, for it appears, one Half of those that are born don't live above 17 Years. 2. That the Growth and Increase of Mankind is not so much stinted by any Thing in the Nature of the Species, as it is from the curious Difficulty most People make of venturing on the State of Marriage. And therefore Celibacy ought to be every Way discouraged by all wise Governments; and those who have numerous Families of Children, to be countenanced and encouraged by good Laws, (*i. e.*) such as the *Jus Trium Liberorum,* among the *Romans,* &c. See on this Subject also *Grant's Observations on the Bills of Mortality*; who reckons that there are 39000 square Miles of Land in *England.*

That in *England* and *Wales* there are 4600000 Souls.

That the People of *London* are about 640000; one fourteenth of the People of *England.*

That *England* and *Wales* are about 10,000 Parishes.

In *Dublin* (then) 30000 People.

That there are 25 Millions of Acres in *England* and *Wales, viz.* about 4 Acres to every Head.

That but 64 out of 100 of the Children born are living at 6 Years old.

That but 40 of 100 are alive at 16 Years End.
But 25 out of 100 at 26 Years End.
But 16 out of 100 at 36 Years End.
But 10 out of 100 at 46 Years End.
But 6 out of 100 at 56 Years End.
But 3 out of 100 at 60 Years End.
But 1 out of 100 at 76 Years End.

That *London* doubles itself in about 64 Years.

Sir *William Petty* also in his Discourse about *Duplicate Proportion,* tells us, that 'tis found by Experience, That there are more Persons living between 16 and 26 than of any other Age: And laying down that as a Supposition: He infers, *That the Square Roots of every Number of Mens Ages under* 16, (whose Root is 4) *shews the Proportion of the Probability of such Person's reaching the Age of* 70 *Years.* v. gr. 'Tis 4 Times more likely that one of 16 Years of Age lives to be 70, than a Child of 1 Year old. 'Tis thrice as probable, That one of 9 Years lives to 70, as such a new-born Child, *&c.*

That the Odds is 5 to 4, that one of 25 dies before one of 16 Years.

That 'tis 6 to 5 (still as the Square Roots of the Ages) that one of 36 Years old dies before one of but 25 Years of Age. And so on according to any declining Age to 70; compared with 4.6: Which is nearly the Root of 21, the Law Age.

The above-mentioned Mr. *Halley,* in his Observations on the *Breslaw* Bills of Mortality, saith; That 'tis 80 to 1, a Person of 25 Years of Age doth not die in a Year.

That 'tis 5 $\frac{1}{2}$ to one, a Man of 40 lives 7 Years; and that one of 30 may reasonably expect to live 27 or 28 Years.

And so great a Difference is there between the Life of Man at different Ages; that 'tis 100 to 1, one of 20 lives out a Year; and but 38 to 1, that one of 50 doth so. Whence, and from some other Observations, with great Pains he computed the following Table, shewing the Value of Annuities for every 5th Year of Life to the 70th.

*A* Table *of the Value of Annuities.*

| Age. | Years Purchase. |
|---|---|
| 1 | 10 . 28 |
| 5 | 13 . 40 |
| 10 | 13 . 44 |
| 15 | 13 . 33 |
| 20 | 12 . 78 |
| 25 | 12 . 27 |
| 30 | 11 . 72 |
| 35 | 11 . 12 |
| 40 | 10 . 57 |
| 45 | 9 . 91 |
| 50 | 9 . 21 |
| 55 | 8 . 51 |
| 60 | 7 . 60 |
| 65 | 6 . 54 |
| 70 | 5 . 32 |

POLLARDS, were formerly a kind of Spurious Coin uſed in *England*, but theſe, as alſo Crocards, Staldings, Eagles, Leaonies, and Steepings have been long ſince diſuſed. See *Matt. Weſt. in Anno.* 1299. *p.* 413. 2 *Inſt. fol.* 577. and *Plowden, fol.* 469.

PONTON: The late invented *Ponton* is a Boat of *Tin* or rather *Latten*, eight Yards long and two broad, having a large Ring at each Corner: When the Army marches it is laid on a Carriage, and drawn by five Horſes. Each Boat hath an *Anchor*, and *Cable*, and *Baulks*, and *Cheſts* belonging to it, The *Baulks* are ſeven Yards long and about five or ſix Inches ſquare: The *Cheſts* are Boards joined together by Wooden Bars about a Yard broad and four Yards long. When theſe *Pontons* are to be uſed, they are ſlipp'd into the Water, and placed about two Yards aſunder, having a ſtrong Rope running through the Rings, which is faſtened on each Side the River you would paſs over, to a Tree, Stake, *&c.* The Baulks or Beams are laid acroſs the Boats at a due Diſtance, and the Cheſts upon them; and theſe are joined cloſe to make a Bridge, over which Foot, Horſe, and even a Train of Artillery may paſs.

PORES. Sir *Iſ. Newton* in his *Opticks* ſhews, that Bodies are much more *rare* and porous than is commonly believed. Water is 19 times lighter and conſequently *rarer* than Gold; and Gold is ſo rare as very readily and without the laſt Oppoſition to tranſmit the Magnetick *Effluvia*, and eaſily to admit Quick-ſilver into its Pores, and to let Water paſs through it; for a Concave Sphere of Gold hath, when filled with Water and ſolder'd up, upon preſſing with great Force, let the Water ſqueeze through it, and ſtand all over its outſide in multitudes of ſmall Drops like Dew, without burſting or cracking the Gold, as he was informed by an Eye-witneſs. Whence we may conclude, that *Gold hath more Pores than ſolid Parts*, and by Conſequence, that *Water hath above* 40 *Times more Pores than Parts.* And he that ſhall find out an Hypotheſis to ſolve how Water can be thus *rare*, and yet not be capable of Compreſſion by Force, may doubtleſs by the ſame Hypotheſis make Gold and Water, and all other Bodies, as much rarer as he pleaſes.

So that Light may find a ready Paſſage thro' tranſparent Subſtances, there being open and free Space ſufficient for ſuch a Paſſage. We find that the Magnet tranſmits its Vertue without any ſenſible Diminution or Alteration, through all cold Bodies that are not Magnetick, as Gold, Silver, Braſs, Glaſs, Water, *&c.* The gravitating Power of the Sun (if you will explain it Mechanically) is tranſmitted entire through all the vaſt Planetary Bodies, ſo that with an equable Force it acts thro' all their Parts, even to their very Centres; *i.e.* according to the Quantity of Matter in each Part. The Rays of Light, let 'em be either Bodies actually coming to us from the Sun, or only Motions or Impreſſions upon the *Medium*, move in Right-Lines, and are hardly ever, unleſs by great Chance, reflected back again in the ſame Right-Line after their Impingence on Objects; and yet we ſee that Light is tranſmitted to the greateſt Diſtances thro' Pellucid Bodies, and that in Right-Lines. Now how Bodies ſhould have *Pores* ſufficient for theſe Effects is hard to conceive, but yet not impoſſible. For Sir *Iſ. Newton* hath ſhewn, That the Colours of all Bodies ariſe from their Particles being of ſuch a determinate Size or Magnitude: (See *Colours.*) Wherefore if we conceive thoſe Particles to be ſo diſpoſed, as that there is as much of Poroſity or Space interſperſed between them as the Quantity of theſe Particles amounts to. And in like Manner, if you ſuppoſe theſe Particles to be compoſed of others much leſs, and that theſe have as much interſperſed Vacuity as their Quantity amounts to; and ſo on till at laſt you come to ſolid Particles without any Pores: Then if in any Body there be 3 (for Inſtance) of theſe Sizes of Particles, and that the laſt be of the *ſolid* or leaſt Sort; that Body will have 7 Times as much Vacuity as Solid Matter. If you ſuppoſe 4 ſuch Degrees or Sizes of Particles, and that the laſt and leaſt be ſolid; the Body will have 15 Times as much *Pores* as *Solidity*. If you imagine any Body to have 5 ſuch Degrees or Sizes of Particles, it will have 31 Times as much Space as Solidity interſperſed: And if it have 6 ſuch Sizes of Particles as before, it will have 63 Times as much Vacuity as Solid Matter, and ſo on. And perhaps in the wonderful Confirmation and Fabrick of Natural Bodies there may be other Proportions of Space to Matter to us wholly unknown, whence 'tis poſſible there may be yet far greater Quantities of Vacuity interſperſed in Bodies.

PORTA or *Vena Portæ*: Dr. *Keil* in *Animal Secretion*, p. 36, 37, *&c.* thinks that he hath found out the true Uſe of this *Vein*, (of which you have a large Deſcription in Vol. I. under *Vena Portæ*) which is, that the Bile being to be mixed with the Chyle as it comes out of the Stomach into the *Duodenum*, could no where be ſo conveniently ſecerned from the Blood, as where the Liver is placed: But if all the Branches of the *Cæliack Artery* carried all the Blood to the Liver, from which the Gall was to be ſeparated; it is evident, conſidering the nearneſs of the Liver to the Heart, and the inteſtine Motion of the Blood, that ſo viſcid a Secretion as the Gall is, could never have been formed in the Blood, and conſequently could never have been ſecreted by any Gland in that Place. In this Caſe Nature is forced to alter her conſtant Method of ſending the Blood to all the Parts of the Body by the Arteries. Here ſhe forms a *Vein*, (which is no Branch of the *Cava*, as all the others are) and by it ſhe ſends the Blood from the Branches of the Meſenterick and Cæliack Arteries, (after it hath paſſed thro' all the Inteſtines, Stomach, Spleen, Call, and Pancreas) to the Liver. By this extraordinary Contrivance the Blood is brought a great way about before it arrives at the Liver; and its Celerity is extremely diminiſhed; ſo that all the Corpuſcles which are to form the Bile, may have ſufficient Time to attract one another, and unite before they come to the ſecerning Veſſel. And thus, ſaith he, have we found out the true Uſe of the *Porta*; which he confirms afterwards, by ſhewing what Nature doth further in Proſecution of the ſame Deſign; in increaſing the Cavities of all the Arteries as they divide, and that as the Trunk of the Meſenterick Artery bears a leſſer Proportion to its Branches than the *Aorta* does to its Branches; ſo the Branches of the Meſenterick Artery are likewiſe leſs in Proportion to their *Conjugate Veins* than the *Aorta* is to the *Vena Cava*. The deſcending Trunk of the *Aorta* below the Emulgents is to the *Vena Cava* at the ſame Place, as

as 324 is to 441. But a Branch of the *Meſenterick* Artery is to its correſponding Branch of the *Porta* as 9 to 25: And therefore the Blood in the Branches of the *Porta* moves above 177 Times Slower than it does in the Trunk of the *Meſenterick* Artery, and then only upon the Account of the Increaſe of the Diameters of the Veſſels. So neceſſary is it to abate the Rapid Inteſtine Motion of the Blood, which would otherwiſe hinder the Coaleſcence of the Particles for the Formation of the Ball.

PORTABLE *Barometer*. See *Barometer*.

PORTFIRE, is a Compoſition of Meal, Powder, Sulphur and Salt-Petre drove into a Caſe of Paper, but not very hard; 'tis about 9 or 10 Inches long, and is uſed to fire Guns and Mortars inſtead of Match.

PORTREVE, is the Title for the Chief Magiſtrate in ſome Sea-Coaſt Towns: And *Cambden* in his *Brit.* ſaith, the Chief Magiſtrate of *London* was ſo called in *William* the Conqueror's Time, as appears by a Charter of his to this City. In *Richard* the Firſt's Time, the City was governed by two Bailiffs appointed by the King; but preſently after King *John* granted them a Mayor for their yearly Magiſtrate.

PORTIFORIUM, was formerly an Enſign or Banner, which was provided in all Cathedral and moſt Parochial Churches, to be ſolemnly carried in the Front of any Proceſſion.

PORTMANNIMOTE, ſometimes hath been uſed for *Portmote*, which ſee.

PORTMOTE, is a Convention or Meeting of the Inhabitants of a Port or Burgh, in which ſome Cuſtomary Duties were anciently paid to the Lord of the Fee.

PORT-NAILS, are ſuch Nails as are uſed to faſten the Hinges to the Ports of Ships.

PORTOISE, aboard a Ship, is the ſame with *Portlaſt*, or the *Gunwale*; and as they ſay *the Yard is down a Portlaſt*, when it lies down on the Deck, ſo for a Ship to *ride a Portoiſe*, is to ride with her *Yards a Portlaſt*, or ſtruck down on the Deck.

PORTRAITS, is the Painters Word for Pictures of Men and Women (either Heads, or greater Lengths) drawn from the Life; and the Word is uſed to diſtinguiſh this kind of Face-Painting (as it is often called) from Hiſtory-Painting.

PORTSOKNE, the *Soke* or Liberties of any *Port*; *i. e.* City or Town.

POST, in the Art Military, is uſed for any ſort of Ground or Place, whether fortified or not, where a Body of Men can make a Stand, fortify themſelves, or be in a Condition to fight an Enemy; and therefore they ſay the *Poſt* was relieved, the *Poſt* was quitted, the *Poſt* was taken Sword in Hand, *&c.* A Spot of Ground ſeized by a Party to ſecure the Front of an Army and to cover the Poſts that are behind, they call an *Advanced Poſt*: And the *Advance Guard* or the *Right* of the 2 Lines of an Army, *&c.* they call the *Poſt of Honour*.

POSTNATI, are ſuch as were born in *Scotland* after the Deſcent of that Crown to K. *James* I. And it was reſolved in the 7th Year of that King's Reign by all the Judges, that ſuch Perſons *are no Aliens* in *England*. But the *Ante-Nati* or ſuch as were born in *Scotland* before that Time, were Aliens as to the Time of their Birth.

POUND, *Libra*, contains 12 Ounces; and tho' now it ſignify 20 *s.* when applied to Money, which is but the 3d part of a Pound in Weight, yet it is becauſe 20 *s.* did heretofore (with us) weigh a full Pound Troy or 12 Ounces, each of theſe Ounces contained ſo many *Solidi* or Shillings, and ſo many *Denarii* or Pence, as they who govern'd the Money Matters thought fit, ſometimes more, ſometimes fewer. The old Saxon Pound did contain 48 Shillings, and each Shilling contained 5 *d.* ſo that the *Libra Anglo-Saxonica* contained 240 *d.* When the Pound was reduced 'tis hard to tell exactly, but in *W.* the Conqueror's time it contained 20 *s.* ſometimes the Pound was compoſed of 12 Ounces or *Oræ*, and then the *Ora* was 20 *d.* and ſometimes of 15 Ounces or *Oræ*, and then the *Ora* was 16 *d.* But tho' either of theſe may be taken for the *Shilling*, yet generally it was 20 *d.* and this was the Value of the Ounce in the *Libra Denariorum* and the *Libra Sterlingorum*, which are the ſame. See *Chro. Preſcioſum*.

POWER *of the County*, See *Poſſe Comitatus* in Vol. 1.

POWERS *Mechanick*, of theſe there are 5 uſually accounted, the *Lever*, the *Balance*, the *Wedge*, or inclined *Plane*, *Screew* and the *Pulley*. About theſe Powers (the Nature of which you will ſee under thoſe Words, or the *Latin* Names) there are ſome Univerſal Laws agreed on, which it would be well for Mechanicks, Engine-Makers, *&c.* to have in Readineſs in their Minds, leſt ſome ſuch impoſſible Whims as the *Perpetual Motion*, &c. ſhould get Poſſeſſion of their Heads.

## RULE I.

*The Moving Forces or Powers are to the Weight to be moved, reciprocally, as the Space paſſed by the Weight, is to that paſſed by the Power.*

Thus in the Windlace *Axis in Peritrochio*, &c. the Circle or Part of ſuch a Periphery, which the Power moves, is to the Periphery of the Axis of the Cylinder reciprocally as the Weight to the Power.

And in Pulleys 'tis plain that the Ropes are ſhortened in Proportion to the Elevation of the Weights.

## RULE II.

*The Power or moving Force, and the Weight are reciprocally proportional to their Velocities.*

## RULE III.

*The ſame Force which can lift (ex. gr.) 100 lb. the height of 2 Feet; will raiſe 200 lb. the height but of one Foot.*

PRAGMATICK *Sanction*, is a Term in the Civil Law for a Letter written to a Corporation, or any Publick Body, by the Emperour, in anſwer to their Requeſt to enquire or know the Law of him. But if this Letter be ſent only to particular Perſons who have conſulted him in the like Caſe, 'tis called a *Reſcript*.

PRÆAMBLE, *Proœmium*, in the Law-ſenſe, is the Beginning of an Act of Parliament, *&c.* and as it were a Key, to open the Intent of the Makers of the Acts, and the Miſchiefs deſign'd to be prevented or remedied by the ſame.

PRÆBEND. See *Prebend*, in Vol. 1.

PRÆMUNIENTES, are Writs ſent to every particular Biſhop to come to Parliament, *Præmunientes, or warning him to bring with him the Deans and Arch-Deacons within his Dioceſs, one Prælor for each Chapter, and two for the Clergy of his Dioceſs.*

PRE-

PRECARIA, the ſame which *Bedrep*, *Binddagg* or *bidendag*, a days Work; which the Tenants of ſome Manners are bound by their Tenure to do for their Lord in Harveſt. See the great Book of the Cuſtoms of the Abbey of *Battel*, Tit. *Apeldarham*. fol. 60.

PRECEPTORIE, or *Commanderie*. As the larger Monaſteries had formerly their remote Country Cells which were Subordinate to the Mother-houſe of Religion; ſo the Knights Templars and Hoſpitalars ſent part of their Fraternity to ſome country Cell, which was govern'd by a Perſon whom they called a *Præceptor* or *Commander*: And thence the Place was called a *Præceptorie* or *Commandrie*: and all theſe were Subject to the Prime Body, who had their Principal Seats in *London*. *Kennet's Paroch. Antiqu.* Sixteen of theſe Præceptories we have the Names of; *viz. Creſſing Temple*, *Balſhall*, *Shengay*, *Newland*, *Yevely*, *Witham*, *Temple-Brue*, *Wallington*, *Rothely*, *Ovennington*, *Temple-Combe*, *Trebigh*, *Ribſtan*, *Mount* St. *John*, *Temple-New-Sum*, *and Temple-Church*.

PRECIPE *quod Reddat*, is a Writ of a great Diverſity both in its form and uſe: For which See *Ingreſſus* and *Entry*. This form is extended as well to a *Writ of Right* as to other Writs of *Entry* or Poſſeſſion. Tis called ſometimes a *Writ of Right Cloſe* as a

PRECIPE *in Capite*, where it iſſueth for the Tenants holding of the King in Chief as of his Crown, and not of him, as of any Honour, Caſtle or Mannor. Sometimes alſo 'tis called *a Writ of Right Patent*, as when it iſſues out of the Chancery *Patent*; i. e. open to any Lords Court for any of his Tenants deforc'd againſt the Deforcer, and muſt be determined there.

PRECONTRACT, is a Contract (uſually underſtood of Marriage) which was made before another Contract, and conſequently as far as 'tis contrary to and inconſiſtent with, annuls the latter.

PRE-EMPTION, was formerly allowed to the Crowns Purveyor, to have the firſt buying of all Corn, other Proviſions, *&c.* before others. See 12 Car. c. 24.

PRE-FINE, (in Law) is that Fine which is paid on Suing out the *Writ of Covenant*.

PREMUNIRE. See PRÆMUNIRE.

PREPOSITUS *Viuæ*, ſome will have to be the Conſtable of a Town, or Petit Conſtable. Tis alſo ſometimes uſed for a *Reeve*: For others ſay in our Old Records, it ſignifies the *Reeve* or *Bailiff* of the Lord of the Mannor who is ſometimes called *Serviens Villæ*. But by the Laws of K. *Henry*. I. the Lord anſwered for the Town where he was Reſident: Where he was not preſent his Deputy or Seneſchal was reſponſible if he were a Baron. But if neither of them could be preſent, then the *Præpoſitus & quatuor de unaquq; villa*, the *Reeve* and 4 of the moſt Subſtantial Inhabitants were Summoned in.

PRESBYTERIUM, the *Presbytery*; The Choir or Chancel of a Church; ſo called becauſe that Place was appropriated to the Biſhops and Prieſts; and other Clergy, while the Laity were confined to the *Nave* and Body of the Church, *Cowel's Interpreter*.

PRESIDENT, in a Legal Senſe, is the Crowns Lieutenant in a Province or Function: As the preſident of *Wales*, *York*, *Berwick*; of the King's Council, *&c.*

PRESSURE; by this Word ſome Philoſophers, addicted to the Carteſian Hypotheſis, mean a kind of *Motion which is impreſſed upon and propagated through a Fluid Medium*. And by this they would explain all the Phænomena of Light and Colours, as well as of many other Effects; by certain new *Modifications* which do there happen to the *Rays* of Light, as they are uſually called. But as our Excellent Sir *Iſ. Newton* ſhews, (p. 307 of the Latin Edition of his Opticks) this is a Miſtake.

For if Light (for Inſtance) conſiſted only in *Preſſure*, propagated without Actual Motion, it could not therefore agitate and warm ſuch Bodies as Reflect and Refract it: And if it conſiſted in an *Inſtantaneous Motion*, or one propagated to all Diſtances in an Inſtant; as ſome have advanced; there would be required an Infinite *vis* or Force, to produce that Motion, every Moment, in every Lucent Particle. And if Light conſiſted either in *Preſſure*, or in Motion propagated in a *Fluid Medium*, whether inſtantaneouſly or in Time, it muſt from thence come to paſs, that it ſhould inflect itſelf *in umbram*. For *Preſſure* or Motion in a *Fluid Medium* cannot be propagated in *Right Lines*, beyond any Obſtacle which ſhall hinder any Part of the Motion; but will inflect and diffuſe it ſelf every Way into thoſe Parts of the Quieſcent Medium which lie beyond the ſaid Obſtacle.

Thus the Force of Gravity tends downward, but the *Preſſure*, which ariſes from that Force of Gravity tends every Way with an Equable Force: And with equal Eaſe and Force, is propagated in Crooked Lines as in Straight. Waves on the Surface of Water while they ſlide by the Sides of any Large Obſtacle, do inflect, dilate and diffuſe themſelves by Degrees, into the Quieſcent Water lying beyond the Obſtacle. The Waves, Pulſes, or Vibrations of our Air in which Sounds conſiſt, do manifeſtly inflect themſelves, tho' not ſo much as the Waves of Water; for the Sound of a Bell or of a Cannon, can be heard over a Hill, which intercepts the Sonorous Object from our Sight: And Sounds will be propagated as eaſily thro' *Crooked Tubes*, as thro' *Straight*: But Light is never obſerved to go in *Curve Lines* nor to inflect it ſelf *in Umbram*. For the fixed Stars do immediately diſappear on the Interpoſition of any of the Planets, as well as ſome Parts of the Suns Body, by the Interpoſition of the *Moon*, *Venus* or *Mercury*.

PREST *Money*, from the French *Preſt*, *ready*; is Money given to Soldiers when they are *Preſt*: And binds ſuch as receive it to be *ready* at Command at all Times appointed by their Officers.

PREST *Sail*: A Ship at Sea is ſaid to *carry a Preſt Sail*, when ſhe carries all that ſhe can poſſibly Croud: Which is ſometimes done in giving Chaſe to an Enemy: But 'tis a dangerous Experiment and ought not to be tryed often, leſt a Ship ſhould over-ſet, or bring her Maſts by the Board, in which latter Caſe ſhe will become a Prey to the Enemy.

PRESTATION *Money*, was according to ſome, a Sum of Money paid by the Arch-Deacons to the Biſhops annually *pro Exteriori Juriſdictione*: But others ſay it was a *Subſidium Charitativum*, which in reaſonable Cauſes a Biſhop might require of his Clergy.

PRETENSED *Right* or *Title*: *Jus Prætenſum*; where one is in Poſſeſſion of Lands or Tenements, and another who is out, claims it and ſues for it. Here the *Pretenſed* Right or Title, is ſaid to be in him who doth thus Claim or Sue.

PREVA-

PREVARICATION, In the Civil Law, is where an Informer colludes with the Defendant, and ſo makes only a feigned Proſecution.

PREVENTER *Rope*, in a Ship, is a ſmall Rope uſed to ſecure the Ties, ſo that if one Part ſhould break, the other may not run thro' the Ram-head. See *Ropes* in Vol. I.

PRICK-*Poſts*, in a Building, are ſuch as are framed into the *Breaſt-Summers* between the principal Poſts for ſtrengthning the Carcaſe of the Houſe.

PRIDIAL *Services*. See Services.

PRIMAGE, is a Duty due to the Mariners and Sailors for the loading of any Ship at the ſetting forth from any Haven. *Anno* 32. *H.* 8. *c.* 14. which in ſome Places is a Penny in the Pound: In others Sixpence for every Pack or Bayl, *&c.* according to the Cuſtom of the Place.

PRIMES, are the firſt larger Diviſions of the ſingle Number on *Gunter's* Line of Proportion, whoſe next Subdiviſions are called Tenths, *&c.* See *Line of Proportion.*

PRIMÆ VIÆ. See *Viæ Primæ.*

PRIMITIÆ, *Firſt-Fruits*: In our Law, the Profits, after Avoidance, of every ſpiritual Living as rated in the King's Books, for one Year.

PRINCIPAL *Poſts*, in any wooden Building, are the Corner Poſts, which are tennanted into the Ground Plates below, and the raiſing Plates above, *i. e.* into the Beams of the Roof.

PRINTING. There is a Diſpute between the Towns of *Harlem* in *Holland*, and *Mentz* in *Germany*, about the Invention of this noble Art.

The *Harlemers* ſay, that *Laurenzs Janzs Koſter* of *Harlem*, was the firſt Inventer of *Printing*, *A. D.* 1430. But that at firſt he uſed only wooden Blocks or Plates, (like thoſe uſed in *China* and ſome other Eaſtern Countries, where that kind of Printing hath been much longer in Uſe, and perhaps gave the firſt Hint to our Manner of Printing now in Uſe;) tho' after ſome Time he left thoſe off, and cut ſingle Letters in Steel, which he ſunk into Copper *Matrices*, and fitting them into Iron Molds, caſt ſingle Letters of Metal in theſe *Matrices*.

They ſay alſo, that his Companion *John Guttenburgh* ſtole his Tools away while he was at *Church*, and with them went to *Mentz* in *Germany*; where ſetting his ſtolen Inſtruments to work, he claim'd the firſt Invention of this Art before *Koſter* did his.

To prove this, they ſay that one *Rabbi Joſeph*, a Jew, in his Chronicle, mentions a printed Book that he ſaw at *Venice* in the Year 5288, according to the Jewiſh Account, and of ours, 1428, as may be ſeen in *Pet. Scriverius*.

But notwithſtanding all this, and alſo what they ſay further of a Book entituled *De Spiegel*, which they ſhew printed at *Harlem* in *Dutch* and *Latin*, tho' without Date; but they pretend it to be the firſt that ever was printed: Notwithſtanding this, ſays *Moxon*, *Guttenburgh* of *Mentz* is more generally taken for the Inventer of Printing, than *Koſter* of *Harlem*.

Dr. *Wallis* ſaith, this *Art* was firſt invented about the Year 1460, and was practiſed in *Germany* immediately, but whether firſt at *Mentz* or *Harlem*, he determines not. He ſaith the Book which bears the Repute of being the firſt that ever was printed, is *Tully's Offices*; which was printed in the Year 1465 or 1466; for the Copy of it in the *Bodleian* Library in *Oxon*, diſagrees a Year with that in the Library of *C. C.* College there. In that Book in the *Bodleian* Library, is a Note written which mentions one *Johannes Fauſtus*, as Coadjutor to *Guttenburgh*, as alſo *Peter Scheffer*, on the ſame Account; and this *Scheffer*, *Joh. Arnoldus in Libello de Chalcographiæ Inventione*, makes the Inventer of the *Matrices*. Theſe three work'd together a while, and then parted.

There is alſo another Note written in a later Hand, in the ſaid Book, which refers the firſt Invention of *Printing* to the Year 1453; but moſt to the Year above-mentioned by Dr. *Wallis*, *viz.* 1460.

Next to theſe two Places of *Mentz* and *Harlem*, it ſeems to have been practiſed firſt at our Univerſity of *Oxon* in *England*: For K. *H.* 6. and *Thomas Bouchier*, then *A. B.* of *Canterbury*, ſent *Wm. Turner*, Maſter of the Robe, and *Wm. Caxton*, Merchant of *London*, over to *Harlem* to learn this Art, who privately prevailed with one *Frederic Corſeles*, (an Under Workman) for a Sum of Money to come over hither; who did ſo, and at *Oxford* ſet up the Art of Printing, before it was uſed any where elſe, except in *Mentz* and *Harlem*. And there is a Treatiſe, ſaid to be of S. *Jerom*, (becauſe found in his Works) but in Reality of *Ruffinus* on the Creed, printed at *Oxon* in a broad Octavo, in the Year 1468, which is but 3 Years after the Edition of *Tully's Offices* at *Mentz*; and perhaps is one of the firſt Books printed on Paper, for that of *Tully* was on Vellum. Soon after this, *Caxton* (who firſt brought it, as is ſuppoſed, to *Oxford*) promoted it to *London*; which *Baker* in his Chronicle ſaith was about 1471: But *Moxon* in his Art of Printing ſaith, he had not ſeen any Books printed at *London* before 1480; about which Time it was received in *Italy*, *Germany*, *&c.*

In *Philoſ. Tranſactions*, *N.* 288, and 310, there is this further Account of the Riſe and Progreſs of the Art of Printing.

*Boxhornius Schrevelius*, and other Authors ſay, That *Koſter* could not, nor did he in Fact print ſo large a Book as the *Speculum Salutis*, without gradual Improvements; and his firſt Eſſays were on ſmall and looſe Leaves of Paper before he attempted whole Books.

In the *Bodleian* Library at *Oxford*, are two Books, and in that of *Bennet Coll.* in *Cambridge* is another very ancient printed Book, printed only on one Side of the Paper; the whole wrought, or caſt on Wood, nor ſet or compoſed with Printing Letter, and printed with Writing-Ink; which do ſufficiently ſhew that they were done when this Art was in its Infancy, and are very probably the Work of *Koſter*; but they are without Date or Printer's Name.

*Koſter* had an Aſſiſtant whoſe Name was *John Fuſt*, or as ſome write him *Fauſt* or *Fauſtus*; from whom he took an Oath of Secrecy, as *Schrevelius* tells us, but *Fuſt* ran away with *Koſter*'s Tools and Materials, and in ſome time ſet up a *Printing-Preſs* at *Mentz*, where he was aſſiſted by his Servant *John Scheffer*, a young Man of a good Genius, and who afterwards married his Daughter, and became his Partner. They tell a Story alſo of *Fuſt*'s going to *Paris*, but whether before or after he ſettled at *Mentz*, is uncertain, and offering there a great number of printed Bibles to Sale, as if they were Manuſcripts: But the *French* conſidering the Number of theſe Books, and their exact Conformity one to another throughout the whole, to a Line, a Word, a Letter, nay even to a Point, and that the beſt of Book-writers could not be thus exact, forc'd the Secret out of

him, by either actually indicting him for a *Magician*, or threatning him at leaſt ſo to do; and this 'tis ſaid gave Riſe to the Story of Dr. *Fauſtus*.

And 'tis probable about this Time many printed Books were ſold up and down for *Manuſcripts*.

'Tis not certain in what Year *Fuſt* and *Scheffer* began firſt to work at *Mentz*. But *Schrevelius* ſaith, *Fauſtus* (as he calls him) printed *Alexandri Doctrinale cum Petri Hiſpani Tractatibus, A. D.* 1442. And *Lambetius in Comment. de Biblioth. Cæſ. Lib.* 2. *p.* 988. ſaith, that he brought from *Inſpruck* to the Imperial Library at *Vienna*, a *Pſalter* printed on Parchment by *Fuſt* and *Scheffer*, 1457. And ſoon after this Date many Books were printed, which are ſtill in Being: as the *Durandus* in the Library of *Baſil*, printed 1458. *Johannis Johannenſis Catholicon*, in his Majeſty's Library, printed 1460. The Latin Bible of 1462 in the *French King's* Library, all before the *Tully's Offices* abovementioned; which was not printed till 1465 or 1466. The firſt Book printed here in *England*, was the *Ruffinus*, printed at *Oxford* 1468, as was ſaid before. But they practiſed the Art earlier in other Countries; and in particular, it was uſed at *Rome* in the Palace of *Maximi*, *A. D.* 1455, by *Conrad. Sweynheim*, and *Arnold Pannartz*, both *Germans*, and who continued Printers there many Years after, as *Martellinus* in his *Romæ Sacræ* affirms.

Some think that Paper, (made of Linnen Rags) was firſt made at *Baſil*, by ſome Greeks, who fled out of their Country after *Conſtantinople* was ſackt, *A. D.* 1452; and this in Imitation of the Cotton Paper uſed in the *Levant*. Certain it is the Cotton Paper hath been of very ancient uſe in the Eaſt; there being in the Bodleian Library an Arabick Manuſcript (among thoſe the Univerſity bought of Dr. *Huntingdon*) written in the 427th year of the *Hegira*, which is *A. D.* 1049, on this Paper; and ſome there are without Dates, which ſeem older.

And as for the Linnen-Rag-Paper, it muſt be much older than 1452; for in the Archives of the Library of the Dean and Chapter of *Canterbury*, there is an Inventory, on our Paper, of the Goods of *Henry Prior* of *Chriſt's Church* there, that is in the 20th Year of *Edw.* 3. which is *A. D.* 1346. and in the *Cotton Library* are ſeveral Writings, on our Paper, as high at leaſt as the 15th of *Edw.* 3.

Some think the *Rolling-Preſs* was invented by *Lipſius*; but there is a printed Book in the Bodleian Library, (placed *Laud. p.* 138.) being a *Miſſale ſecundum uſum Eccleſ. Herbipolenſis*, (i. e. *Wurtzburgh*) in *Germany*. At the Beginning of this Book is an Inſtrument of *Rodulfus* the *A. B.* of this Church, containing the Reaſons of the Publication of this *Miſſale*, and inſtead of a *Seal*, there is annexed a Print engraven of the Arms of the See, &c. very finely done (for that Time, for 'twas before *Durer*) and on which are evident Marks of the *Preſſure* by the *Plate*, with ſome Touches of Ink at the Edges, &c. which all that have ſeen it judge to be plain Marks of its being done or wrought off in a *Rolling-Preſs*. And there are ſufficient Reaſons to prove that this Book is as ancient as 1481.

Mr. *Bagford* thinks we had not the firſt Hint of Printing from the Chineſes, of whom we had no Knowledge hardly, when this Art was invented: But rather from *Old Medals*, *Seals*, &c. and the Letters on them. But if it be certain, as it ſeems to be, that Cards are as old as *H.* 6. nothing ſeems to give a better Hint to the Invention of Printing than Card-making, as is evident by the firſt Specimen of *Printing* at *Harlem*; and by thoſe Books above-mentioned in the Bodleian Library, and that of *Bennet-College* in *Cambridge*.

The cutting of the Molds or Blocks for making our Playing Cards, is after the ſame Manner as that of the old Books firſt printed at *Harlem*. They lay a Sheet of wet or moiſt Paper on the Form or Block, being firſt lightly bruſhed over with Ink made of *Lamp-Black* mixt with Starch and Water. Then they rub it off with a round Liſt with their Hand, which is done with great Expedition. They colour the Court Cards by the help of ſeveral Patterns or *Stanefiles*, as they call them; being Card-Paper cut thro' with a Penknife for every Colour, as *Red*, &c. (for at the firſt Printing, the Card hath only a meer Out-line.) Theſe Patterns are painted with Oil-Colours to keep them from wearing out by the Bruſhes; for they lay it upon the Picture, and by ſliding a Bruſh that is full and looſe over the Pattern, it fixes the Colour into the cut Holes, and leaves it on the Print that is to be a Card; and ſo they go thro' with all the Colours on the Cards: This very probably was the Way of their firſt printing at *Harlem*, as might have been diſcovered before this, if they had conſider'd that the *Great Letters* in our old *MSS.* (of 900 Years old) are done by the Illuminators, after this of *Card-making*.

The next Form of Printing in *Harlem* was by cutting whole Forms in Wood from *MSS.* exactly written, and without Pictures. Such perhaps was the *Donatus*, which might bear Date about 1450; ſome ſay, 1440. This appears plain, ſaith Mr. *Bagford*, from Copy Books which we have ſeen printed at *Rome*, *Venice*, *Switzerland*, and *England*, as high as 1500.

The third way of Printing was with *ſingle Types* made of Wood; but who invented this is not known; it was at firſt eſteemed ſo great a Rarity, that the Printers carried about their Letters in Bags at their Backs, and got Money at great Mens Houſes by printing the Names of the Family, Epitaphs, Songs, and other ſmall Pamphlets.

The fourth Improvement of this noble Art was the Invention of *Single Types* made of Metal: which is owing to *Peter Scheffer*, above-mentioned, firſt Servant, and then Son-in-law to *Fauſtus*, who work'd at *Mentz*. Sometimes you have the Names of theſe two Men printed at the End of their Books, and ſometimes not; ſometimes with *Dates* as high as the Year 1457, and as low as 1490.

As for *John Guttenburgh*, who by many Authors is ſaid to be the firſt Inventor of Printing, we cannot find one Book with his Name and Printing.

As the firſt *Harlem* Printing was only a Book with Pictures, and the Impreſſion taken off with a Liſt coiled up, as our Card-makers do now uſe; ſo when they came to uſe *ſingle Types*, they made uſe of ſtronger Paper, with Vellum and Parchment, and then the *Preſs* was firſt uſed; tho' afterwards much improved; as was their *Printing-Ink*.

*Rolling-Preſs-Printing* was not uſed in *England* till K. *James* I. and then brought hither from *Antwerp* by our induſtrious *John Speed*.

As to the Art or Practice of *Printing* it ſelf, 'tis ſo uſeful to the Common-wealth of Learning, to have it better underſtood by Authors and Editors of Books than it uſually is, that I ſhall here give a full

a full but ſuccinct Account of the whole Matter from Mr. *Moxon*'s Mechanick Exerciſes of Printing; and from what I could collect from my own Obſervation, or get by Information.

The principal Officer in this Affair is called the *Maſter Printer*: Who contrives or finds a Room or Rooms, for ſetting up what they call a *Printing Houſe*; or who furniſhes a *proper Place*, with all Tools and Inſtruments uſed in Printing.

And firſt he muſt conſider what Number of *Preſſes* and *Caſes* he ſhall want that his Room may be proportionate to his Number. They uſually allow about 7 Foot ſquare on the Floor, for each *Preſs*: And for every *Frame* of *Caſes*, which holds 2 pair of *Caſes*, *viz.* a pair of *Roman* and a pair of *Italick*, five Foot $\frac{1}{2}$ in Length and $4\frac{1}{2}$ in Breadth; tho' they contain but 2 Foot and 9 Inches: But then Room enough will be left to paſs freely between the Frames.

The *Caſes*, muſt be ſo placed that the Light may fall to the left Hand of the *Compoſitor*; or elſe his Hand will interpoſe between the Light and his Eyes, and ſo ſhadow or obſcure the Letter he is to take up.

The *Preſſes* alſo muſt be ſo placed as that the Light may fall from a Window right before the *Form* and *Tympan*.

The *Correcting Stone*, or *Stones* muſt alſo ſtand againſt a good Light; and as near as can be in the Middle of the Room, if there be but one, that the ſeveral *Compoſitors*, may come the better to it.

In ſome Corner of the Room with a Sink under it, muſt the *Lee Trough* and *Rinſing Trough* be placed; or in ſome other Place if there be Room enough.

The *Diſtributing Frame*, ſtands alſo pretty near the Middle of the Room; and round about the Sides *Neſt Frames* may be placed to hold the *Caſes*, that lie out of preſent Uſe; and the *Letter Boards*, with *Forms* ſet on them; that both the *Caſes* and the *Forms*, may be the better ſecured from running to *Pye*.

Having thus contrived his Room or Rooms to the beſt Advantage; it is to be next furniſhed with its proper Materials as *Letter*, *Caſes*, *Preſſes*, *Chaſes*, *&c.* of which next in Order.

### Of *Letter*.

The Printer muſt be provided with a good *Fount* as they call it, or *Found* of *Letter*, and of all *Bodies*: For moſt Printing Houſes have all theſe that Fellow, except the two firſt: And the *Dutch* (and I believe the *French* of late) have ſeveral other *Bodies*, and we have one more, which is ſometimes uſed in *England* which they call a *Small Pica*: But this differs but little from the *Pica*.

Theſe *Bodies*, are commonly *caſt* with a *Roman*, *Italick*, and ſometimes an *Engliſh Face*: But the Printer hath alſo ſome Bodies with *Hebrew*, *Syriack*, *Greek*, and with the Muſick Face: As alſo Characters Mathematical, Chymical, Algebraical, *&c.* The following Table ſhews the Names and *Sizes* of theſe ſeveral *Bodies*: Or what Number of each Body is contained in a Foot.

| | | |
|---|---|---|
| *Pearl* | 148 | contain'd in a Foot. |
| *Nompareil* | 150 | |
| *Brevier* | 112 | |
| *Long Primer* | 92 | |
| *Pica* | 75 | |
| *Engliſh* | 66 | |
| *Great Primer* | 50 | |
| *Double Pica* | 38 | |
| *Two Lined Engliſh* | 33 | |
| *Great Cannon* | $17\frac{1}{2}$ | |

In the Choice of his *Letter*, a Printer hath great Scope to ſhew his Judgment and Skill as to their Shape, *&c.* and I think in the whole, the Preference muſt be given to the *Dutch Types* or *Letters*: But be their Shape what it will, the Letters muſt be deep cut, that they may print clear, laſt longer, and be leſs ſubject to entertain *Picks*. They muſt alſo be deep ſunk in the *Matrices*, leſt the Bottom Line of a Page ſhould *Beard*; and the *Beard* muſt alſo be well cut off by the *Letter Founder*.

There muſt be provided alſo *Braſs Rules* of about 16 Inches long; for the *Compoſitor* to cut into ſuch Lengths as his Work requires: Theſe *Rules* muſt be exactly *Letter high*; for if they are much to high they cut thro' the Paper, Tympans, and Blankets: And if but a little ſo, their *Shoulder* or *Beard* will *print black*; and they will alſo bear the *Platten* off the *Letters* that ſtand near them, ſo that thoſe *Letters* will not Print at all; and if they be too *Low*, then the *Rules* themſelves will not Print. Theſe Rules muſt alſo be ſtraight all their whole Length: Their Edges of equal Breadth and neither too thick nor too thin: and the *Braſs* ſhould be very well *Planiſhed*, that it may be Stiff and Strong.

### Of *Caſes*.

What they call a pair of *Caſes* is an *Upper* and a *Lower one*: They are uſually both of equal Length, Breadth and Depth: *viz.* 2 Foot 9 Inches long, one Foot 4 Inches $\frac{1}{2}$ broad, and about one Inch $\frac{1}{4}$ deep beſides the bottom Board. Theſe *Caſes* are encompaſſed about with a *Frame* about $\frac{3}{4}$ of an Inch broad; that the Ends of the ſeveral Partitions may be let into the Subſtance of the Frame: but the hithermoſt Side of the Frame is about $\frac{1}{2}$ Inch higher than the other Sides, that when either the *Galley*, or another pair of Caſes are ſet upon them, the Bottom edge of the *Galley*, or of theſe *Caſes* may ſtop againſt that higher Frame and not ſlide off. Both *upper* and *Lower Caſe* have a thick Partition about $\frac{3}{4}$ of an Inch broad; but the Diviſions for the ſeveral *Boxes* of the *Upper* and *Lower Caſes* are not alike: For each half of the length of the *Upper Caſe* is divided into 7 equal Parts, and its Breadth into 7 alſo; ſo that the whole makes 49 Boxes. But the 2 half Lengths of the Lower Caſe are divided each into 8 equal Parts, and its Breadth into 7: And yet not throughout ſo neither, but the Lower Caſe hath 4 ſeveral Sizes of Boxes.

Theſe *Caſes* ſhould be placed in good ſubſtantial *Frames*; which ſhould be ſo placed with an *eaſy Declivity*, that the *Compoſitor* may the better ſee and come at his Letters.

### Of the *Galley*.

Theſe *Galleys* are of different Sizes according to the Page to be compoſed. They are commonly made of 2 Flat wainſcot Boards each of $\frac{1}{4}$ or $\frac{1}{8}$ of an Inch in Thickneſs: The uppermoſt to ſlide in Grooves of the Frame cloſe down to the undermoſt. The 3 Sides of the Frame are fixed faſt and ſquare down on the upper Plain of the undermoſt Board, to ſtand about $\frac{1}{5}$ of the height of the Letter above the Superficies of the *Slice*.

The Sides of the Frame muſt be broad enough to admit of a pretty many good ſtrong *Oaken Pins* along the Sides, to be drove hard into the bottom Board, and almoſt quite through the Sides of the Frame, that the Frame may be firmly fixt to it; but

but they must not be *glewed*; because the Compositor may have sometimes Occasion to wet the *Page* in the *Galley*.

### Of the *Correcting Stone*.

This Stone is made of *Marble*, *Purbeck*, or any other Stone that may be made flat and smooth: It should be capacious enough to hold two Chases or more; that the *Compositor* on Occasion, may set some Pages by on it ready to *Impose*, tho' two Chases lie on the Stone: So that it may be about 2 Foot broad and $4\frac{1}{2}$ Feet long. It must be placed on a strong Frame like a Table about 3 Foot one Inch from the Ground or Floor.

### Of *Letter Boards* and *Paper Boards*.

*Letter Boards*, are to lay the Letters on, and are oblong Squares; about 2 Foot long, 18 Inch. broad and 1 an $\frac{1}{4}$ Inch thick: These should be made strong, and clampt on the under side within about 4 Inches of either End with Pieces of about 2 Inches square as well to keep them from warping, as that the *Compositors* may easily take them to remove them. *Paper Boards* are only to set Heaps of *Paper* on, and to press the *Paper* with.

### *Of Furniture*, Such as

*Head-sticks*, &c. must be made of dry Wainscot that they may not shrink when the Form stand by; they are Quadrate High, Straight, and of an even Thickness all their Length: and both these and *Side-sticks* are called *Riglet*, if they are not above an Inch in Thickness.

*Side-sticks*, and *Foot-sticks*, are of the same height with the *Head-sticks*; the latter serving to determine the Breadth, at Bottom and Top; as the *Side-sticks* do the length of each *Page*.

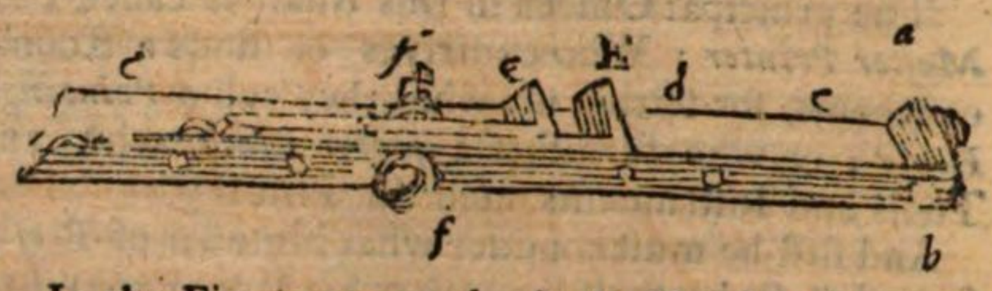
*Gutter-sticks*, are used to set *between Pages*, on either Side the Crosses, as in $8^{vos}$. $12^{mos}$. $16^{mos}$. and Forms upwards.

There are *Quoins* also used to lock up the *Forms*, or wedge them so close together (with a *Mallet* and *Shooting-stick*) both on the Sides and Head and Foot of the *Page*, that every *Letter* bearing hard against every other *Letter*, the whole *Form* may *Rise*, as you will see hereafter. The *Shooting-stick*, should be of Box, and is of a wedge-like Shape and of about 6 Inches long.

There is also a *Dressing-block*, usually made of Pear Tree, about 3 Inches square and an Inch high; its use is by being run over the Face of the *Form*, and gently knockt there with the Head of the *Shooting-stick*, to press down such Letters, as may happen to stand higher than the rest.

### Of the *Composing Stick*.

This is made of a thin Iron Plate, about 10 Inches long and doubled up square so as that the bottom may be $\frac{1}{2}$ Inch and $\frac{1}{8}$ broad, and the Back about an entire Inch broad. At the further End of the Iron Plate so doubled up, is soldered on an Iron Head which must stand square to the Bottom, about the thickness of a *Long-Primmer*: But all its outer Edges are basil'd and filed away into a moulding. About 2 Inches from this Head and in the Bottom, is begun a Row of round Holes about an Inch asunder to receive the Shank of the *Male Screw*, that Screws the *sliding Measures* fast down to the Bottom: So as these sliding Measures may be set nearer or further from the Head, as the measure of the *Page* requires.




In the Figure annexed *a* is the Head of the *Composing Stick*, *bb* the Bottom, *cc* the Back, *d* the Lower *Sliding Measure* or Check, *e* the Upper *Sliding Measure* or Check, *ff* the *Male Screw*, *g* the *Female Screw*.

The *Lower sliding Measure* is a pretty thick Iron Plate, as broad as the Inside of the Bottom; about 4 Inches in length: And in its Middle is a Groove, quite thro' it, within about half an Inch of each End, to receive the Shank of the Screw.

On the fore End of this Plate stands square another Iron Head about a *Brevier* thick, and reaching as high as the Top of the Back. The *Upper sliding Measure* is made just like the *Lower*, only $\frac{3}{4}$ of an Inch Shorter. Between these 2 *sliding Measures*, they can compose *Marginal Notes* to any Breadth.

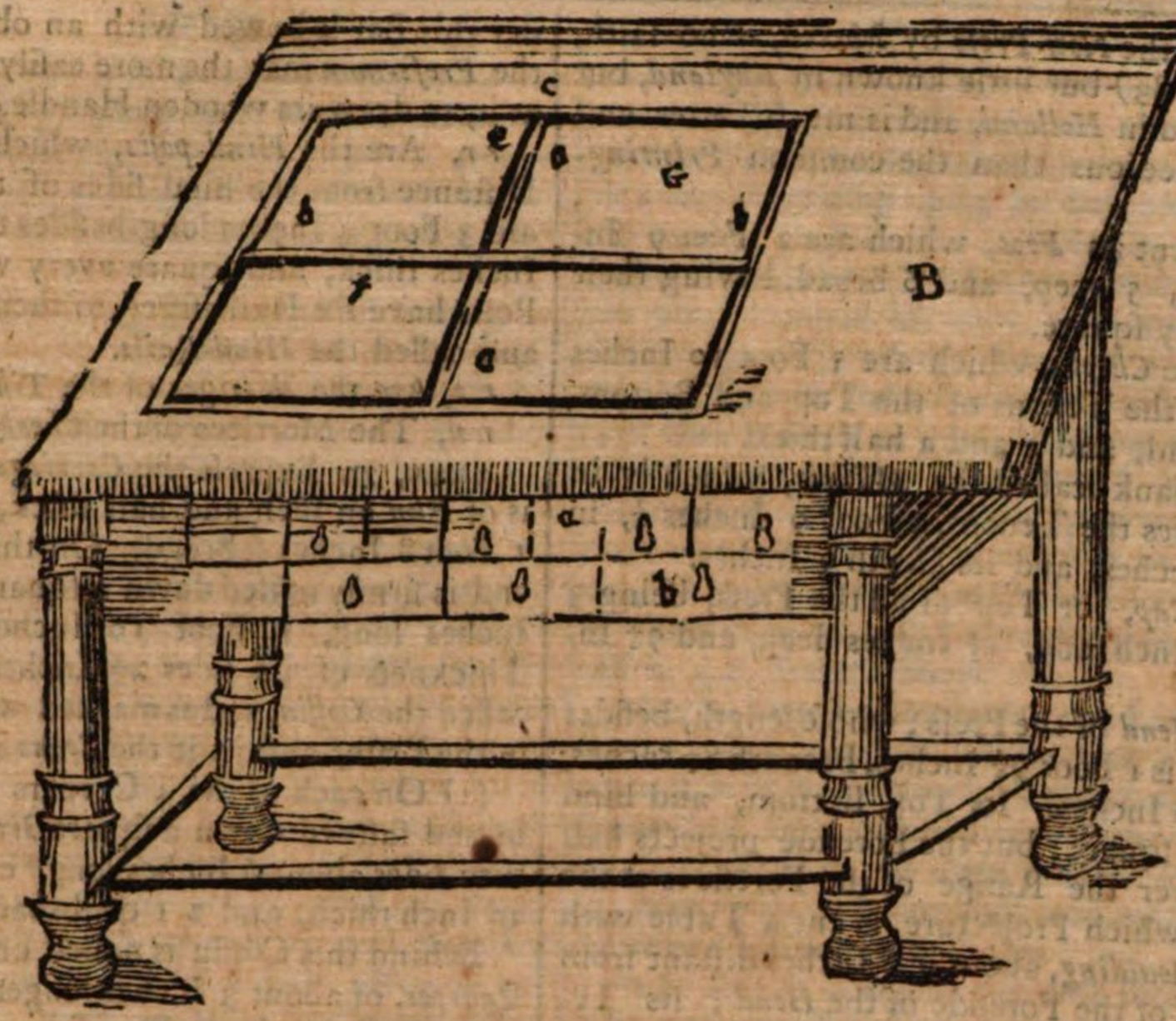
The *Compositor* uses a Bodkin of Steel of about 2 Inches in length from the Shank of the Handle: the Handle is of soft Wood; that when 'tis knockt on the *Face* of any single *Letter*, which happens to stand too high, it may not batter it.

### Of *Chases*.

These are Iron Frames about 22 Inches long, 18 broad, and $\frac{1}{2}$ Inch and $\frac{1}{8}$ thick, and the breadth of the Iron on every Side is $\frac{3}{4}$ of an Inch usually, but it should be an entire Inch: All the Sides must be truly square to one another; that when 'tis laid on the *Correcting Stone*, it may lie truly flat, and the out and inside must be filed straight and smooth. Each *Chase* hath 2 Crosses belonging to it: One *Shorter* than the other; they are square to one another and are called the *Short* and the *Long Cross*. They have at each End a male Dove-tail filed bevil-way from the under to the upperside of the Cross, so that the underside of the Dove-tail is narrower than the upper: These *Male-dove-tails*, are fitted into *Female ones*, filed in the Inside of the *Chase*; and which are also wider on the upper Side of the *Chase*, than on the under, that the upper Side of the *Cross* may not fall thro' the lower Side. The *Short-Cross* is thus dove-tailed into the Middle of the 2 long Sides of the *Chase*; and the *Long Cross* into the Middle of the 2 other Sides. The *Short Cross* is moveable also in the *Chase* about 3 Inches $\frac{1}{2}$ from the Middle. The Middle of these 2 *Crosses*, are filed or notched half Way thro', one on its upper, the other on its under Side, that they may be let into one another, and in the Middle between the 2 Edges of the upper Side of the *Short Cross* are made 2 Grooves parallel to the 2 Sides of the *Cross*, beginning at about 2 Inches from each End: They are $\frac{1}{4}$ an Inch deep all the Way, and about $\frac{1}{4}$ of an Inch broad, that the Points may fall into them. The *Short Cross* is about $\frac{3}{4}$ of an Inch thick; and the *Long* about half as much.

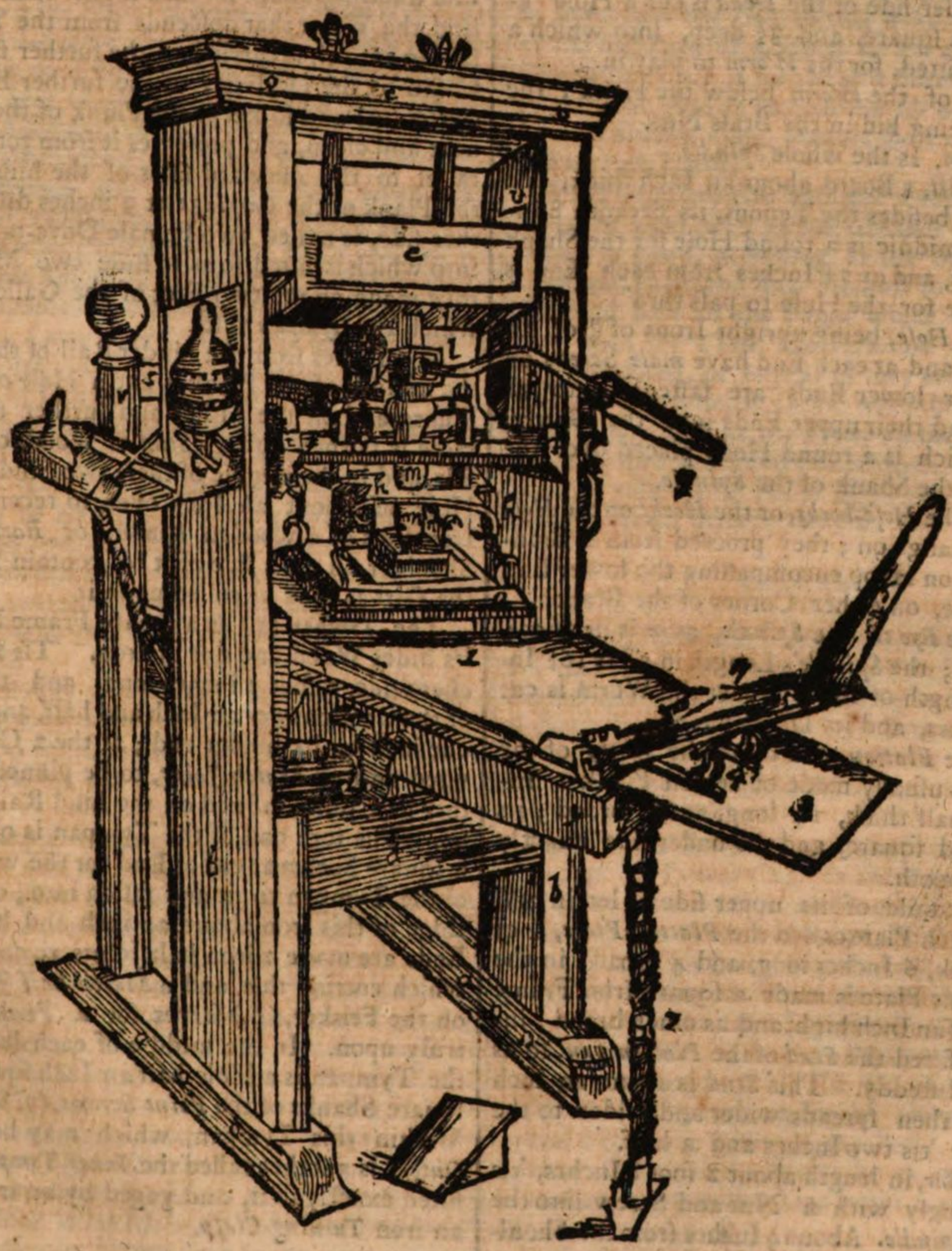
See their Figure as they lie on the *Correcting-stone*.

Of




## Of the *Press*.

The Printing Press, whose Figure is here annexed, was invented by the famous *Willem Janſca Blaeu*, of *Amſterdam*; who was eminent not only for his good and great Printing, but also for his Globes and Geographical Maps and Charts.



'Tis called the *New Preſs* by *Moxon*, who ſaith, it was (in 1683) but little known in *England*, but generally uſed in *Holland*, and is much better and more commodious than the common *Printing-Preſs*.

*aa*, Repreſent its *Feet*, which are 2 Feet 9 Inches ½ long, 5 deep, and 6 broad, having their Outſides truly ſquare.

*bb*, Are the *Cheeks*, which are 5 Foot 10 Inches long beſides the Tenons of the Top and Bottom, 8 Inches broad, and 4 and a half thick.

*d*, Is a Plank called the *Winter*, which is in Length beſides the Tenons, a Foot 9 Inches ¼, in Breadth 8 Inches, and its Depth 9 Inches.

*c*, Is the *Cap*, or Top of all the Preſs, being 3 Foot and 1 Inch long, 4½ Inches deep, and 9½ Inches broad.

*e*, Is the *Head* of the Preſs; whoſe length, beſides the Tenons, is 1 Foot 9¼ Inches, Breadth 8½ Inches, and Depth 8 Inches. Its Top, Bottom, and hind Sides are all ſquare; but the Foreſide projects half an Inch over the Range of the Foreſides of the *Cheeks*: In which Projecture is cut a Table with an hollow *Moulding*, about it 2 Inches diſtant from all the Sides of the Foreſide of the *Head*; its Tenons are 3 Inches broad, and are cut down at either End, from the Top to the Bottom of the Head, and made fit to *Mortices* in the *Cheeks*, that may ſlide right, and yet play in them.

In the Under-ſide of the *Head* is cut a Hole about 4 Inches ſquare, and 3½ deep, into which a Braſs *Nut* is fitted, for the *Worm* to play in.

*i*, Is Part of the *Worm* below the Head; the upper Part being hid in the Braſs Nut.

*i, k, l, m, n*, Is the whole *Spindle*.

*f*, Is the *Till*, a Board about an Inch thick, one Foot 9¼ long beſides the Tenons, its Breadth 8 Inches; in its middle is a round Hole for the Shank of the *Spindle*, and at 7¼ Inches from each End is a ſquare Hole for the Hoſe to paſs thro'

*gg*, Are the *Hoſe*, being upright Irons of ¾ of an Inch ſquare, and at each End have *male Screws* on them. Their lower Ends are faſtened into the *Hoſe-hooks*, and their upper Ends into the *Garters* or *Curts*, which is a round Hoop placed over the flat Neck of the Shank of the *Spindle*.

*hhhh*, are the *Hoſe-hooks*, or the *Hooks* on the *Hoſe* the Platten hangs on; they proceed from 2 Branches of an Iron Hoop encompaſſing the lower End of the Spindle, on either Corner of the Branch.

*k, l*, Is the *Eye* of the *Spindle*, as *m* is its *Shank*, and *n* its *Toe*; the *Spindle*'s Length in all is 16½ Inches, the Length of the Cylinder the Worm is cut on is 3¼ Inches, and its Diameter 2¼.

*oooo*, Is the *Platten*, tied on to the *Hooks* of the *Hoſe*; this is uſually made of beaten Plank 2 Inches and a half thick, 14 long, and 9 broad; its Sides are tied ſquare, and its under ſide exactly plain and ſmooth.

In the middle of its upper ſide is let in and faſtned an Iron Plate called the *Platten-Plate*, ¼ of an Inch thick, 6 Inches long, and 4 broad; in the middle of this Plate is made a ſquare Iron Frame of about half an Inch high, and as much broad; into which is fitted the *Stud* of the *Platten-pan*, ſo as it may ſtand ſteddy. This *Stud* is about an Inch thick, and then ſpreads wider and wider to the Top, where 'tis two Inches and a half.

*p* Is the *Bar*, in length about 2 foot 8 Inches, 'tis faſtned ſtrongly with a Nut and Screw into the Eye of the *Spindle*. About 4 Inches from the Shoulder this Bar is bowed with an obtuſe Angle, that the *Preſs-man* may the more eaſily and readily catch at it, to draw its wooden Handle *q* within its reach.

*r r*, Are the *Hind-poſts*, which ſtand at a Foot Diſtance from the hind ſides of the *Cheeks*; they are 3 Foot 4 Inches long beſides the Tenons, and 4 Inches thick, and ſquare every way. Theſe hind Poſts have ſix Rails fitted to them, and marked *ss*, and called the *Hind-Rails*.

*t t*, Are the Wedges of the *Till f*.

*u u*, The Mortices of the *Cheeks bb*.

*xxxx, yy*, Expreſs the *Carriage*; whoſe Plank is of *Elm* an Inch and half thick, 4 Foot long, and 1 Foot 8 Inches ¾ broad. On this Plank at its fore end is firmly nailed down a ſquare Frame 2 Foot 4 Inches long, 1 Foot 10 Inches broad, and the Thickneſs of its ſides 2½ Inches ſquare. This is called the *Coffin*, and is marked with the Figure (1) in the Plate, and in it the *Stone* is bedded.

(1) On each of the 4 Corners of the *Coffin* is let in and faſtned down a ſquare *Iron Plate*, with return-ſides about 6 Inches long, each ſide 1 8th of an Inch thich, and 2 1 qr. broad.

Behind this Coffin is nailed on to its Outſide a *Quarter*, of about 3 Inches longer than the Breadth of the *Coffin*; it hath all its ſides 2 Inches over, and 3 of them ſquare: But its upper ſide is hollowed round to a Groove or Gutter (2) an inch and half over. This *Gutter* is ſo nail'd on, that its hither End ſtanding about an inch higher than its further End, the Water that deſcends from the *Tympan* (5) falling into it, is carried on the further ſide of the Coffin by the Declivity of the further End of the *Gutter* (2,) and ſo keeps the Plank of the Carriage neat and clean, and preſerves it from rotting. Parallel to the outward ſides of the hinder part of the Plank of the *Carriage* at 3 inches diſtant on either ſide, is nailed two Female Dove-tail Grooves, into which is fitted ſo as to ſlide two Male Dove-tails made on the two Feet of the Gallows (4) on which the *Tympan* reſts.

At 3 inches from the hinder Rail of the Coffin in the middle of the Plank is cut a Hole of 4 inches ſquare, and on the hither and further ſide of this Hole is faſtned down a *Stud* of Wood, one on each ſide, and in the middle of theſe two Studs is a round Hole of about an Inch over, to receive the two Iron Pins of a wooden *Rowler*, or *Barrel*, with a Shoulder on each ſide of it to contain ſo much of the Girt as ſhall be rolled upon it.

The *Tympan* (5) is a ſquare Frame having 3 of its Sides Wood and one of Iron. 'Tis 2 foot 8 Inches wide, 2 foot 2 inches long, and the Breadth of the wooden ſides an Inch and half, and the depth one inch on its hinder end; at the 2 Corners is rivited an iron *Match Joint*, to be pinned on to another half Joint, faſtned on the hind Rail of the *Coffin*. The fore end of the Tympan is of Iron, with a ſquare Socket at either End for the wooden Ends of the Tympan to fit and faſten into; on the outer Edge of this Iron about an inch and half from its Ends are made 2 iron half Joints, to contain a Pin, which entring this, and a *Match half Joint*, made on the Friſket, (6,) ſerves for a Friſket to move truly upon. In the middle of each long Rail of the Tympan is a Hole half an Inch ſquare, for the ſquare Shanks of the *Point Screws*, (7, 8) to fit into. Within this Tympan, which may be called the *Outer*, is another called the *Inner Tympan*, which is fitted exactly to it, and gaged by an iron Pin, and an iron *Turning-Claſp*.

I hope

I hope this Deſcription may ſerve to make the Figure a little Intelligible, and to give a general Idea of the *Printing Preſs*; but no words can poſſibly explain it ſo well, as once ſeeing of it work will do.

I ſhall omit deſcribing the manner of making the *Types* or ſeveral ſorts of *Letters*, uſed in Printing; but whoſoever hath a mind to ſatisfy himſelf further may conſult Mr. *Moxon*'s book of Printing, where he will find the whole affair very largely and plainly deſcribed.

I ſhall only add ſomething further about the Rules and Methods of *Diſtributing* and *Compoſing*.

After the *Preſs-man* hath wrought off as many Sheets from a *Form*, as he is appointed; he firſt waſhes the *Form*, and brings it to a place which they call the *Rinſing Trough*, and rears it a little aſlope on one end of the *Chaſe*; for when 'tis ſo placed the *Face* of the Letter is leſs liable to damage, and the *Form* ſtands in a proper poſition for the *Compoſitor* to rear a *Letter Board* againſt the Backſide of it; by which he raiſes it up, and then ſets *Letter Board*, and *Form* both a little aſlope in the *Rinſing Trough*. Next with his *Mallet* and *Shooting-ſtick* he *opens* or *Unlocks* (as they call it) the *Quoins* and *Form*: and then the Furniture; *viz.* the *Head-ſticks*, the *Inner Side-ſticks*, and *Gutter-ſticks*, if the *Form* have any, that he may have the more Room to open the Letter in order to its receiving the water the more plentifully: which is thrown on it by diſh fulls to Rinſe and Clean it, and the *Face* of the letter is rubbed with the Fingers, and ſhook ſo that the water may get between the Letters to clean them; and this is done till the water thrown and rubbed on, runs away quite clear and colourleſs. Then he thruſts the Letter and Furniture cloſe up together again that the letter may not *Squabble*, as they call it, that is, break and fall aſunder: after it hath ſtood a while to dry; he carries *Letter Board*, *Form* and all to the *Diſtributing frame*: and there he *ſtrips* it of its Furniture, Quarter by Quarter, taking out the *Quoins*, &c. and then with his *Diſtributing ſtick* or *Riglet*, he takes up out of the Form as many *Lines* of Letter as he can, and turning their Face towards him, he carries them to his *Caſe*, and taking out the Letters &c. one by one, but very quick and nimbly, he *diſtributes* each of them to its proper Box in the Caſe. Then he proceeds to *take off* and *Diſtribute* another parcel, and ſo goes on till he hath done, or till his *Caſe* is full.

They uſually chooſe to diſtribute their Letter over Night, that they may have a *Dry Caſe* to work on in the morning, for wet Letters are leſs eaſy to take up, and beſides the Lye makes their fingers ſore.

The *Compoſitor* next ſets himſelf to the *Compoſing work*: and here he muſt firſt Determine his *Meaſure*; to which he fits his *Compoſing ſtick* (above deſcribed) by looſening the ſcrew, and Sliding the Cheeks nearer to or further from its head.

Having *fitted his Meaſure*, he Places the *Galley* on his upper Caſe on the Right hand, and placing his Copy before him, he reads 5 or *ſix words* or ſuch a part of it as he can keep in his mind, and then ſpells it over Letter by Letter, taking up the proper Letters out of their reſpective *Boxes* in the *Caſe*: he ſets *a Space* between every word till they come to the end of the Line; but there none. He holds his ſtick in his left hand, and with his Thumb gently preſſes the Letters cloſe to the *cheek*, keeping it ſecure, tight and cloſe together, as with his right hand he puts them into the Stick ſucceſſively. And 'tis a very ſurprizing thing to ſee how very quick this work is performed; and how in an inſtant he ſpells, reſolves upon, and takes out the ſeveral letters which compoſe his work, and ſupply his ſtick.

Having compoſed one Line; if it ends with a *word*, or a *Syllable* and a *Diviſion*, and juſt fill the *Meaſure*, then it needs no more *Juſtifying* as they call it, the *Stick* being duly filled; but if the Line conclude not ſo, then he puts a *Space* more between every word, or at leaſt ſo many as will fill up the *meaſure* pretty Stiff, or *juſtify* the Line. And here he takes care that his Letter don't *Hang*, as they call it, *i. e.* Stand a Skew.

After he hath thus compoſed one Line, he begins another, and ſo goes on till his Stick be full: and when it is ſo, he empties it, laying it down on his *Lower Caſe*, and by means of a *Riglet* of juſt the length of the Line, he claps it down into the *Galley*, placing the firſt line cloſe and upright againſt the lower Ledge of the *Galley*.

As he *Sets* or compoſes this firſt ſtick of Letter, ſo he goes on till his page is out, remembring after the laſt line of every Page to ſet a *Direction*; that is, he ſets a Line of *Quadrats* and at the End of it the firſt word of the next Page, or if the word be very long and the Line very ſhort, two Syllables, or ſometimes but one, of that word. And when 'tis the firſt Page of a Sheet, he ſets a *Signature* as 'they call it *(i.e.)* *A* for the firſt Sheet, *B* for the Second, &c. And ſo ſucceſſively till he come to *W* which is always skipt, becauſe the Latin Alphabet hath no ſuch Letter.

When our *Compoſitor* hath got a full Page in his *Galley*, he next ties it up faſt together with a Packthread, or Cord, according to the bigneſs of his Letter and Page, and then carries it to the *Correcting ſtone*, and here all the Pages which belong to a ſheet, with the *Chaſe* and *Furniture* about them, are duly placed, or *Impoſed* as they call it: that is, ſo diſpoſed or ordered, as that when the Sheet comes to be wrought off at the Preſs, all the Pages may be folded into an orderly Succeſſion. And the 4 different volumes of *Folios*, *Quartos*, *Octavos*, and *Twelves*, are all diverſly *Impoſed*.

### *Correction.*

In *Correcting* Faults, if there be but a *few* of them, and theſe *Eaſy* ones, the Compoſitor gathers the Corrections in his *Stick*, beginning at the bottom of every Page and ſo aſcending: becauſe when he is Correcting, the corrections of the Top of the Page ſtand the *firſt* in the *Stick*, and therefore are readieſt to his hand.

But if there be many and conſiderable Faults, he brings the Lower Caſe to the *Correcting Stone*, and takes his *Corrections* as he uſes them. Then he *unlocks* the *Form*, but keeps the *Quoins* pretty tight up, leaſt his Letter ſhould *hang* or *ſquabble*: and there folding the Proof, ſo that the *Head-line* in it may lie in the ſame Range with the *Head-line* of the Metal, &c. ſo that all the lines in the *Proof* coincide or range right with the reſpective ones in the Metal; by running his eye along eaſily the ſeveral Places, or Lines in the Proof, where the *Corrector* had mark'd a Fault; he as eaſily mends it in the Correſponding Line in the *Letter* of *Metal*.

If there be a *Long* word or more than one left

out, the Compoſitor is uſually forced to *over-run*, as they call it: *i. e.* he muſt put ſo much of the forepart of the Line, into the Line above it; or ſo much of the hinder part of the line into the next Line under it, as will make Room for what is left out.

If much be left out, he muſt *over-run* many lines either backwards or forwards, or both, till he come to a *Break*; and when he comes thither if it be not *Gotten in*, as their word is, then he is forced to *Drive out* a Line: and ſometimes to get in that Line, he is forced to over run the next Page backwards or forwards, till that Line can come in.

The Quite contrary Proceſs muſt he take, if he happen inſtead of *Leaving out*, to ſet any thing *twice over*: for if it be but little he muſt take it out, then *Drive out* his *Matter*: But if it be as much as two or three Lines, &c. Then he muſt over-run the next Page, or more, and ſometimes the whole Sheet, till it be *Driven out*.

After all this Correcting there is, or always ſhould be a *Reviſe*, to ſee that the Faults are truly mended; and if not, to have them *Re-Corrected*, by unlocking either the whole *Form*, or only that Quarter of it where the faults are, &c.

And becauſe 'tis a Thing very uſeful for all Authors, and Correctors of Printing preſſes to be acquainted with, I ſhall conclude this Account of Printing with proper directions for both.

And firſt the Author ſhould well examine his Copy before it go to the Preſs; and *Point* and *Mark* it ſo, as that the *Compoſitor* may know what words to Set in *Engliſh*, *Italick*, *Capitals*, &c. For his *Italick* words, he ſhould draw a line under them *Thus*: for Engliſh words two Lines *Thus*: and for Capitals a Line of Points *Thus*, or elſe a Line with Red Ink. If there are no Proper *Breaks* made in the Copy; the Author muſt ſupply them by a Crotchet [*Thus*, before the word he would have begin his new Paragraph.

And every Author, if he can poſſibly, out of a due regard to his own Reputation, which elſe may much ſuffer, or at leaſt as much as he can, will correct the *Sheets* of his Book himſelf; that is, look them over, after the Printers Corrector hath mended the Common Typographick Faults: And whether it be the Author himſelf, or ſome other Corrector, that hath this Care upon him, the way of correcting Faults ſo as they may be mended by the Compoſitor is after this manner.

When one Letter is put inſtead of another, as in this word *Tho* for *The*; he daſhes out the wrong *Letter* thus *thø*, and Writes the *Letter* it ſhould be on the Right Hand *Margin* of the *Page*, right againſt the ſame *Line*, and makes a Daſh behind it, as you may ſee in the *Margin*. e|

If two or three, or more Words in the ſame *Line* have *Faults* in them as in theſe Words, Pøtienge peø føree; where firſt an o is *Set* inſtead of a, e inſtead of c, t inſtead of r, and c inſtead of o: Theſe he marks in an orderly ſucceſſion towards the Right Hand, againſt the ſame *Line*, as you may ſee in the *Margin*. a| c| r| o|

But if one word be ſet inſtead of another, as *Scoff* inſtead of *Smile*, here he marks Scoff out thus Scoff, and writes Smile, as in the *Margin*. Smile

If a *Word* or *Words*, or *Letter* or *Point* be *Left out*, he makes this mark ʌ, where it is *Left out*, for a mark of Inſertion, and Writes in the *Margin* what muſt come in.

If a *Space* be *Left out*, he makes the former mark of Inſertion where it ſhould come in, and makes this mark # in the *Margin*. #|

If a whole Sentence be *Left out*, too long to be Writ in the *Margin*, he makes the mark of *Inſertion* where it is *Left out*, and only Writes (Out) in the *Margin*. If the Sentence *Left out* be not very long, he Writes it under the *Page*, or on the Left Hand *Margin* of the *Page*: But if it be too large to be Writ in the *Margin*, or under the *Page*, he Writes in the *Margin*, See the Copy. (Out) (See the Copy)

If a Word or Sentence be *Set* twice, as Him Him, he marks out one Him thus Him, and makes this mark ϑ in the *Margin*, for *Dele*, to take out. ϑ|

If a *Letter* be turned thus ℵ, he daſhes it out as you ſee, and makes this mark in the *Margin*. ℵ|

If Words are *Tranſpoſed*, that is, if one Word ſtand in another Words place, as, no I love Swearing, and it ſhould be, I love no Swearing; he marks this *Fault* thus, no I love Swearing, and makes this mark G in the *Margin*. The like mark he makes in *Matter* and *Margin* if two *Letters* are *Tranſpos'd*. G

If a *Space* or an m or n *Quadrate*, &c. ſtick up and *Print Black*, as tween theſe words, he marks in the *Margin* thus.

If a *Word* be *Set* in *Roman Letter* inſtead of *Italick* or *Engliſh Letter*, he daſhes the Word underneath thus, and Writes *Ital.* or *Eng.* in the *Margin*. Ital| Eng|

In like manner, if a ſingle *Letter* or more *Letters* be *Set* in *Roman Letter*, and it ſhould be *Italick* or *Engliſh Letter*; or if in *Engliſh* or *Italick*, and it ſhould be *Roman Letter*, he daſhes the *Letter* or *Letters* thus underneath, and writes *Ital. Rom.* or *Eng.* in the *Margin*: Or if *Lower Caſe Letters* be *Set* inſtead of *Capitals*, he daſhes them underneath, and Writes *Capt.* in the *Margin*. Ital| Rom| Eng| Capt|

Having Read the *Matter* of the *Proof* he examines again if the *Form* be right *Impos'd*, for though he before turn'd the *Pages* in the *Proof* as he read them according to their orderly places, yet he will ſcarce truſt to that alone, but again examines them on purpoſe, and diſtinctly, which he does not only by the *Direction Word*, but by examining the whole Sentence the *Direction* comes in, both at the end of the *Page*, and the beginning of the next *Page*.

He examines that all the *Signatures* are right, and all the *Titles* and *Folio's*.

If the Work be large *Forms* and ſmall *Letter*, he has a ſecond, and ſometimes a third *Proof*, which he Reads as the firſt,

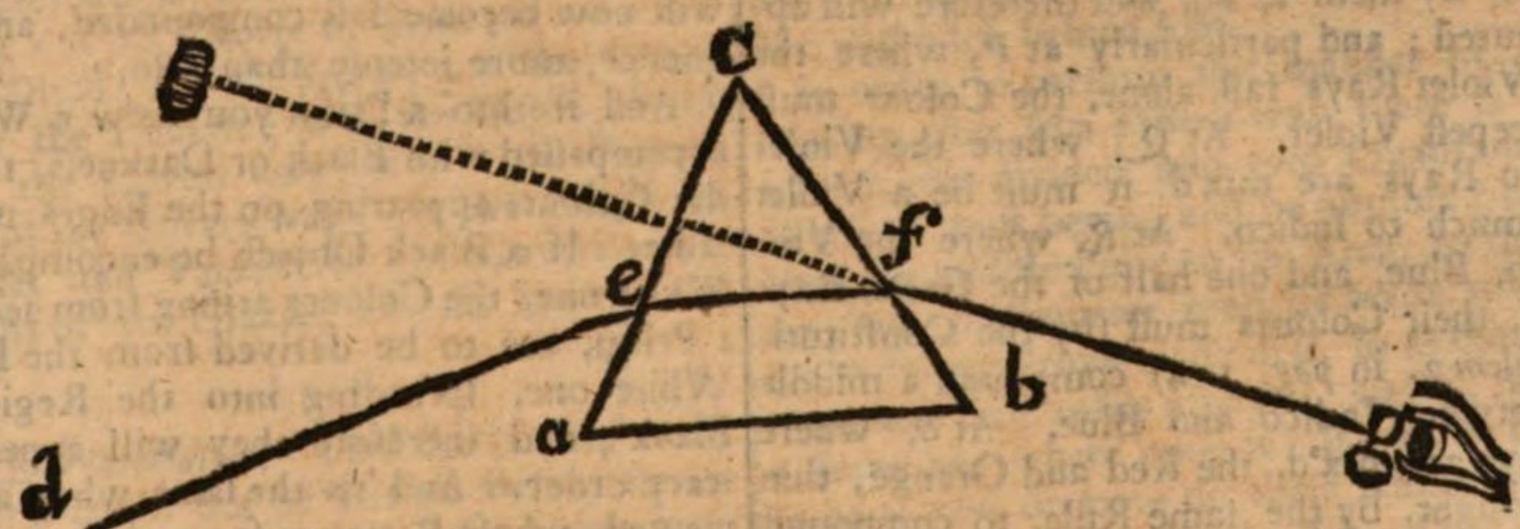
After the Second or Third *Proof* he has a *Reviſe* which is alſo a *Proof-ſheet*: He examines in this *Reviſe Fault* by *Fault*, if all the *Faults* he markt in the laſt *Proof* were carefully mended by the *Compoſitor*; if not, he marks them in the *Reviſe*,

PRINTS. The Original of *Prints* or *Cutts*, as we ſometimes call them, was this; in the Year 1460, one *Maſo Finiguerra*, a Goldſmith of *Florence*, graved his Plate; and then caſting ſome of it in melted Brimſtone, he perceived, that what came out of the Mold was markt with the ſame Prints as his Plate, by the Black which the Sulphur had taken from the Graving: after this he tried to do as much on Silver Plates with wet paper, by rolling it ſmoothly with a Roller, and this ſucceeded. This Novelty tempted *Baccio Baldini*, a Goldſmith of the ſame City, to attempt the ſame thing, which he did with Succeſs; ingraving ſeveral Plates of *Sandro Boticello's* Invention and Deſign; and upon this *Andrew Mantegna*, who was then at *Rome*, ſet about engraving ſome of his own Pieces. This knowledge getting into *Flanders*, *Martin* of *Antwerp*, a famous Painter, graved abundance of Plates of his own Invention, and ſent ſeveral Prints into *Italy*, which were markt thus, *M. C.* After him the Famous *Albert Durer* appear'd and gave the world a vaſt number of Prints, both in wood, and copper. About this time one *Hugo de Carpi*, an *Italian* Painter of no great Capacity, but of a ready Invention, found out a way, by means of ſeveral Plates of wood, to make Prints reſemble Deſigns of *Claro-Obſcuro*: and ſome Years after the Invention of *Etching* was diſcovered, which was ſoon made uſe of by *Parmeggiano*.

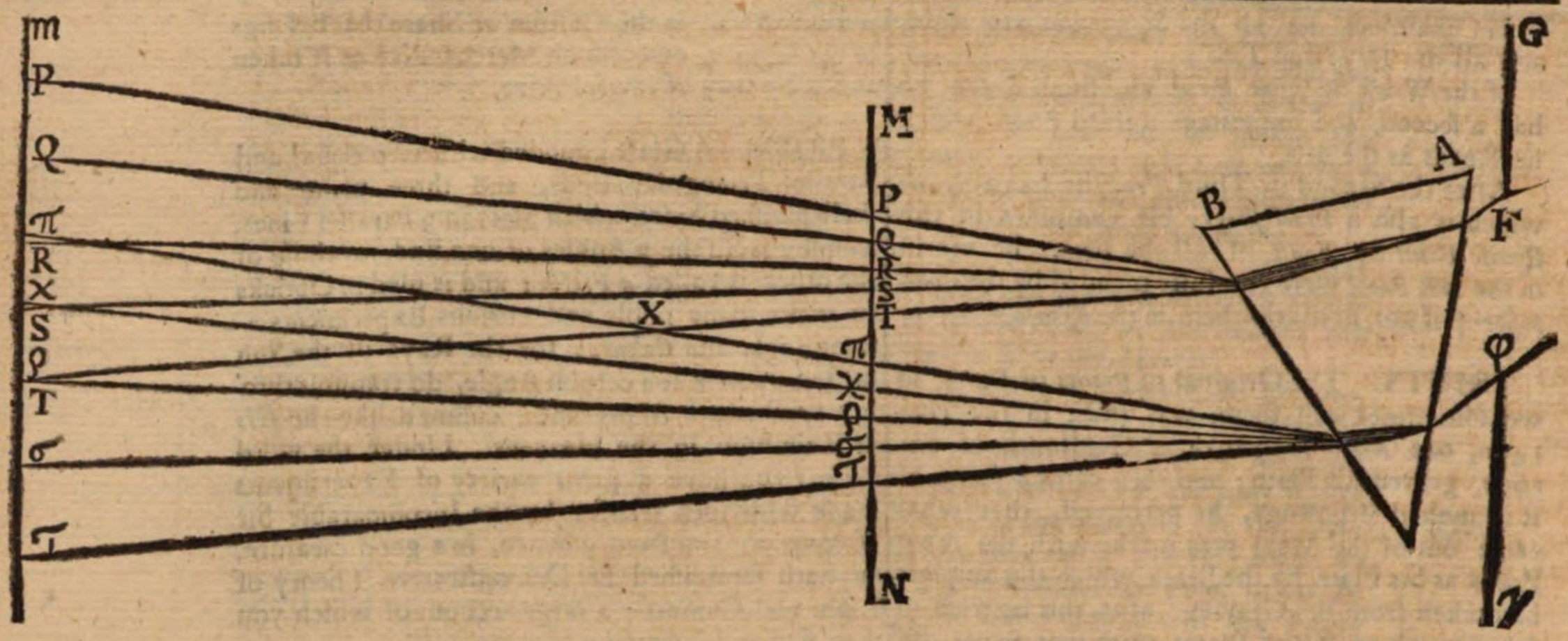
PRISAGE, is the Cuſtom or Share that belongs to the Queen, out of ſuch Merchandice as is taken at Sea by way of lawful Prize,

PRISM: A Glaſs bounded with two equal and parallel Triangular Ends, and three plane and well-poliſhed Sides, which meet in 3 Parallel Lines, running from the 3 Angles of one End, to thoſe of the other, is called *a Priſm*; and is uſed in Opticks to make many noble and curious Experiments about *Light* and *Colours*; for the Rays of the Sun falling upon it at a certain Angle, do tranſmit thro' it a *Spectrum* or Appearance, colour'd like the *Iris* or Rain-bow in the Heavens. Under the word *Colours* you have a great variety of Experiments made with ſuch Glaſſes, by the Incomparable Sir *Iſ. Newton*; and from whence, in a good meaſure, he hath eſtabliſhed his Demonſtrative Theory of Light and Colours; a large account of which you may find in his *Opticks*.

How to find the Refraction of a Ray of Light paſſing thro' ſuch a Priſm, the ſame Author ſhews thus: Let *a b c* repreſent the Section of this Priſm made by a Plane paſſing tranſverſely to three parallel Lines or Edges, then when the Light paſſeth thro' it; and let *d e* be the Ray incident on the firſt ſide of the Priſm *a c*, where the Light goes into the Glaſs: Then by putting the Line of Incidence to the Line of Refraction as 17 to 11: Find (by the Direction given under the word *Incidence* in this Volume) *e f* the firſt refracted Ray; then taking this Ray for the *Incident Ray* on the ſecond ſide of the Glaſs *b c*, where the Light goes out, find the next refracted Ray *f g*; by putting the *Ratio* of the Line of Incidence to the Line of Refraction as 11 to 17; for if the Line of Incidence out of Air into Glaſs be to that of Refraction as 17 to 11, the Line of Incidence back again, out of Glaſs into Air, muſt be as 11 to 17,




The ſame admirable Author, *Opticks*, *p.* 121, ſhews, how by the Properties of Light diſcovered by his moſt accurate Experiments, to explain the *Phænomena* of Colours made by Priſms; thus,




Let *a b c* be a Priſm refracting the Sun's Light, brought into a darkned Room, by the Hole F φ, almoſt as broad as the Priſm; and let *m n* be a White Paper on which the refracted Light is caſt: And ſuppoſe the moſt refrangible or deepeſt Violet Rays to fall on the Space P π, the leſt refrangible or deepeſt Red Ray on the Space T τ; the middle ſort, between the Indico and Blue Rays, on the Space Q χ; the middle ſort of the Green Rays on the Space R ϱ; the middle ſort between the Yellow and Orange Rays on the Space S σ; and the other intermediate ſorts on intermediate Spaces. For ſo the Spaces on which the ſeveral ſorts adequately fall, will, by reaſon of the different Refrangibility of theſe ſorts be one lower than the other. Now if the Paper *m n* be ſo near the Priſm that the Spaces *P t* and π τ do not interfere with one another, the diſtance between them T σ will be illuminated by all the ſorts of Rays in that Proportion to one another which they have at their very firſt coming out of the Priſm, and conſequently, will be White. But the Spaces *P T* and π τ on either hand, will not be illuminated by them at all, and therefore will appear coloured; and particularly at *P*, where the outmoſt Violet Rays fall alone, the Colour muſt be the deepeſt Violet. At Q where the Violet and Indico Rays are mix'd, it muſt be a Violet inclining much to Indico. At *R*, where the Violet, Indico, Blue, and one half of the Green Rays are mix'd, their Colours muſt (by the Conſtitution of *Problem* 2. in *pag.* 114) compound a middle Colour between Indico and Blue. At *S*, where all the Rays are mix'd, the Red and Orange, thin Colours, ought, by the ſame Rule, to compound a faint Blue, verging more to Green than Indico. And in the progreſs from *S* to *T* this Blue will grow more and more faint and dilute; till at T, where all the Colours begin to be mix'd, it ends in Whiteneſs.

So again on the other ſide of the White at *T*, where the leaſt refrangible or utmoſt Red Rays are alone, the Colour muſt be the deepeſt Red. At σ, the Mixture of Red and Orange will compound a Red inclining to Orange. At ϱ, the Mixture of Red, Orange, Yellow, and one half of the Green, muſt compound a middle Colour between Yellow and Orange. At χ, the mixture of all Colours but Violet and Indico, will compound a faint Yellow, verging more to Green than Orange: and this Yellow will grow more faint and dilute continually, in its progreſs from χ to π, where it will become White by a mixture of all ſorts of Rays.

Theſe Colours ought to appear were the Sun's Light perfectly White; but becauſe it inclines to Yellow, the exceſs of the Yellow Rays, wherewith it is tinged, being mix'd with the faint Blue between *S* and *T*, will draw it to a faint Green. And ſo the Colours in order from *P* to *T* ought to be Violet, Indico, Blue, very faint Green, White, faint Yellow, Orange, Red: Thus it is by computation, and they that pleaſe to view the Colours made by a Priſm will find it ſo in Nature.

Theſe are the Colours on both ſides the White, when the Paper is held between the Priſm and the Point χ where the Colours meet, the Interjacent White vaniſhes: For if the Paper be held ſtill farther off from the Priſm, the moſt refrangible and leaſt refrangible Rays will be leaſt in the middle of the Light, and the reſt of the Rays which are found there, will by mixture, produce a fuller Green than before; alſo the Yellow and the Blue will now become leſs compounded, and by conſequence, more intenſe than before.

And if thro' a Priſm you view a White Object encompaſſed with Black or Darkneſs, the reaſon of the Colours appearing on the Edges is much the ſame. If a Black Object be encompaſſed with a White one, the Colours ariſing from ſeeing it thro' a Priſm, are to be derived from the Light of the White one, ſpreading into the Regions of the Black; and therefore they will appear in a contrary order. And 'tis the ſame when an Object is viewed, whoſe Parts are ſome of them leſs or more luminous than others: For in the Borders of the more or leſs luminous parts, Colours ought always, on the ſame Principles, to ariſe from the exceſs of the Light of the more luminous, and to be of the ſame kind as if the darker parts were Black, but yet to be more faint and dilute.

And what is thus ſaid of the Colours which are exhibited by Priſms, may eaſily be applied to thoſe Colours which the Glaſſes of Teleſcopes and Microſcopes, or even the Humours of the Eye produce: For if the Object Glaſs of a Teleſcope be thicker in one part than another; or if one half of the Glaſs, or one half of the Pupil of the Eye, be covered by any Opake Body, then that Object Glaſs, or its half; or the half of the Eye which is uncovered may be conſidered, as a kind of *Cuneus*

with

with curved Sides. And every Glaſs, or Pellucid *Cuneus* (or Wedge) will produce the ſame effect as a *Priſm*, by refracting the Rays of Light as they are tranſmitted thro' it.

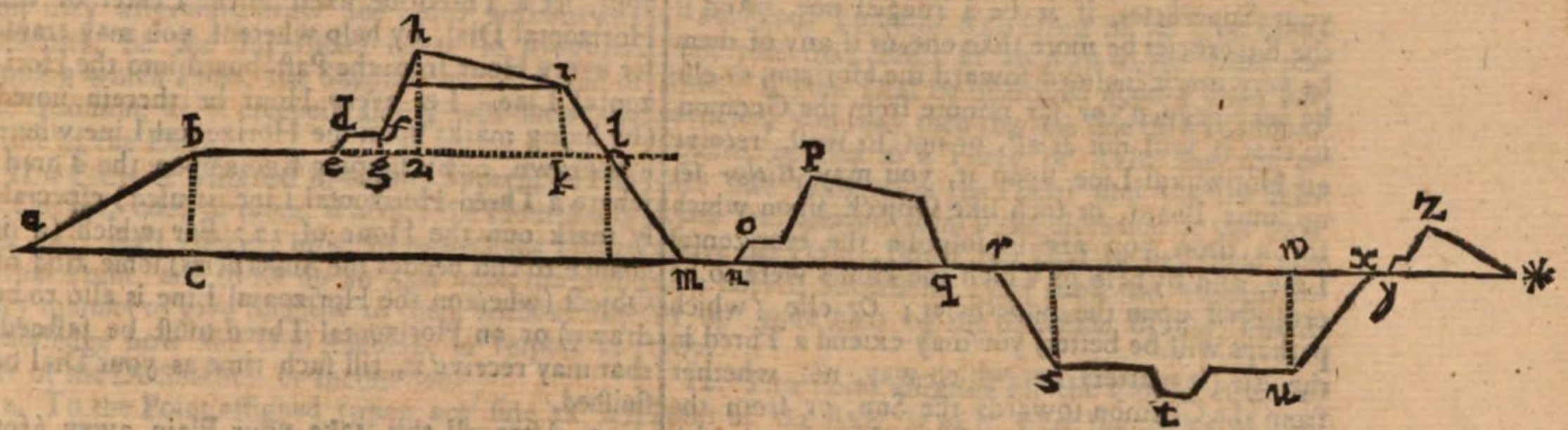
PROCURATIONS, are a Pecuniary Sum or Compoſition paid by the Pariſh Prieſt to an Ordinary or ſome other Eccleſiaſtical Judge, as an Archdeacon, *&c.* to commute for the Proviſion or Entertainment which was otherwiſe to have been procured for him; which Entertainment was called *a Procuration.*

PROCURATOR, is uſed for one that gathereth the Fruits of a Benefice for another man; 3 *R.*2 *Stat.* 1. *cap.* 3. as *Procuracy* was the word for the Inſtrument impowering him to do it. In the Weſt of *England*, ſuch Perſons are called *Proctors* to this day. *Cowel.*

PRODES *Homes:* This is a Title often given in our old Books to the Barons or other Military Tenants, who were called to the King's Council; and was no more than *Homines diſcreti & fideles.*

PROFER, *Profrum vel Proferum*; is the Time appointed for the Accounts of Sheriffs, and other Officers in the Exchequer; which is twice a Year. *An.* 51 *H.* 3. 5. In another Senſe *Profer* alſo ſignifies the Officer or Endeavourer to proceed in any Action by any Man concerned ſo to do.

PROFILE, in Fortification, is the Repreſentation of the Height, Depth and Thickneſs of any Work; and ſuppoſe the Work cut perpendicularly down from Top to Bottom; as in the Figure annexed, where you have the Profile of a *Rampart*, *Fauſſebray*, *Foſs*, *Covert-way* and *Eſplenade*.




*a b l m* is the Solidity of the Rampart, *a m* its Baſe; *b l* its Top; *b c* its perpendicular Height; *a b* its inward *Talus* or Slope; *l m* its outward *Talus* or Slope; *b e* is the *Terre-plain*; *e l* is the Baſe of the *Parapet*, *e d* its *Banquet*; *f h* is the inward *Talus* of the Parapet, *i l* the outward one, *h i* its upper one; *h* 2 is the inward Height of the Parapet, *i k* the outward Height; *l* the *Cordon*; *n o p q* repreſents a Fauſſebray with its Banquet, *&c.* *q r* is its *Liziere* or *Berm*; *r s t u x* is the Foſs or Ditch; *r s* the *Scarp*; *u y* the Counterſcarp; *t* the Lunette; *w u* the Depth of the Ditch; *x y* the Covert-way; *x z* * the Parapet and Glacis of the Covert-way; *y z* the Height of the Barnquet and Parapet of the Covert-way; *x* * the Baſis of the Glacis; *z* * the Slope of the *Glacis.*

PROFRE *Vicecomitis.* Tho' the certain *Debet* of the Sheriff could not be known before the finiſhing his Accounts, yet it ſeems there was anciently an Eſtimate what this conſtant Charge of the Annual Revenue amounted to, and what the conſtant Allowances amounted to according to a *Medium*; and thoſe Summs were paid into the Exchequer at the Return of the Writ of Summons of the Pipe; and they were and are to this day called by this Name *Profre Vicecomitis.* But altho' theſe *Profers* are paid, yet if on concluſion of the Sheriffs Accounts, and after the Allowances and Diſcharges had by him, it appears that he be in Surpluſage, or that he be charged with more than indeed he could receive, he hath his *Profers* paid or allowed to him again.

PROJECTIVE *Dialling*, is the way of Drawing, by a method of Projection, the true Hour-Lines, Furniture of Dials, *&c.* on any *kind of Surface* whatſoever, without any regard had to the *Situation* of thoſe Surfaces, either as to *Declination*, *Re-* or *Inclination.* This curious and in many Caſes moſt uſeful manner of Dialling, ſeems to have been the Invention of our Mr. *Sam. Foſter*, formerly Aſtronomy Profeſſor in *Greſham College.* Something of this was printed in his *Poſthumous Miſcellanies* 1659, and more added by Mr. *Leybourn* (in his *Dialling*) from a Manuſcript which Mr. *Foſter* left behind him.

In order to perform this manner of *Projective Dialling* after Mr. *Foſter's* way, there is neceſſary a *Semicircle* divided into two Quadrants, whoſe Diviſions muſt begin, and be numbred both ways from the middle Point in the Arch, to the Diameter; which Diameter muſt be made to receive a Ruler into a Grove made in it, ſo as that the *Semicircle* may ſlide eaſily along it, and be faſtened by a Scrue any where upon it: It will be convenient to have two or more of theſe Rulers of different Lengths. You may ſee the Fig. of this Semicircle and Ruler in *Leybourn's Dialling*, *p.* 198. But there is no difficulty in underſtanding the uſe of it at all; and a Quadrant, divided on both ſides, may very well ſupply the place of the Semicircle.

The General Uſe of this Inſtrument is; *Upon a Line drawn any where, to project an Altitude or Depreſſion, above or below the Horizon, from a fix'd Point placed at a diſtance from that Line.*

The manner of doing which is very eaſie; For if you hold the Edge of the Ruler to the fix'd Point, and alſo apply the Point of the Edge of the Ruler to the Line given, removing it higher or lower (as occaſion requires) till the Thread and Plummet of the Semicircle or Quadrant fall on the degr. of Altitude or Depreſſion intended; for then the

the Ruler lies at the Altitude or Depth, and ſo projects it from the fix'd Point into a Line, as was deſigned.

*Two General and Eaſie ways to project Hour Lines on all Surfaces, Concave, Convex, &c. Inclining, Reclining or Declining.*

1. Let a Gnomon, being firſt ſharpened into a Point, be ſhaped and faſtned in ſuch wiſe, that it no way hinder either the draught of the Horizontal Line, or the Point of the Shadow from having free acceſs to the Dial at all times of the Year.

2. Draw an Horizontal Line, by help of your Semicircle in a true Level both in regard of it ſelf, and alſo to the Point of the Gnomon, through the whole Superficies on which the Dial is to be deſcribed. Or having two Points in the ſame Level, with the Point of the Gnomon, project it upon your Superficies, if it be a rugged one. And if the Superficies be more than one, or if any of them be very much inclined toward the Horizon, or elſe be very rugged, or far remote from the Gnomon ſo that it will not at all, or not ſo well, receive an Horizontal Line upon it, you may *Either* ſet up ſome Board, or ſuch like Object, upon which for a time you are to inſcribe the Horizontal Line, and by help of which the Hours were to be projected upon the Superficies; *Or* elſe (which perhaps will be better) you may extend a Thred in the Air (it matters not which way, nor whether from the Gnomon towards the Sun, or from the Sun: whether ſtretcht out in one length, or with returns, ſo long as it lieth juſtly parallel, in every Point of it, to the Horizon, and in the ſame Level with the Point of the Gnomon:) which being fixed in this manner, will very well ſupply the uſe of the Horizontal Line: or the Horizontal Line may be partly Thred, and partly drawn upon the Superficies, as occaſion ſhall be. And upon it may any Point be transferred, and ſigned out by ſlipping knots of Thred tied upon it.

3. Upon the Superficies of the Dial, obſerve the Point of the Shadow of the Gnomon (making a mark at it) and the Sun's Altitude, both of them at the ſame inſtant of time.

4. By the Altitude obſerved, compute the Azimuth of the Sun from the Meridian.

5. The ſame Azimuth muſt be transferred unto, or projected upon, the Horizontal Line by help of a Perpendicular Thred, covering to your ſight (as it hangeth down) the Points of the Gnomon and Shadow both together; and at the ſame view cutting through the Horizontal Line: obſerve then punctually where it cuts through the ſame Line, for that ſame Section being ſigned thereon, ſhall be the Azimuth projected into the Horizontal Line.

6. Let any kind of Board or Paſt-board be now applied to the Point of the Gnomon; ſo, as that it may be ſtaid, either upon the Horizontal Line (where it may ſo be conveniently) or at leaſt ſo placed toward the Horizontal Line, that it may have a juſt reſpect unto it, and in that poſture may have ſome ſtay for the edge of it to reſt upon, that after it is furniſhed with ſuch neceſſary Lines as muſt be drawn upon it, it may be placed in its former juſt poſture without any Impeachment. Upon this plain ſo placed, let the Point of the Gnomon be ſigned, which may be called the Center; and from this Center to the Sign of the Azimuth before projected into the Horizontal Line, draw a right Line: this right Line ſo drawn, ſhall repreſent upon the Board or Paſt-board; the ſame Azimuth which was before computed.

7. Then taking away the ſame Plain, draw upon it the Meridian or Line of 12; extending it from the Center before noted, at the true Angle that it hath from the Azimuth before computed and deſcribed, and alſo toward the true Coaſt of the World. And let it be extended on both ſides the Center if need be.

8. To the Meridian ſo pitched upon the Paſt-board, draw (from the Center) the Lines of an Horizontal Dial made to the Latitude wherein you are.

9. Then again, let the plain Board or Paſt-board be applied to its former ſituation, the Center of the Horizontal Dial reſting upon the Point of the Gnomon, and every thing elſe anſwering to the ſame juſt poſture that it had at the firſt. Which done, let a Thred be fixed in the Center of the Horizontal Dial, by help whereof you may tranſfer every Hour from the Paſt-board into the Horizontal Line. Let every Hour be therein noted (by fixing marks upon the Horizontal Line where it is drawn, or by ſlipping Knots upon the Thred, where a Thred Horizontal Line is uſed) eſpecially mark out the Hour of 12: For which (if it chance to run beſides the Superficies) ſome kind of Object (whereon the Horizontal Line is alſo to be drawn) or an Horizontal Thred muſt be faſtned, that may receive it, till ſuch time as your Dial be finiſhed.

10. After all this, take your Plain away (for there will now be no more need of it) and conjecture whereabout the Axis of the World would paſs from the Point of the Gnomon to the Poles of the World, for into that place is the Meridian to be projected. Which that it may be done more commodiouſly, if no object ſtand in the way that will receive it, you muſt place one there, it matters not whether above or below the Gnomon, chuſe that which is moſt convenient: Or, a Thred laid aſlope in the Meridian juſtly as it ought, will ſerve as well as may be. If then you hold up a perpendicular Thred, ſo that by your Eye you may ſee the Point of the Gnomon, and alſo the Point of 12 in the Horizontal Line, both together, the ſame Thred ſo hanging, ſhall ſhew where the Meridian is to be drawn. Or, you may extend a Thred from the Point of the Gnomon to the Point of 12 in the Horizontal Line, which Thred ſhall repreſent the Line of 12: And ſtaying your Thred there, cloſe to it, hang up two perpendicular Threds at a good diſtance, ſo ſhall the ſame two Threds, give you the track of the Meridian Line.

11. The next Work will be to project one of the Poles of the World (that namely, which lies the ſame way that this projected Meridian doth from the Point of the Gnomon) into this Meridian. And this is done by elevating or depreſſing your Semicircle, from the Point of the Gnomon towards the Meridian Line, according to the Latitude of your Place; for ſo will the Ruler of the Semicircle, or a Thred extended along by it, Sign out the very Pole Point. If now you extend a Thred from this Pole Point, to the Point of the Gnomon, the ſame ſhall repreſent the Axis of the World.

12. Laſt of all; by theſe helps, all the Hours may eaſily be projected. For if the Eye do lay, or project, this Thred or Axis upon each Point of thoſe Hours that were inſerted before into the Horizontal

rizontal Line, the Axis upon an Hour Point, or a Point upon the Axis, each one of thoſe Projections ſhall repreſent upon your Dial, each of the Hours required, and will ſhew upon every Object that ſtands in the way, where the Hours are to be drawn. Or, where convenient room is wanting to place the Eye, ſo as it may make this Projection; there may two Threds be uſed for the ſame purpoſe, one whereof muſt be faſtned to the Point of the Gnomon, the other to the Pole deſigned in the Meridian Line. Then ſtretching one of the Threds to any of the Points noted in the Horizontal Line, and holding it there, you may take the other, and extend it to the Superficies, ſo as it may cloſely paſs by the firſt Thred, by which Work you may make as many Points upon your Superficies as you pleaſe, thro' which each Hour is to be drawn. Having thus traced the way before hand, you may afterward draw the Hour without any difficulty, be the Superficies never ſo irregular. Among which Lines, the Shadow of the Point of the Gnomon, as it creepeth along, will ſhew the Time of the Day.

If a Point be aſſigned upon any Superficies Flat or Curved, one, or more, wherein the Hour-Lines and Axis ſhall concur, how to project the Hours to that Point, and to ſet up an Axis after the ordinary manner to give Shadow to them without any knowledge how the Dial ſtandeth, in reſpect either of the Declination or Inclination.

1. To the Point aſſigned (upon any ſide of it) by direction of your Semicircle or other Level, ſtretch out an Horizontal Thred, ſerving for the Horizontal Line: this Horizontal Line need not be one direct Line, but may be turned at one or more Angles, provided that it lie totally in the Superficies of the Horizon.

2. With a perpendicular Thred held up, project the Sun into the aſſigned Point, and into the Horizontal Thred, and tie a little mark of Thred upon the ſame Horizontal, through which the Shadow cutteth. At the ſame inſtant alſo, take the Sun's Altitude.

3. By the Altitude taken, find out the Azimuth; This Azimuth, what-ever it be, is repreſenred by the knot.

4. Apply a Paſt-board to the Aſſigned Point, and hold it flat that it may anſwer to the Horizontal Thred alſo, and upon this Paſt-board, protract your Azimuth by a Thred extended from the Point aſſigned for the Center, to the mark upon the Horizontal Thred. This done,

5. By help of that Azimuth upon your Paſtboard, protract the Meridian Line, obſerving the true Coaſt, and quantity of the Angle from the Azimuth: and to the Meridian deſcribe an Horizontal Dial.

6. Applying the Paſt board to its place again, all things ſtanding right as before, project all the Hours in the Horizontal Thred from off the Paſtboard, and ſet marks upon the ſame for the Points of each ſeveral Hour, which marks may be little moveable Knots to ſlip to and fro upon the ſame Thred.

7. Project the Meridian Point by a perpendicular Thred upon ſome object into that place whereabouts you imagine the Axis of the World would paſs, above or below from the Point aſſigned for the Center.

8. With your Semicircle elevated or depreſſed (as it ſhall be required) from the Point aſſigned for the Center, according to your Latitude project the Pole of the World.

9. Extend a Thred from the Point aſſigned for the Center to the Poles of the World, which ſhall repreſent the Axis.

10. By the Point upon the Horizontal Thred, and this Axis (either by your Eye, laying the Axis to the Hour-points, or laying the Hour-knots to the Axis) you may project all the Hours and draw them; Or elſe you may let the Axis alone, and content your ſelf with the Pole point projected into the Meridian, for if from the Point aſſigned to be the Center or meeting of the Hours and Axis, you extend a Thred to each Hours-point in the Horizontal Line, and do repoſe (with your Eye) the ſame Thred upon the Pole-point, then ſhall the Shadow of the Thred give you that Hour-line, and do ſo in all the reſt.

11. Your Thred or Axis lying in its true ſituation, you may eaſily fit an Axis to the ſame poſture. If your Dial be deſcribed upon a plain Superficies, you may then (by one ſide of a Nominal Square, applied to a Thred or Axis, and the other ſide lying upon the Plain) find out the ſubſtyle, and meaſure from it the elevation of the Axis above the Plain: But if the Dial be deſcribed upon a curved Superficies, you muſt be content to ſet up your Axis by the direction of the Thred only.

12. This Point aſſigned for the Center, being a Point of the Axis, is as it were the Apex of the Gnomon, unto which all the Work is projected. But if it be required to ſet up an Axis to ſuch a Superficies, upon which the Axis and Hours will not meet in any tolerable manner, becauſe perhaps the Axis may be but of very ſmall elevation above the Superficies, and yet an Axis is required: in this caſe, ſet up any Point (of Wire, or ſuch like) of ſuch diſtance from the Superficies, as that the Axis and Hours may be diſtinct: And through that Point let it be required to make the Axis paſs, you have no more to do but only to project to this Point, as before, by letting the Shadow of a perpendicular Thred paſs through that Point, and noting the ſame upon your Horizontal Thred, and counting that end of the Wire as your Center, proceed as before, for the Thred that lies to project the Hours is a pattern for the Axis.

This way is as general as the former, ſerving to project the Hours upon many Superficies, be they plain or curved, and however ſituate whether contiguous, or ſeparate, and that without any laborious inquiſition of any of their Situations, in reſpect of Inclination or Declination. If you will put in that Furniture which is uſual, you muſt make ſome Mark (Notch, or Button) upon your Axis, unto which (as repreſenting the Center of the World) by help of your Semicircle you are to project the Altitudes of ſuch great or leſſer Circles as you intend to inſert; as hereafter ſhall be taught.

The 12 Propoſitions in the firſt way were to project to an Apex.

Theſe 12 Propoſitions anſwerable in the ſecond way are to project to an Axis.

And after this method it will be eaſie, and often very uſeful and curious, to Project a Dial from a ſmall Hole made in a Pane or Quarry of Glaſs; (the reſt of the Glaſs being covered) or which is better, a Plate of Tin with a round Hole of $\frac{1}{8}$ of an Inch in Diameter, being put in the room of a Pane of Glaſs) for the Sun ſhining thro' that Hole, will

will caſt a bright Spot of Light into the Room. Suppoſe then ſuch a Hoſe to be the *Nodus*, or Point of the Top of the Perpendicular Stryle of any Dial, you may draw one or *more* Dials, (each ſide or part of the Room being a different Plane) after this manner.

(1.) Apply an Horizontal Dial in a true Horizontal Poſition, ſo that its Centre lie in that of the Hole in the Pane; and then by a Thred fixed at one end of the Centre of the Dial, and laid over ſucceſſively, every Hour, Half Hour, Quarter, *&c.* find correſponding Points in the Sides of the Room where thoſe Hour-Lines interſect them: Then (2.) The Twelve a Clock Line being an Azimuth alſo as well as an Hour Line, you may by a String and Plummet brought juſt to touch that Thred when ſtrained over the 12 a Clock Hour Line, transfer that *Meridian Line* up to the Ceiling or down on the Floor, as you ſhall find occaſion. (3.) Next in this *Meridian Line* find another Point, (by help of a Thred elevation to a proper Height (in degrees) by means of a Quadrant) from which, a Line or Thred extended to the Hole in the Window may repreſent either the *Direct* (or *Reverſed*) *Axis* of the Earth; and therefore if you fix a Thred in one or both of theſe Points (or rather *Poles*) and extend it or move it along by the ſide of the other Thred, as it is brought ſucceſſively over every Hour Line on the Horizontal Dial (in whoſe Centre, as well as in that of the Hole it is fixed) and as it is extended to the correſponding Hour Points before found in the Room: I ſay, that moveable String ſhall any where on the Ceiling or on the Floor, trace out any Hour Line which the Horizontal Thred ſhall ſucceſſively repreſent.

And this Method of Projective Dialling, will direct us into this excellent Mechanick way of *Dialling* or drawing *Hour Lines* on any Plane how irregular ſoever as to Surface or Situation. Under the Plane where you intend to make a Dial, draw a true Level or *Horizontal Line*, and then to it ſet horizontally, a Scaffold or Frame of Boards, greater or leſſer, according to the deſigned Bigneſs of the Dial. Next, by ſome good Dial, Clock, Equinoctial Ring *&c.* get exactly the true Hour of the Day, and ſet your Minute Watch to it Then place a good Horizontal Dial for the Latitude of the Place and which hath a fine String faſtened in its Centre, on your Level Plane or Scaffold, and the Sun ſhining, turn it about till it ſhew the true Hour of the Day there. Then fix it; and by the motion of your Thred over every Hour, Half, Quarter, *&c.* you may eaſily project them all into your Plane or Place deſigned for the Dial.

PROLATE *Spheroid*, is a Solid produced by the Revolution of a Semi-Ellipſis about its *longer* Diameter; but if a Solid be formed by the Revolution of a Semi-Ellipſis about its *ſhorter* Diameter; 'tis then called an *Oblate Spheroid:* And of this Figure is the Earth we inhabit, and perhaps all the Planets are ſo too, having their *Equatorial* Diameter longer than their *Polar*.

PROMONTORY, is an Hill or High Land running out into the Sea: The Extremity of which towards the Sea, is uſually called a *Cape* or an *Headland*.

PROPORTIONAL *Scales*, ſometimes alſo called *Logarithmetical*; are only the Artificial Numbers or Logarithms placed on Lines, for the eaſe and advantage of Multiplying, Dividing, Extracting Roots, *&c.* by the means of *Compaſſes*, or by *Sliding Rules*; and they are only ſo many *Lines of Numbers*, as they are called by Mr. *Gunter*. (See *Gunter's Line.*) But make *Single*, *Double*, *Triple*, or *Quadruple*; beyond which they ſeldom go.

PROSTYLE, in the ancient Greek Architecture, was a Rank or Row of 4 Columns only, and whoſe Station was in the Front of a Temple, or other great Building.

PROVINCE, was uſed among the *Romans* for a Country without the Limits of *Italy*, and gained to their Subjection by the Sword. But with us the word is moſt commonly uſed for the Circuit of an Archbiſhop's Juridiction; and in ſome of our Statutes 'tis uſed for a County.

PROVISION, in the Canon Law, is uſed for the providing of a Biſhop or any other Perſon, an Eccleſiaſtical Living. by the Pope, before the Incumbent be dead. 'Tis called alſo *Gratia Expectativa*, and *Mandatum de Providendo*.

PROVISIONS: The Acts to reſtrain the exorbitant abuſe of Arbitrary Power, made in the Parliament at *Oxford*, 1258, were called *Proviſions*; becauſe they provided againſt the King's Abſolute Will and Pleaſure.

PROVISO, in the Sea Phraſe, for a Ship to *Moor a Proviſo*, is for her to have one Anchor out, and alſo a Hawſer aſhore, and ſo ſhe is moored with her Head to the Shore with two Cables.

PROVISOR, is he that ſues to *Rome* for a *Proviſion*; which ſee.

PROVOST *Marſhal*, of an Army, is one appointed to ſecure Deſerters, and all other Criminals: He is to go often abroad round the Army, to hinder the Soldiers from Pillaging: 'Tis part of his Office to indite Offenders, and to execute the Sentence paſs'd upon them. He likewiſe regulates the Weights and Meaſures, and the Price of all Proviſions, *&c.* in the Army. There is alſo a

PROVOST *Marſhal* in the Royal Navy, who hath charge of the Priſoners taken at Sea. 13 *Car.* 2. *c.* 9.

PRUDENCE, is by the Writers of Ethicks defined to be a Habit of the Mind, by which a Man judges and determines truly how he ſhould act and proceed, what he ſhould do or avoid, in all things relating to his Temporal or Eternal Advantage, ſo as to render himſelf happy here and hereafter.

PRYAN *Tin*, is a ſort of Tin that is found mix'd with a Gravelly Earth, ſometimes White, but uſually Red; 'tis not half ſo good as the other which is made out of Stone.

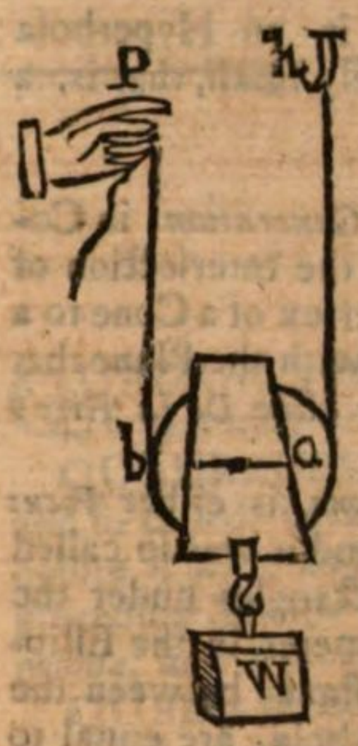
PTOLEMAICK *Syſtem* of the Heavens, was that invented by *Ptolemy*; in which he ſuppoſes the Earth immoveable any way in the Centre of the Univerſe, round about which the Moon firſt moves in a Circle; next her *Mercury*, then *Venus*: above whom moves the Sun, then *Mars*; above him *Jupiter*, and laſt of all *Saturn*, all in the Zodiack from Weſt to Eaſt. Above *Saturn* he places the Sphere of the fix'd Stars, which he ſuppoſes to move ſlowly alſo from Eaſt to Weſt, on the Poles of the Ecliptick. While the fix'd Stars themſelves, and all the Planets, move from Eaſt to Weſt on the Poles of the Equator, in the ſpace of a Natural Day or 24 Hours. This Vulgar Syſtem of Aſtronomy, (in which I omit to mention the *Epicycles* and *Deferents*, &c. with which they endeavoured to ſolve the *Phænomena* which did almoſt

moſt all of them contradict this Scheme) was plainly overturned and refuted as ſoon as ever the uſe of the Teleſcope acquainted us with the *Phaſes* of *Venus* and *Mercury*; for from thence it was apparent, that their Orbits included the Sun, and therefore by degrees it came to be quite diſuſed, and conſequently I ſhall ſay no more of it.

PULLET, in a Ship, is a little Room within her Hold, in which the Piggs of Lead, or ſuch like weighty things are put, that the Ship may be well ballaſted in a little Room.

PULLEY, is a compounded Mechanick Power, conſiſting of one or more *Shivers* or *Rundles* with proper Blocks, *&c.* to raiſe up any Weight, *&c.* and this Inſtrument ſo fitted is called *Trochlea* or the *Pulley*; and at Sea with Ropes, *&c.* fitted ſo to it, it is called *a Tackle*.

*Fig.* 1.




In every Pulley, from the Poſition and Number of the Shivers, you may know how much the Weight *W* is diminiſhed, by making the *Vis Motrix*, or Power, to be to the Weight: as 1 to the Number of the parts of the Rope going up and down.

Only this you muſt obſerve, that it is the *lower* Pulleys, or Blocks with Shivers, that give any Force to the Motion; for if a Weight hang on any upper Pulley or Shiver, it will require a Power to ſuſtain it that ſhall be fully equal to the Weight.

*Fig.* 2.

Thus if a Weight hang as in the Poſition *a W*, it would certainly fall, if a Force or Power equal to it did not hold the Rope *b d*.

And all upper *Shivers* being every where of the ſame Nature, none of them can conduce any thing towards eaſing the Power or lightening the Weight; but they only ſerve for the Convenience of the Motion.

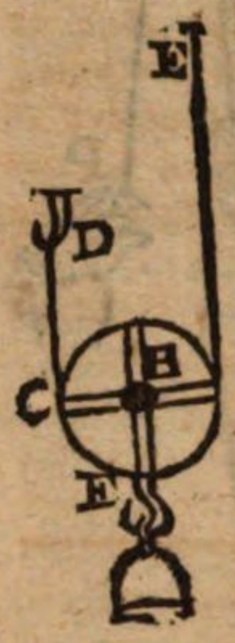
But if you ſuppoſe the Weight *W* (as in *Fig.* 1.) to be ſuſtained by the Hook *h*, above the Block *a b*, then 'tis plain that the Hook *h* will ſuſtain juſt half the Weight, and therefore the Power at *P* need be but equal to half the Weight *W*; for 'tis all one as if the Weight were hung to the middle of a Balance or Libra *a b*, whoſe equal Arms were upheld by two ſeveral Strings, as *h a* and *P b*.

'Tis alſo apparent in *Fig.* 1. That in order to raiſe the Weight *W*, the Height of one Foot, each part of the Rope, *viz. h a* and *P p*; (accounting downwards from the Hook *h*) muſt be made a Foot ſhorter, *i. e.* the Power muſt move two Feet, in order to raiſe the Weight but one: Wherefore in this Engine, the way of the Power is double to that of the Weight; and therefore their Celerities will alſo be in the ſame Ratio; wherefore if the Power be to the Weight as 1 to 2, its *Moment* will be equal to *that* of the Weight, and ſo will ſuſtain the Weight.

If the Weight be ſuſtained by 3 Turns of the Rope, and be made to aſcend one Foot (as in *Fig.* 3.) then each Part, or Turn, or Fall of the Rope muſt be ſhortened 1 Foot (reckoning as before from the Hook at *h*) and this cannot be done unleſs the Power in *P* move three Feet: Here therefore the way of the Power is *triple* to that of the Weight, as is alſo its Celerity; wherefore if the Power be to the Weight as 1 to 3, or one third of it, it will ſuſtain the Weight.

And ſo on in the 4th *Fig.* the Power *P* muſt be one fourth of the Weight, *&c.*

The *Pully* is a Wheel not only turning round its *Axis*, but made ſo, that at the ſame time 'tis *drawn up* by a Rope or Cord that goes round it: This may be conſidered as a perpetual *Homodromous* Lever or *Vectis*; for the Cord which is put over the Wheel *A F C* being faſtned at one End at *D*, and the other End at *E* being drawn or held by ſome Power, ſo that the Weight ſuſpended from the middle of the Wheel *A F C*, be kept *in Æquilibrio*; 'tis then plain, that the moving Force is apply'd to the *lower Pulley* or *Shiver* in *A*, one of the Extremes of the Lever *A C*, the other Extreme *C* riſing on the fix'd Rope or Chord *D C* as on an *Hypomochlion*. 'Tis plain alſo, that the Weight *F* is ſuſpended from the middle Point *B*, and conſequently as *A C*, the diſtance of the moving Force from the *Hypomochlion*, to *B C*, the diſtance of the Point of Suſpenſion of the Weight from the ſame (that is, as 2 to 1): : ſo is reciprocally (from the Nature of the Lever) the Weight *F* to the Force ſuſtaining it in *E*; and conſequently one under-Pulley takes off always half the Weight, or raiſes double the Weight with the ſame Power or Force.




But if the Pulley be fix'd above only, it affords no help towards lifting up the Weight more eaſily; for here the moving Force in *E* muſt be equal to the Weight in *W*, becauſe the *Hypomochlion* in this caſe is in the middle at *B*; and conſequently the Weight and Power equidiſtant from it, as in the Balance.

The upper Pulleys or Shivers then are of no other uſe but to facilitate the Motion of this Rope by their Volubility and apt Poſition.

So that to eſtimate the Power of the Combination of never ſo many Shivers or Pulleys put together, you need only *double the Number of the lower Shivers, or of the Cords which paſs over them without conſidering the upper ones, and they will give you the Multiple of the Weight to be raiſed this way*; in compariſon of what could be raiſed without any ſuch help by the ſame Power.

So the Force of 50*lb.* in a Pulley with two lower Shivers will raiſe four times as much, *viz.* 200 *lb.*

If the Force of 50 *lb.* and the Weight 200 *lb* be both given, and the Number of *Shivers* be required, 'tis plain you muſt divide 200 by 50; that is, the *Weight* by the *Power*, and the Quotient will be 4, the Number of Ropes, and the half of that is the Number of lower *Shivers*,

If the Weight, ſuppoſe 1000 *lb.* be given, and the Number of Pulleys or Ropes, ſuppoſe 4; then divide the Weight by the Pulleys, and the Quotient is the Power of Force required; *viz.* 250 *lb.* And this Method of proceeding will give you the *Deſiderata* in any Combination of Pulleys, and in any Conjugation of many Combinarions.

PULMONES. See *Lungs* in Vol. II.

PULVINATA, in Architecture, is the Term for a *Freeze*, which ſwells out like a Pillow.

PUMPS, in a Ship are of ſeveral ſorts, as the *Chain-Pumps* which are uſed in great Ships; and theſe go with more eaſe than others, yield more Water, and are eaſily mended. *Bare Pumps*, are ſmall ones made of a Cane or a piece of Wood bored thro', and are uſed to pump Beer or Water out of the Caſks. *Bur-Pumps*, are uſed by the *Dutch*, who have them by their Ships ſides. In theſe there is a long Staff with a Bur at the end like a Gunner's Spunge, to pump up the *Bildge-water*: Theſe are alſo called *Bildge Pumps*.

PUNCHINS, in Architecture, are ſhort pieces of Timber, placed to ſupport ſome conſiderable Weight: They commonly ſtand upright between the Poſts, and are ſhorter and ſlighter than either the *Principal Poſts* or *Prick Poſts*. Thoſe that ſtand on each ſide of a Door are called *Door Punchins*.

PUNCTATED *Hyperbola*, is an Hyperbola whoſe Oval Conjugate is infinitely ſmall, that is, a *Point*. See *Curves*.

PUNCTUM. See *Point*.

PUNCTUM *Formatum* ſeu *Generatum*, in Conicks, is a Point determined by the Interſection of a Right-Line drawn thro' the Vertex of a Cone to a point in the Plane of the Baſe, with the Plane that conſtitutes the Conick Section. See *De la Hire's Latin Conicks, p.* 15. 16.

PUNCTUM *ex Comparatione*, is either *Focus* in an Ellipſis and Hyperbola; and it was ſo called by *Apollonius*, becauſe the Rectangles under the Segment of the Tranſverſe Diameter in the Ellipſis, and under that and the Diſtance between the Vertex and Focus in the Hyperbola, are equal to $\frac{1}{4}$ part of what he calls *the Figure*.

PUNCTUM *Lineans*; is that point of the generating Circle, which in the Formation of either Simple Cycloids or Epicycloids, produces any part of a Cycloidal Line. See *Epicycloid*.

PUNITORY *Intereſt*, is a Term in the Civil Law, for ſuch Intereſt of Money as is given for Delay, or Breach of Truſt.

PURE *Hyperbola*, is one which by the Impoſſibility of its 2 Roots is without any *Oval*, *Node*, *Spike*, or *Conjugate Point*. See *Curves*.

PURGATIVE *Medicines*; the manner of their Operation is very well accounted for by Dr. *Cheyne* in his Book of *Fevers*, thus: Purgative Medicines being receiv'd into the Stomach by the Mouth, their Particles do there vellicate or ſtimulate the Fibres of the Stomach, and thereby encreaſe the Digeſtive Faculty; *i. e.* bring the Muſcular Fibres of the Stomach, and the Muſcles of the *Abdomen* and *Diaphragm* into more frequent Contractions than ordinary, till they are admitted into the *Inteſtines*; the *Fibres* and *Glands* of which being more ſenſible than thoſe of the Stomach (whoſe Parts, by the frequent rough Contacts of one againſt another, and of the groſs Bodies which are often thrown into it, are as it were deadned) they eaſily move and bring them into frequent forcible Contractions; whereby theſe Glands are ſqueezed, and ſo emit a Fluid which lubricates the Paſſages: And this mixing with the Fæculent Matter of the Inteſtines (which is rendred fluid by the ſame active and ſtimulating Quality of the Purgative Medicine) renders it more fluid; by which, and by

by the uncommon Contractions of the Inteſtines, it paſſes more eaſily and plentifully into the *Rectum Inteſtinum*, and is thence ejected by Stool. Thus gentle and eaſie Purges act, and do only cleanſe the Inteſtines, few of their Particles entring in by the Lacteal Veins and ſo affecting the Blood: But in violent Purgatives, the ſtimulating Particles are mixed with the Blood, and produce there many times very great effects by occaſioning unnatural Fermentations, by ſeparating the natural Cohe ſions of the Liquors of the Body; and alſo by vellicating the Spiral Fibres of the Veins and Arteries, bring thoſe into more forcible Contractions, and thereby accelerate the Motion of the Blood; all which may ſometimes have a good and ſometimes a bad effect.

PURLINS, in Architecture, are thoſe Pieces of Timber which lie acroſs the Rafters on the Inſide, to keep them from ſinking in the middle of their Length.

PURPARS, *a Purparty*, is that part or ſhare of an Eſtate, which being held in Common by Co-partners, is by Partition allotted to any one of them.

PUTLOGS, are ſhort pieces of Timber (about 7 Foot long) uſed in Building Scaffolds; they lie at Right-Angles to the Wall with one of their Ends reſting upon the *Ledgers* or Poles which lie parallel to the ſide of the Wall of the Building.

PYRAMIDALES *Papillæ*. See *Papillæ Pyramidales*.

PYRAMIDOID, is what is ſometimes called a *Parabolick Spindle*; and is a ſolid Figure formed by the Revolution of a *Parabola* round its *Baſe* or *greateſt Ordinate*; and if you conſider it according to the method of Indiviſibles, you may conceive its Solidity to conſiſt of an infinite ſeries of Circles whoſe Diameters are all parallel to the *Axis* of the *Revolving Parabola*.

PYTHAGORICK *Tetractys*, was a Point, a Line, a Surface, and a Solid.



QUADRAGATA *Terræ*; a *Team* of Land: or which may be tilled with 4 Horſes.

QUADRAGESIMA, is the firſt *Sunday* in *Lent*, and ſo called, becauſe 'tis about the fortieth Day before *Eaſter*; and on the ſame account the three preceding *Sundays* are called *Quinquageſima*, *Sexageſima*, and *Septuageſima*.

QUADRAGESIMALS: In Popiſh Times 'twas the Cuſtom for People to viſit their *Mother Church* on *Midlent Sunday*, and to make their Offerings at the High Altar. And the like kind of Superſtitious Devotion was alſo uſed in *Whitſon week*: But as the Proceſſions and Oblations at *Whitſontide* were ſometimes commuted for a rated Payment of *Pentecoſtals* or *Whitſon Farthings*; ſo theſe were changed into a Cuſtomary Payment, and were called *Quadrageſimals*; *Denarii Quadrageſimales*; and ſometimes *Lætare Jeruſalem*, becauſe that Hymn was ſung on *Midlent Sunday*. The Cuſtom of *Mothering*, as 'tis called in many places in *England*, is ſtill retained, being that of viſiting Parents on *Midlent Sunday*; and it ſeems to be called *Mothering* from the Reſpect thus in old Time paid to the *Mother Church*. And the Epiſtle of *Galat.* 4. 21. is ſtill retained on *Midlent Sunday*, which began *Jeruſalem mater omnium*, &c. tho' the occaſion of it is forgotten.

QUADRANS, the fourth part of a Penny, or a Farthing; for before the Reign of *Edw.* 1. our ſmalleſt Coin was a Penny, called then *Sterling*; and it was ſtamp'd with a Croſs or Traverſe Stroke, ſo that it might on occaſion be cut eaſily or broken into Halves or Quarters: But to avoid the Fraud of unequal diviſion of the Penny, this King *Edw.* 1. coined Half-pence and Farthings in round diſtinct Pieces. *Matt. Weſt. in Anno* 1279.

QUADRANT *of Davis*. See *Back ſtaff*.

QUADRANTATA *Terræ*, the fourth part of an Acre.

QUADRAT: To Quadrat a Piece of Ordnance, is to ſee whether it is duly placed in its Carriage, and that the Wheels be of an equal Height.

QUADRATRIX of the *Hyperbola*: There is a new Curve lately invented by Mr. *J. Perks* of *Great Swinford* in *Worceſter ſhire*, for the Quadrature of the Hyperbola; of which ſee an Account in *Phil. Tranſ. N.* 306.

QUADRATURE *Lines*, or *Lines of Quadrature*; are two Lines placed uſually, or at leaſt ſometimes, on Mr. *Gunter*'s Sector, and eaſily known there, by being mark'd with the Letter Q, and the Figures 5, 6, 7, 8, 9, 10; of which Q ſignifies the ſide of a Square, and the other Figures the ſides of Polygons of 5, 6, 7, &c. Sides. *S.* there ſtands for the Semi-diameter of a Circle, and 90 for a Line equal to 90 Degr. in the Circumference.

Their Uſes are readily (tho' not exactly) Theſe:

1. *To make a Square equal to a given Circle.*

Open the Sector to the Radius of the given Circle by applying it over in the Point *S*, *S*, and then the Parallel Diſtance between the Points Q. Q. is the ſide of the Square required.

2. *To make a Circle equal to a given Square.*

Apply the ſide of the Square over in Q. Q. ſo will the Parallel Diſtance between *S*, *S*. be the Radius of the Circle ſought.

3. *To reduce a Square, or a Circle, into a Pentagon or other regular Polygon equal to it.*

Take the Side of the Square, or Radius of the Circle given, and apply it over in its proper Points, and then the Parallel Diſtances between the Points of any of the other Polygons, ſhall be the Sides of thoſe Regular Figures.

QUADRATURE *of Curves*, by Sir *Iſ. Newton*.

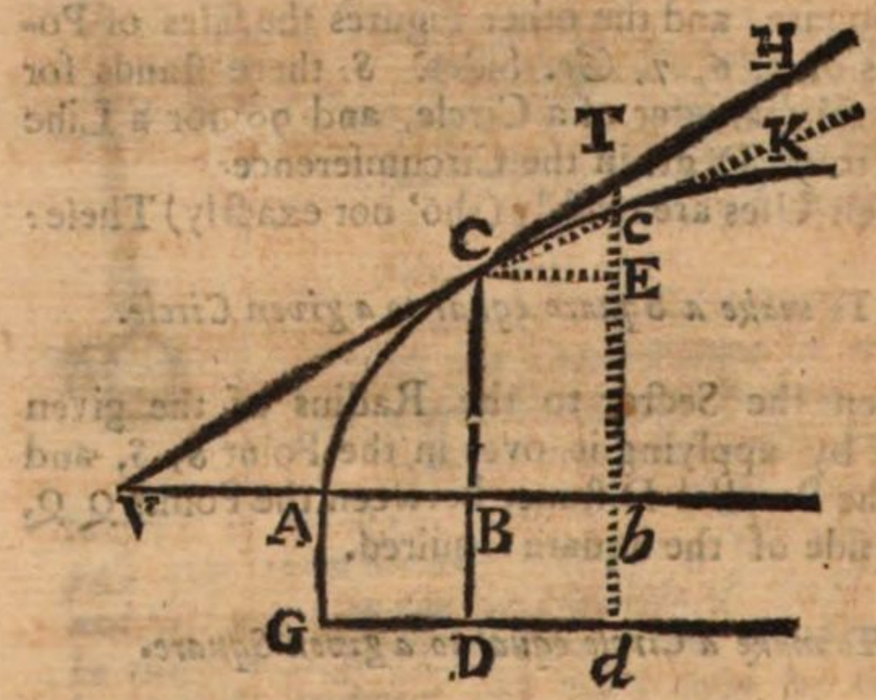
I don't here conſider Mathematical Quantities as compoſed of Parts *extreamly ſmall*, but as *generated*

*by a continual motion.* Lines are deſcribed, and by deſcribing are generated, not by any appoſition of Parts, but by a continual motion of Points. Surfaces are generated by the motion of Lines, Solids by the motion of Surfaces, Angles by the Rotation of their Legs, Time by a continual flux, and ſo in the reſt. Theſe *Geneſes* are founded upon Nature, and are every Day ſeen in the motion of Bodies.

And after this manner the Ancients by carrying moveable right Lines along immoveable ones in a Normal Poſition or Situation, have taught us the Geneſes of Rectangles.

Therefore conſidering that Quantities, encreaſing, in equal times, and generated by this encreaſing, are greater or leſs, according as their Velocity by which they encreaſe, and are generated, is greater or leſs; I endeavoured after a Method of determining the Quantities from the Velocities of their Motions, or Increments, by which they are generated; and by calling the Velocities of the Motions, or of the Augments, by the Name of *Fluxions*, and the generated Quantities *Fluents*, I (in the Year 1665 and 1666) did, by degrees, light upon the Method of *Fluxions*, which I here make uſe of in the *Quadrature of Curves.*

Fluxions are very nearly as the Augments of the Fluents, generated in equal, but infinitely ſmall parts of Time; and to ſpeak exactly, are in the *Prime Ratio* of the naſcent Augments: but they may be expounded by any Lines that are proportional to 'em. As if the *Areas ABC, ABDG* be deſcribed by the Ordinates *BC, BD*, moving with an uniform motion along the Baſe *AB*, the Fluxions of theſe *Areas* will be to one another as the deſcribent Ordinates *BC* and *BD*, and may be expounded by thoſe Ordinates; for thoſe Ordinates are in the ſame Proportion as the Naſcent Augments of the Areas.



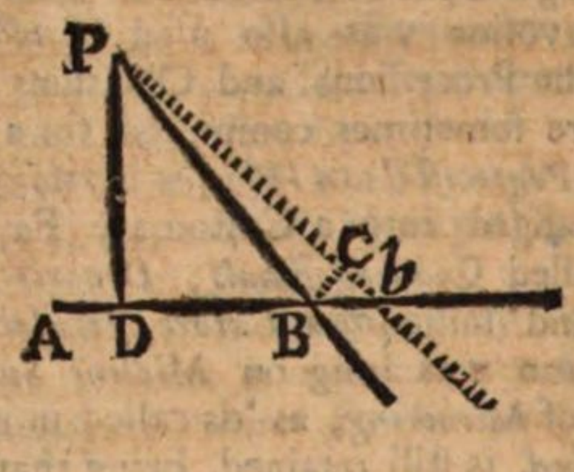

Let the Ordinate *BC* move out of its place *BC* into any new one *bc*: Compleat the Parallelogram *BCEb*, and let the right Line *VTH* be drawn which may touch the Curve *C* and meet *bc* and *BA* produced in *T* and *V*; and then the juſt now generated Augments of the Abſciſſa *AB*, the Ordinate *BC*, and the Curve Line *ACc*, will be *Bb*, *Ec*, and *Cc*; and the Sides of the Triangle *CET*, are in the *Prime Ratio* of theſe Naſcent Augments, and therefore the Fluxions of *AB*, *BC* and *AC* are as the Sides *CE*, *ET*, and *CT* of the Triangle *CET*, and may be expounded by thoſe Sides, or, which is much at one, by the Sides of the Triangle *VBC* ſimilar to it.

'Tis the ſame thing if the Fluxions be taken in the *ultimate Ratio* of the Evaneſcent Parts. Draw the Right Line *Cc*, and produce the ſame to *K*. Let the Ordinate *bc* return into its former place *BC*, and the Points *C* and *c* coming together, the Right Line *CK* co-incides with the Tangent *CH*, and the Evaneſcent Triangle *CEc* in its ultimate form becomes ſimilar to the Triangle *CET*, and its Evaneſcent Sides *CE*, *Ec* and *Cc* will be ultimately to one another as are *CE*, *ET* and *CT* the Sides of the other Triangle *CET*, and therefore the Fluxions of the Lines *AB*, *BC* and *AC* are in the ſame *Ratio*. If the Points *C* and *c* be at any ſmall diſtance from one another, then will *CK* be at a ſmall diſtance from the Tangent *CH*. As ſoon as the Right Line *CK* coincides with the Tangent *CH*, and the ultimate Ratio's of the Lines *CE*, *Ec* and *Cd* be found, the Points *C* and *c* ought to come together and exactly to coincide. For Errours, tho' never ſo ſmall, are not to be neglected in Mathematicks.

By the ſame way of arguing, if a Circle deſcribed on the Centre *B* with the Radius *BC*, be drawn with an uniform motion along the Abſciſſa *AB*, and at Right Angles to it, the Fluxion of the generated Solid *ABC* will be as the generating Circle, and the Fluxion of its Surface will be as the Perimeter of that Circle and the Fluxion of the Curve Line *AC* conjointly. For in what time the Solid *ABC* is generated by drawing the Circle along the Abſciſſa *AB*, in the ſame time its Surface is generated by drawing the Perimeter of that Circle along the Curve *AC*.

Of this Method take the following Examples.

*Let the Right Line* P B *revolving about the given Pole* P *cut the Right Line* A B *given in Poſition; the Proportions of the Fluxions of the Right Line* A B *and* P B *is required.*

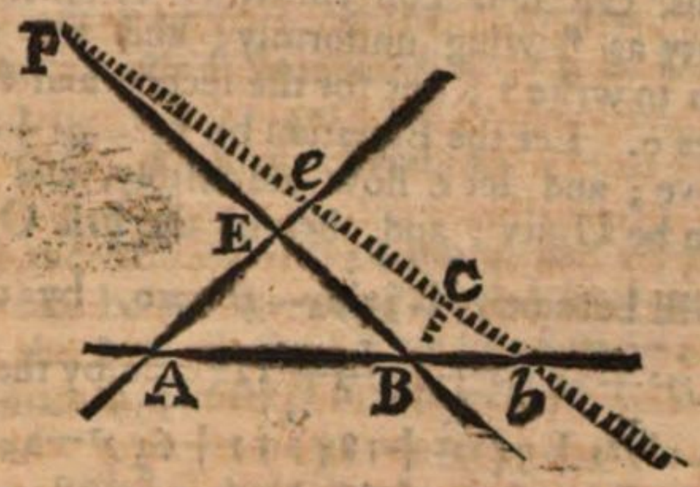



Let the Right Line *PB* go out of its place *PB* into a new one *Pb*: In the Line *Pb* take *PC* equal to *PB*, and draw *PD* to *AB* ſo that the Angle *bPD* may be equal to the Angle *bPC*; and then from the Similarity of the Triangles *bBC*, *bPD*, the Augment *Bb*, will be to the Augment *Cb* as *Pb* is to *Db*.

Now let *Pb* return into its former place *PB*, that thoſe Augments may vaniſh, and the ultimate Ratio of the Evaneſcent Augments, that is, the ultimate Ratio of *Pb* to *Db* will be the ſame as that of *PB* to *DB*, the Angle being right; and therefore the Fluxion of *AB* is to the Fluxion of *PB* in this Ratio.

*Let the Right Line* P B *revolving about the given* P *Pole cut* A B *and* A E *two other Right Lines given in Poſition in* B *and* E; *'tis required to find the Proportion of the Fluxions of thoſe Right Lines* A B *and* A E.

Let




Let the revolving Line P B move out of its place P B into a new one P b, cutting A B, A E into the Points b and E, and draw B C parallel to A E, meeting P b in C; then B b will be to B C as A b is to A e; and B C to E e as A b × P B, to A e × P E. Now let the Right Line P b return into its former place P B, and the Evaneſcent Augment B b will be to the Evaneſcent Augment E e as A B × P B is to A E × P E, and therefore in this Ratio is the Fluxion of the Right Line A B to the Fluxion of the Right Line A E.

Hence if the revolving Right Line P B cut any Curve Lines given in poſition in the Points B and E, and the moveable Right Lines A B, A E touch thoſe Curves in B and E, the Points of Section; the Fluxion of the Curve which the Right Line A B touches, will be to the Fluxion of the Curve which the Right Line A E touches, as A B × P B is to A E × P E. The ſame thing will happen if the Right Line P B always touch any Curve given in Poſition in the moveable Point P.

*Let the Quantity x flow uniformly, and let the Fluxion of $x^n$ be to be found.* In the ſame time that the Quantity $x$ by flowing becomes $x + o$, the Quantity $x^n$ will become $\overline{x + o}|^n$, that is, by the Method of Infinite Series's $x^n + noo x^{n-1} + \frac{nn-n}{2} oo x^{n-2} +$, &c. and the Augments $o$ and $noo x^{n-1} + \frac{nn-n}{2} oo x^{n-2} +$, &c. are to one another as 1 and $nx^{n-1} + \frac{nn-n}{2} oo x^{n-2} +$, &c. Now let thoſe Augments vaniſh, and their ultimate Ratio will be the Ratio of 1 to $nx^{n-1}$; and therefore the Fluxion of the Quantity $x$ is to the Fluxion of the Quantity $x^n$ as 1 to $nx^{n-1}$.

By like ways of arguing, and by the method of Prime and Ultimate Ratio's, may be gathered the Fluxions of Lines, whether Right or Crooked in all caſes whatſoever, as alſo the Fluxions of Surfaces, Angles and other Quantities. In Finite Quantities ſo to frame a Calculus, and thus to inveſtigate the Prime and Ultimate Ratio's of Naſcent or Evaneſcent Finite Quantities, is agreeable to the Geometry of the Ancients; and I was willing to ſhew, that in the Method of Fluxions there's no need of introducing Figures infinitely ſmall into Geometry. For this Analyſis may be performed in any Figures whatſoever, whether finite or infinitely ſmall, ſo they are but imagined to be ſimilar to the Evaneſcent Figures; as alſo in Figures which may be reckoned as infinitely ſmall, if you do but proceed cautiouſly.

From the Fluxions to find the Fluents is the more difficult *Problem*, and the 1ſt ſtep of the Solution of it is equivalent to the *Quadrature of Curves*; concerning which I have formerly written the following Tract.

## *A Treatiſe of the Quadrature of Curves.*

I conſider indetermined Quantities as encreaſing or decreaſing by a perpetual motion, that is, as flowing encreaſingly or decreaſingly; and I repreſent 'em by the Letters $z$, $y$, $x$, $v$, and I mark their Fluxions or their Celerities by which they encreaſe by the ſame Letters with Points over 'em thus, $\dot{z}$, $\dot{y}$, $\dot{x}$, $\dot{v}$. There are likewiſe Fluxions of Fluxions, or Mutations more or leſs ſwift, which may be called the *Second Fluxions* of $z$, $y$, $x$, $v$, and may be marked thus, $\ddot{z}$, $\ddot{y}$, $\ddot{x}$, $\ddot{v}$; and the *Firſt Fluxions* of theſe, or the *Third Fluxions* of $z$, $y$, $x$, $v$, thus, $\dddot{z}$, $\dddot{y}$, $\dddot{x}$, $\dddot{v}$; the *Fourth* thus $\ddddot{z}$, $\ddddot{y}$, $\ddddot{x}$, $\ddddot{v}$, &c. And as $\ddot{z}$, $\ddot{y}$, $\ddot{x}$, $\ddot{v}$, are Fluxions of the Quantities $z$, $y$, $x$, $v$, and theſe are Fluxions of the Quantities $\dot{z}$, $\dot{y}$, $\dot{x}$, $\dot{v}$, and theſe Fluxions of the Quantities, $z$, $y$, $x$, $v$: So theſe Quantities may be conſidered as Fluxions of others, which I ſhall mark thus, $\dot{z}$, $\dot{y}$, $\dot{x}$, $\dot{v}$; and theſe as Fluxions of others $\ddot{z}$, $\ddot{y}$, $\ddot{x}$, $\ddot{v}$, and theſe as Fluxions of others $\dddot{z}$, $\dddot{y}$, $\dddot{x}$, $\dddot{v}$. Wherefore $\dddot{z}$, $\dot{z}$. $\dot{z}$, $\ddot{z}$, $\dddot{z}$, $\ddddot{z}$, $\dot{z}$, $\ddot{z}$, &c. repreſent a Series of Quantities, in which every ſubſequent one is the Fluxion of the precedent, and any preceding one is a flowing Quantity or a Fluent, which has for its Fluxion that which follows it.

Of the like nature is this Series $\sqrt{az - \dot{z}\dot{z}}$, $\sqrt{a\dot{z} - z\dot{z}}$, $\sqrt{az - \dot{z}\dot{z}}$, $\sqrt{a\dot{z} - \dot{z}\dot{z}}$, $\sqrt{a\dot{z} - \dot{z}\dot{z}}$, $\sqrt{a\dot{z} - z\dot{z}}$; as alſo this Series,

$$\frac{a\dot{z} + \dot{z}^2}{a - \dot{z}}, \frac{a\dot{z} + \dot{z}^2}{a - z}, \frac{a\dot{z} + \dot{z}^2}{a - z}, \frac{a\dot{z} + \dot{z}^2}{a - \dot{z}}, \frac{a\dot{z} + \dot{z}^2}{a - z}, \frac{az + z\dot{z}}{a - z}.$$

And it is to be obſerved, that any preceding Quantity in theſe Series's is as the Area of a Curvilineal Figure, whoſe *Ordinate Applicate* apply'd at Right Angles is the flowing Quantity; and its *Abſciſſa* $z$: as $\sqrt{az - \dot{z}\dot{z}}$ is the Area of a Curve whoſe Ordinate Applicate is $\sqrt{a\dot{z} - \dot{z}z}$ and the Abſciſſa $z$.

The deſign of all this will be apparent from the following *Propoſitions*.

### *Prop.* 1. *Prob.* 1.

*Having given an Equation involving any number of fluent or flowing Quantities, to find their Fluxions.*

#### *Solution.*

Multiply every Term of the Equation by the Index of the Power of each flowing Quantity contained in that Term, and in each Multiplication change the Root of the Power into its Fluxion; and then the Aggregate of all the Products under their proper Signs will be the new Equation.

*Expli-*

*Explication.*

Let $a$, $b$, $c$, $d$, &c. be determined and immutable Quantities, and let any Equation be proposed containing the fluid or flowing Quantities $z$, $y$, $x$, &c. as $x^3 - xyy + aaz - b^3 = o$. First let the Terms be multiply'd by the Indexes of the Powers of $x$, and in each Multiplication, instead of the Root or Side of the Power, or instead of $x$ of one dimension only, write $\dot{x}$, and the Summ of the Products will be $3\dot{x}x^2 - \dot{x}yy$. Let the same be done by $y$, and you will have $-2\dot{y}xy$: Do the same by $z$, and there will be produced $aa\dot{z}$. Let the Summ of the Products be put equal to $o$ and you will have the Equation $3\dot{x}x^2 - \dot{x}yy - 2\dot{y}xy + aa\dot{z} = o$; I say that in this Equation the Relation of the Fluxions is determined.

*Demonstration.*

For let $o$ be a Quantity extreamly small, and let $o\dot{z}$, $o\dot{y}$, $o\dot{x}$, be the Moments of the Quantities $z$, $y$, $x$; that is, the momentaneous synchronal Increments. And if the flowing Quantities are now $z$, $y$, and $x$, these after a moment of time being augmented by their Increments $o\dot{z}$, $o\dot{y}$, $o\dot{x}$, will become $z + o\dot{z}$, $y + o\dot{y}$, $x + o\dot{x}$, which being substituted in the first Equation instead of $z$, $y$, and $x$, give this Equation, $x^3 + 3xo\dot{x} + 3xoo\dot{x}\dot{x} + o^3\dot{x}^3 - xyy - oxyy - 2xo\dot{y}y - 2xoo\dot{y}y - xoo\dot{y}\dot{y} - xo^3\ddot{y}y + aaz + aao\dot{z} - b^3 = o$. Subduct the former Equation from it and the Residual divided by $o$ will be $3\dot{x}x^2 + 3\dot{x}xo\dot{x} + \dot{x}^3oo - \dot{x}yy - 2\dot{x}y\dot{y} - 2\dot{x}o\dot{y}y - \dot{x}o\dot{y}\dot{y} - \dot{x}oo\ddot{y}y + aa\dot{z} = o$. Let the Quantity $o$ be lessened infinitely, and neglecting the Evanescent Terms, there will remain $3\dot{x}x^2 - \dot{x}yy - 2\dot{x}y\dot{y} + aa\dot{z} = o$. *Q. E. D.*

*A more full Explication of the same thing.*

After the same manner, if the Equation were $x^3 - xyy + aa\sqrt{ax - yy} - b^3 = o$, there would be produced $3\dot{x}x^2 - \dot{x}yy - 2\dot{x}y\dot{y} + aa\sqrt{\dot{a}\dot{x} - \dot{y}y} = o$; where, if you wou'd take away the Fluxion $\sqrt{\dot{a}\dot{x} - \dot{y}y}$, put $\sqrt{ax - yy} = z$, and then will $a\dot{x} - \dot{y}y = \dot{z}z$, and (by this Proposition) $a\dot{x} - 2\dot{y}y = 2z\dot{z}$ or $\frac{a\dot{x} - 2\dot{y}y}{z} = \dot{z}$, that is, $\frac{a\dot{x} - 2\dot{y}y}{2\sqrt{ax - yy}} = \sqrt{\dot{a}\dot{x} - \dot{y}y}$:

And thence $3\dot{x}x^2 - \dot{x}yy - 2\dot{x}y\dot{y} + \frac{a^3\dot{x} - 2aa\dot{y}y}{2\sqrt{ax - yy}} = o$.

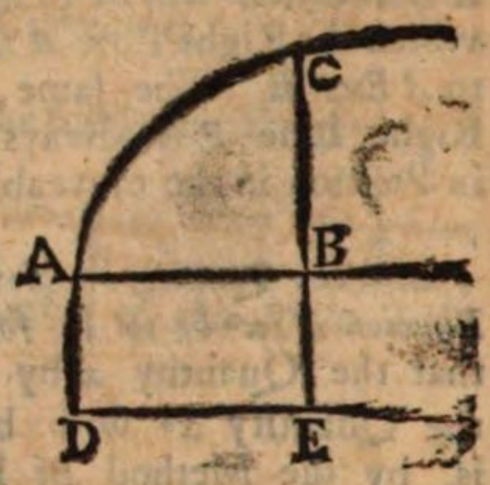
And by the same Operation, you may proceed to Second Fluxions, Third Fluxions, and so on: Let the Equation $zy^3 - z^4 + a^4$ be $= o$, then it will be made by the first Operation, $\dot{z}y^3 + 3z\dot{y}y^2 - 4\dot{z}z^3 = o$, by the Second Operatation $\ddot{z}y^3 + 6\dot{z}\dot{y}y^2 + 3z\ddot{y}y^2 + 6\dot{z}y^2y - 4\ddot{z}z^3 - 12\dot{z}^2z^2 = o$; and by the Third, $\dddot{z}y^3 + 9\ddot{z}\dot{y}y^2 + 9\dot{z}\ddot{y}y^2 + 18\dot{z}\dot{y}^2y + 3z\ddot{y}y^2 + 18z\dot{y}\ddot{y}y + 6z\dot{y}^3 - 4\dddot{z}z^3 - 36\ddot{z}\dot{z}z^2 - 24\dot{z}^3z = o$.

But when we thus proceed to Second and Third Fluxions, &c. it is convenient to consider some Quantity as flowing uniformly; and for its first Fluxion to write 1; but for the second and following ones o. Let the Equation be $zy^3 - z^4 + a^4 = o$, as above; and let $z$ flow uniformly, and let its Fluxion be Unity; and then by the first Operation it will become $y^3 + 3z\dot{y}y^2 - 4z^3 = o$, by the Second $6\dot{y}y^2 + 3\ddot{z}y^2 + 6z\dot{y}^2y - 12z^3 = o$, by the Third $9\ddot{y}y^2 + 18\dot{y}^2y + 3\ddot{z}y^2 + 18\dot{z}\dot{y}y + 6z\dddot{y}^3 - 24z = o$.

But in Equations of this kind we must conceive, that the Fluxions in each of the Terms are of the same Order, that is, that they are all either of the first Order $\dot{y}$, $\dot{z}$, or all of the Second $\ddot{y}$, $\dot{y}^2$, $\dot{y}\dot{z}$, $\dot{z}^2$, or all of the Third, $\dddot{y}$, $\ddot{y}\dot{y}$, $\ddot{y}\dot{z}$, $\dot{y}^3$, $\dot{y}^2\dot{z}$, $\dot{y}\ddot{z}^2$, $\dot{z}^3$, &c. And when the thing happens otherwise, the Order is to be compleated by the supposed Fluxions of a Quantity flowing uniformly; and then the last Equation, by compleating the third Order, becomes $9\dddot{z}\dot{y}y^2 + 18\ddot{z}\dot{y}^2y + 3z\ddot{y}y^2 + 18z\dot{y}\ddot{y}y + 6z\dot{y}^3 - 24\dot{z}z^3 = o$.

*Prop.* 2. *Prob.* 2.

*To find the Curves that are Quadrable.*




Let $ABC$ be the Figure, whose Area is to be found; $BC$ an Ordinate apply'd at Right Angles, and $AB$ the Abscissa: Produce $CB$ to $E$ that $BE$ may be $= 1$, and compleat the Parallelogram $ABED$; and the Fluxions of the Areas $ABC$, $ABED$ will be as $BC$ and $BE$: Therefore take any Equation by which the Relation of the Areas may be determined, and thence will be given the relation of the Ordinates $BC$ and $BE$, (by *Proposition* 1.) *Q. E. D.*

We shall give Examples of this thing in the two following *Propositions*.

*Prop.* 3. *Theor.* 1.

If $z$ be used promiscuously for the Abscissa $AB$ and the Area $AE$, or $AB \times 1$; and $R$ be put for $E + fz^n + gz^{2n} + hz^{3n} +$, &c. Let the Area of the Curve be $z^\theta R^\lambda$, and the Ordinate Applicate $BC$ will be $= \theta E^{+\theta}_{+\lambda n} fz^n \,^{+\theta}_{+2\lambda n} gz^{2n} \,^{+\theta}_{+3\lambda n} hz^{3n} +$ &c. into $z^{\theta-1} R^{\lambda-1}$.

*Demonstration.*

For if $z^\theta R^\lambda = v$, then by the first *Prop.* will $\theta\dot{z}z^{\theta-1} R^\lambda + \lambda z^\theta \dot{R} R^{\lambda-1} = \dot{v}$. Instead of $R^\lambda$ in the first term of the Equation, and $z^\theta$ in the second, write $R R^{\lambda-1}$ and $zz^{\theta-1}$, and then the Equation will become $\theta\dot{z}R + \lambda z\dot{R}$ into $z^{\theta-1} R^{\lambda-1} = \dot{v}$. But $R$ was taken equal to $E + fz^n + gz^{2n} + hz^{3n}$, &c. and consequently (by *Prop.* 1.) $\dot{R} = nfz\dot{z}z^{n-1} + 2ngz\dot{z}z^{2n-1} + 3nhz\dot{z}z^{3n-1} +$, &c. which being substituted in their stead, and $BE$ or 1 placed in the room of $\dot{z}$; Then

then will $\theta : \overset{+\theta}{+\lambda n} f z^n \overset{+\theta}{+2\lambda n} g z^{2n} \overset{+\theta}{+3\lambda n} b z^{3n} +$ &c. into $z^{\theta-1} R^{\lambda-1}$ be $= v = BC$. Q. E. D.

*Prop.* 4. *Theor.* 2.

If for the Abſciſſa $AB$ be put $z$, for $e + fz^n + gz^{2n} +$, &c. be put $R$, and $S$ for $k + lz^n + mz^{2n} +$ &c. Let the Area of the Curve be $z^\theta R^\lambda S^\mu$; then the Ordinate Applicate $BC$ will be =

$$\left.\begin{array}{l} \theta e k \overset{+\theta}{+\lambda n} f k z^n \overset{+\theta}{+2\lambda n} g k z^{2n} \cdot * \cdot \cdot \cdot \cdot * \cdot \cdot \cdot \cdot \\ +\theta\ e l z^n \overset{+\theta}{+\lambda n} f l z^{2n} \overset{+\theta}{+2\lambda n} g l z^{3n} * \cdot \cdot \cdot \cdot \cdot \\ +\mu n \quad +\mu n \quad +\mu n \\ +\theta \quad +\theta \quad +\theta \\ +2\mu n\ em z^{2n} \ +\lambda n\ fm z^{3n} \ +2\lambda n\ gm z^{4n} \\ +2\mu n \quad +2\mu n \end{array}\right\} \begin{array}{l} \text{into} \\ z^{\theta-1} \\ R^{\lambda-1} \\ S^{\mu-1} \end{array}$$

This is demonſtrated after the ſame manner as the former Propoſition.

*Prop.* 5. *Theor.* 3.

If $z$ be put for the Abſciſſa of the Curve $AB$, and $R$ be put for $e + fz^n + gz^{2n} + bz^{3n} +$ &c. And let the Ordinate Applicate be $z^{b-1} R^{\lambda-1}$ multiply'd into $a + bz^n + cz^{2n} + dz^{3n} +$ &c. and let $\frac{\theta}{n}$ be put $= r$. and $r + \lambda = S$. $S + \lambda = t$. $t + \lambda = v$, &c. Then the Area will be $z^\theta R^\lambda$ multiply'd into $\frac{1}{n}a + \frac{\frac{1}{n}b \cdot Sf A}{r+1, e} z^n + \frac{\frac{1}{n}C - \frac{s}{1}fB \cdot tgA}{r+2, e} z^{2n} + \frac{\frac{1}{n}d - \frac{s}{1}fC - \frac{t}{2}gB \cdot vhA}{r-3, e}$

$z^{3n} + \frac{-\frac{s}{1}fD - \frac{t}{1}gC - \frac{v}{1}hB}{r+4, e} z^{4n} +$, &c. where $A$, $B$, $C$, $D$, &c. denote the whole given Co-efficients of each Term in the Series with their Signs + and −, *viz.* $A$ denotes the Co-efficient of the firſt Term $\frac{1}{n}a$, $B$ the Co-efficient of the ſecond Term $\frac{\frac{1}{n}b - Sf A}{r+1, e}$, $C$ the Co-efficient of the third Term $\frac{\frac{1}{n}C - \frac{s}{1}fB - tgA}{r+2, e}$, and ſo on.

*Demonſtration.*

According to *Prop.* Third.

Let the *Ordinates* of the *Curves* be, and their *Areas*

$$\left.\begin{array}{l} 1,\ \theta : A \overset{+\theta}{+\lambda n} f A z^n \overset{+\theta}{+2\lambda n} g A z^{2n} \\ \quad +\theta \\ \quad +3\lambda n\ h A z^{3n}, \text{ \&c.} \end{array}\right\} A z^\theta R^\lambda$$

$$\left.\begin{array}{l} 2. \ldots \overline{\theta+n}, eBz^n \overset{+\theta+n}{+\lambda n} fBz^{2n} \\ \quad +\theta+n \\ \quad +2\lambda n\ gBz^{3n}, \text{ \&c.} \end{array}\right\} B z^{\theta+n} R^\lambda$$

$$\left.\begin{array}{l} 3. \ldots\ldots\ldots +\theta+2n, eCz^{2n} \\ \quad +\theta \\ \quad +\lambda n\ +2nfCz^{3n}, \text{ \&c.} \end{array}\right\} C z^{\theta+2n} R^\lambda$$

$$\left.\begin{array}{l} 4. \ldots\ldots\ldots\ldots +\theta+3n, \\ eDz^{3n}, \text{ \&c.} \end{array}\right\} D z^{\theta+3n} R^\lambda$$

$\Big\}\ z^{\theta-1} R^{\lambda-1}$

And if the Sum of the Ordinates be put equal to the Ordinate $a + bz^n + cz^{2n} + dz^{3n} +$, &c. multiply'd into $z^{\theta-1} R^{\lambda-1}$, the Sum of the Areas $z^\theta R^\lambda$ into $A + Bz^n + Cz^{2n} + Dz^{3n} +$, &c. will be equal to the Area of a Curve which has that for an Ordinate. Therefore let the Correſponding Terms of the Ordinate be equal; and then $a$ will become $= \theta : A$, $b = \frac{\theta}{+\lambda n} fA \overset{+\theta}{+n} eB$; $C = \frac{\theta}{+2\lambda n} gA \overset{+\theta n+n}{+\lambda n} fB + \theta + 2n$, $eC$, &c. and thence $\frac{a}{\theta e} = A$. $\frac{b - \overline{\theta+2\lambda n}, fA}{\theta+n, e} = B$. $\frac{C - \overline{\theta+2\lambda n}, gA - \overline{\theta+n+\lambda n}, fB}{\theta+2n, e} = C$. And ſo on *ad Infinitum*.

Now put $\frac{\theta}{n} = r$. $r + \lambda = S$. $S + \lambda = t$, &c. and in the Area $z^\theta R^\lambda \times A + Bz^n + Cz^{2n} + Dz^{3n}$, &c. write the values of $ABC$ found above, and there will come out the propos'd Series. Q. E. D.

And it is to be obſerved, that every Ordinate is reſolved into a Series two ways: For the Index $n$ may either be Affirmative or Negative. Let an Ordinate be propoſed $\frac{3k - lzz}{zz\sqrt{kz - lz^3 + mz^4}}$ this may be either written $z - \frac{5}{2} \times \overline{3k - lzz} \times \overline{k - lzz + mz^3}\,|^{\frac{1}{2}}$ or thus, $z \times \overline{-l + 3kz^{-2}}\,| \times m - lz^{-1} + kz^{-3}|^{-\frac{1}{2}}$. In the former Caſe $a = 3k$. $b = 0$. $c = -l$. $E = k$. $f = 0$. $g = -l$. $b = m$. $\lambda = -\frac{1}{2}$. $n = 1$. $\theta - 1 = -\frac{5}{2}$. $\theta = -\frac{3}{2}$ $= r$. $S = -1$. $t = -\frac{1}{2}$. $v = 0$. In the latter Caſe $a = -l$. $b = 0$. $C = 3k$. $e = m$. $f = -l$, $g = 0$. $b = 1$. $\lambda = -\frac{1}{2}$. $n = -1$. $\theta - 1 = l$. $\theta = 2$, $r = -2$. $S = -1\frac{1}{2}$. $t = -1$. $v = -\frac{1}{2}$. Each of theſe Caſes muſt be try'd; and if either of the Series be broken off and terminated, the Terms at length growing different, the Area of the Curve will be had in Finite Terms. So in the former Caſe of this Example, by writing in the Series the Values of $a$, $b$, $c$, $e$, $f$, $g$, $h$, $\lambda$, $\theta$, $r$, $s$, $t$, $v$, all the Terms except the firſt vaniſh *ad infinitum*, and the Area of the Curve becomes $-2\sqrt{\frac{k - lzz + mz^3}{z^3}}$. And this Area, by reaſon of the negative Sign, adjoyns to the Abſciſſa produced beyond the Ordinate. For every Affirmative Area adjoyns to both the Abſciſſa and Ordinate, but a Negative one falls on the contrary parts of the Ordinate, and adjoyns to the Abſciſſa produced, the Sign of the Ordinate remaining. By this means one of the Series, and ſometimes both, is always terminated and finite; if the Curve can be ſquared Geometrically.

But if the Curve don't admit of ſuch a Quadrature, both Series will be continued *in infinitum*, and one of 'em will converge and give the Area by approximation, except where $r$ (by reaſon of the infinite Area) is either nothing or an Integer Number and Negative, or where $\frac{z}{e}$ is equal to Unity. If $\frac{z}{e}$ be leſs than Unity, that Series will converge in which the Index $n$ is affirmative; but if $\frac{z}{e}$ be greater than Unity, the other Series will converge. In one Caſe the Area adjoyns to the Abſciſſa drawn as far as the Ordinate, in the other Caſe it adjoyns to it produced beyond the Ordinate.

Note farther, that if the Ordinate be a Rectangle under the Rational Factor $Q$ and the Surd irreducible Factor $R^\pi$, and the Side $R$ of the Surd Factor does not divide the Rational Factor $Q$; then $\lambda - 1$ will be $= \pi$; and $R^{\lambda-1} = R^\pi$: but if the Side $R$ of the Surd Factor divide the Rational Factor once, $\lambda - 1$ will be $= \pi + 1$ and $R^{\lambda-1} = R^{\pi+1}$: if it divide it twice, $\lambda - 1$ will be $= \pi + 2$

and

and $R^{\lambda-1}=R^{\pi+2}$: If thrice, $\lambda-1$ will be $=\pi+3$ and $R^{\lambda-1}=R^{\pi+3}$, and so on, *&c.*

If the Ordinate be a rational irreducible Fraction whose Denominator is composed of two or more Terms; the Denominator is to be resolved into all its first Divisors. And if there be any Divisor which has never another equal to it, the Curve is not Quadrable. But if there be two or more Divisors equal, one of them must be thrown away, and still there will be two others or more, which are equal amongst themselves and unequal to the former; one of these also must be rejected, and so of all others that are equal, if there still be more; then the Divisor that is left, or the Product under all the Divisors which are left, if there be more, must be put instead of $R$ and $R^{-2}$ the reciprocal of the Square of $R$ for $R^{\lambda-1}$, except where that Product is a Square, or a Cube, or a Biquadrate, *&c.* in which case the Side of it is to be put instead of $R$, and the Index of the Power 2, 3, or 4, taken negatively instead of $\lambda$; and the Ordinate must be reduced to the Denominator $R^2$, $R^3$, $R^4$, or $R^5$, &c.

Let the Ordinate be $\frac{z^5+z^4-8z^3}{z^5+z^4-5z^3-z^2-8z-4}$; because this Fraction is irreducible, and the Divisors of the Denominator are equal, *viz.* $z-1, z-1, z-1, z+2$, & $z+2$, I reject one Divisor of either magnitude, and the product of the remaining $z-1, z-1, z+2$, which is $z^3-3z+2$ I put instead of $R$; and the Reciprocal of the Square of $R$ which is $\frac{1}{R^2}$ or $R^{-2}$ instead of $R^{\lambda-1}$. Afterwards I reduce the Ordinate to the Denominator $R^2$ or $R^{1-\lambda}$, and it becomes $\frac{z^6-9z^4+8z^3}{\overline{z^3-3z+2}|2}$, that is, $z^3\times\overline{8-9z+z^3}\times\overline{2-3z+z^3}|-2$. And thence is $a=8$. $b=-9$. $C=0$. $d=-1$, &c. $E=2$. $f=-3$. $g=0$. $h=1$. $\lambda-1=-2$. $\lambda=-1$. $n=1$. $\theta-1=3$. $\theta=4=r$. $S=3$. $t=2$. $v=1$. and these being put in the Series, the Area comes out $\frac{z^4}{z^3-3z+2}$; all the Terms in the Series, except the first, vanishing.

If lastly, the Ordinate be an irreducible Fraction, whose Denominator is a Product under the Rational Factor $Q$, and the Surd irreducible Factor $R^\pi$, you must find all the first Divisors of the Side $R$, and reject one Divisor of each magnitude; and by those Divisors that remain, if there be any, multiply the Rational Factor $Q$; and if that Product be equal to the Side $R$, or any Power of that Side whose Index is an Integer Number; let that Index be $m$, and $\lambda-1$ will be $=-\pi\cdot m$ and $R^{\lambda-1}=R^{\pi\cdot-m}$, so that if the Ordinate be $\frac{3q^5-q^4x+9q^2xx-qqx^3-6qx^4}{qq-xx\sqrt{q^3+qqx-qxx-x^3}}$, because the Side $R$ of the Surd Factor or $q3+qqx-qxx-x^3$ has the Divisors $q+x$, $q+x$, $q-x$, which are of two Magnitudes, I reject one Divisor of each Magnitude, and multiply the rational Factor $qq-xx$ by the Divisor that is left $q+x$. And because the Product $q3+qqx-qxx-x3$ is equal to the Side $R$, I put $m=1$. and thence, since $\pi$ is $\frac{1}{3}$, $\lambda-1$ becomes $=-\frac{4}{3}$. Therefore I reduce the Ordinate to the Denominator $R-\frac{4}{3}$, and 'tis made $\frac{\overline{z0\times zq^6+2q^5x+8q^4xx+8q^3x^3\cdot 7qqx^4\cdot 6qx^5}\times\overline{q^3+qqx-qxx-x^3}|-\frac{4}{3}}{}$. from whence $a$ is $=3q^6$. $b=2q^5$, &c. $e=q^3$. $f=qq$, &c. $\theta-1=0$. $\theta=1=n$. $\lambda=-\frac{1}{3}$. $r=1$. $S=\frac{2}{3}$. $t=\frac{1}{3}$. $v=0$. and these Values being put in the Series, the Area comes out $\frac{3qqx+3x^3}{\sqrt[3]{a3+aax-axx-x^3}}$, all the Terms in the whole Series after the third, vanishing.

*Prop.* 6 *Theor* 4.

If the Abscissa $A\,B$ of a Curve be $z$, and $R$ be be put in the room of $e+fz^n+gz^{2n}+bz^{3n}+$,&c. and $S$ in the room of $k+lz^n+mz^{2n}+nz^{3n}$, &c. then let the Ordinate Applicate be $z^{\theta\cdot1}\,R^{\lambda\cdot1}\,S^{\mu\cdot1}$ multiply'd into $a+bz^n+Cz^{2n}+dz^{3n}$, &c. if there be the Rectangles of the Terms $e$, $f$, $g$, $h$, &c. and $k$, $l$, $m$, $n$, &c.

$$\left.\begin{matrix} ek & fk & gk & bk \\ el & fl & gl & bl \\ em & fm & gm & bm \\ en & fn & gn & bn \end{matrix}\right\}\ \&c$$

And if the numeral Co-efficients of those Rectangles be respectively,

$\frac{1}{n\theta}=r$, $r+\lambda=S$. $S+\lambda=t$. $t+\frac{1}{n}\lambda=v$. &c.

$r+\mu=\dot{S}$. $S+\ =\dot{t}$. $t+\mu=\dot{v}$. $v+\mu=\dot{w}$. &c.

$\dot{S}+\mu=\ddot{t}$. $\dot{t}+\mu=\ddot{v}$. $\dot{v}+\mu=\ddot{w}$. $\dot{w}+\mu=\ddot{x}$ &c.

$\ddot{t}+\mu=\dddot{v}$. $\ddot{v}+\mu=\dddot{w}$. $\ddot{w}+\mu=\dddot{x}$. $\ddot{x}+\mu=\ddddot{y}$. &c.

The Area of the Curve will be

$$\frac{\begin{matrix} tgk & & & \\ -S+1,\ fk & B & -tfl & A \\ -s+1,\ el & C & -\ddot{t}em & \\ \hline -r+2,\ ek & & & \end{matrix}}{}z^{2n}$$

$$\begin{matrix} -vbk & A \\ -\dot{v}gl & \\ -\ddot{v}fm & B \\ -\dddot{v}en & \end{matrix}$$

$$+\frac{\begin{matrix} -S+2,\ fk & B & -t+1,\ fl & C \\ -s+2,\ el & C & -\ddot{t}+1,\ em & \\ \hline -r+3,\ ek & & & \end{matrix}}{}z^{3n}+,\ \&c.$$

Where $A$ denotes the given Co-efficient of the first Term, $\frac{\frac{1}{n}a}{rtk}$ with its Sign $+$ or $-$, $B$ the given Co-efficient of the second Term, $C$ the given Co-efficient of the Third, and so on. But of the Terms $a$, $b$, $c$, &c. $e$, $f$, $g$, &c. $k$, $l$, $m$, &c. one or more

more may be wanting. This Propoſition is demonſtrated after the manner of the former, and what was obſerved there takes place here alſo. But the Series of ſuch Propoſitions as theſe run on *ad infinitum*, and the Progreſſion of the Series is evident.

*Prop.* 7. *Theor.* 5.

If $R$ be put inſtead of $e+fz^n+gz^{2n}$, &c. as above, and in the Ordinate of any Curve $z^{\theta}\pm n\sigma R^{\lambda}\pm\tau$ there remain the given Quantities $\theta, n$ $\lambda$, $e$, $f$, $g$, &c. and inſtead of $\sigma$ and $\tau$ be put any Integer Numbers ſucceſſively, and if the Area of one of theſe Curves be given, which are denoted by innumerable Ordinates coming out in theſe forms, if the Ordinates be Binomials in the *Vinculum* of the Root, or if the Areas of two of thoſe Curves be given; if the Ordinates be Trinomials in the *Vinculum* of the Root, or the Areas of three of thoſe Curves; if the Ordinates are Quadrinomials in the *Vinculum* of the Root, and ſo on infinitely: I ſay, that the Areas of all theſe Curves will be given. For *Nomes* I here take all the Terms in the *Vinculum* of the Root, as well deficient as entire, the Indexes of whoſe Powers are in an Arithmetical Progreſſion. So the Ordinate $\sqrt{a4-ax3+x4}$ by reaſon of the two different Terms between $a4$ and $ax^3$ ought to be reckoned a Quinquenomial. But $\sqrt{a4+x4}$ is a Binomial, and $\sqrt{a4+x4-\frac{x^8}{4}}$ a Trinomial, ſeeing the Progreſſion now proceeds by greater differences. This Propoſition is thus demonſtrated.

*Caſe* 1.

Let the Ordinates of two Curves be $pz^{\theta-1}R^{\lambda-1}$ and $qz^{\theta+n-1}R^{\lambda-1}$, and their Areas $pA$ and $qB$, $R$ being the Trinomial Quantity $e+fz^n+gz^{2n}$. And by *Prop.* 3. ſince $z^{\theta}R^{\lambda}$ is the Area of a Curve whoſe Ordinate is $\theta e\overset{+\theta}{+\lambda n}fz^n\overset{+\theta}{+2\lambda n}gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, ſubduct the former Ordinates and Areas from this latter Ordinate and Area, and there will remain $\begin{matrix}\theta e\\ -p\\ -qz^n\end{matrix}+\overset{\theta}{\lambda n}fz^n\overset{+\theta}{+2\lambda n}gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$ the new Ordinate of the Curve; and $z^{\theta}R^{\kappa}-pA-qB$ its Area. Put $\theta e=p$, and $\theta f+\lambda n f=q$ and the Ordinate will be found $\frac{\theta}{+2\lambda n}gz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, and the Area $z^{\theta}R^{\lambda}-\theta eA-fB-\lambda nfB$. Divide both by $\theta g+2\lambda ng$, and call the Area that will come out $C$, and taking $r$ at pleaſure, $rC$ will be the Area of a Curve whoſe Ordinate is $rz^{\theta}+z^{n-1}R^{\lambda-1}$. And after the ſame manner that from the Areas $pA$ and $qB$ we find the Area $rC$ agreeing to the Ordinate $rz^{\theta}\times z^{n-1}R^{\lambda-1}$, we may from the Areas $qB$ and $rC$ find a fourth Area, as $SD$, agreeing to the Ordinate $Sz^{\theta+3n-1}R^{\lambda-1}$, and ſo on infinitely. And from the Areas $B$ and $A$ there is a like Ratio of Progreſſion towards a contrary part. If any of the Terms $\theta$, $\theta+\lambda n$, and $\theta+2\lambda n$ be wanting, and break off the Series, aſſume the Area $pA$ in the beginning of one Progreſſion, and the Area $qB$ in the beginning of the other, and from theſe two Areas will be given all the Areas in both Progreſſions. And on the contrary, from any two other Areas aſſumed, one may go back by an Analyſis to the Areas $A$ and $B$, ſo that from theſe two Areas given, all the reſt may be given likewiſe. *Q. E. D.* This is the caſe of thoſe Curves where $\theta$ the Index of $z$ is encreaſed or diminiſhed by a perpetual addition or ſubduction of the Quantity $n$. The other is the caſe of thoſe Curves where the Index $\lambda$ is encreaſed or diminiſhed by Unites.

*Caſe* 2.

If the Ordinates $pz^{\theta-1}R^{\lambda}$ and $qz^{\theta+n-1}R^{\lambda}$, whoſe correſponding Areas are $pA$ and $qB$, be multiply'd by $R$, or $e+fz^n+gz^{2n}$, and afterwards be again divided by $R$, they become $pe+pfz^n+pgz^{2n}\times z^{\theta-1}R^{\lambda-1}$, and $qez^n+qfz^{2n}+qgz^{3n}\times z^{\theta-1}R^{\lambda-1}$. And by the 3d *Prop.* $az^{\theta}R^{\lambda}$ is the Area of a Curve whoſe Ordinate is $\theta ae\overset{+\theta}{+\lambda n}afz^n\overset{+\theta}{+2\lambda n}agz^{2n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$, and $bz^{\theta+n}R^{\lambda}$ is the Area of a Curve whoſe Ordinate is $\begin{matrix}\theta\\ +n\\ +\lambda n\end{matrix}bez^n+\overset{\theta}{+n}bfz^{2n}\overset{+\theta}{+n}bgz^{3n}$ multiply'd into $z^{\theta-1}R^{\lambda-1}$. The Summ of theſe 4 Areas is $pA+qB+az^{\theta}R+bz^{\theta+n}R^{\lambda}$, and the Summ of their correſponding Ordinates.

$$\theta ae\overset{+\theta}{+\lambda n}afz^n\overset{+\theta}{+2\lambda n}agz^{2n}\overset{+\theta}{+n}bgz^{3n}\overset{+\theta}{+2\lambda n}\text{ into }z^{\theta-1}R^{\lambda-1}$$

$$+pe\overset{+\theta}{+n}be\quad\overset{+\theta}{+n}bf\quad+qg$$
$$+\lambda n$$
$$+pf$$
$$+pg$$
$$+qe\quad+qf$$

If the Firſt, Third and Fourth Term be ſeparately put equal to nothing; by the firſt Term, $\theta ae+pe$ will be made $=0$ or $-\theta a=p$, by the Fourth $-\theta b-nb-2\lambda nb=q$, and by the Third (ſtriking out $p$ and $q$) $\frac{2ag}{f}=b$. From whence the ſecond Term becomes $\frac{\lambda naff-4\lambda nage}{f}$, and therefore the Summ of the four Ordinates is $\frac{\lambda naff-4\lambda nage}{f}z^{\theta+n-1}R^{\lambda-1}$, and the Summ of ſo many correſponding Areas is $az^{\theta}R^{\lambda}+\frac{2ag}{f}z^{\theta+n}R^{\lambda}\ \theta aA-\frac{2\theta+2n+4\lambda n}{f}agB$. Divide theſe Summs by $\frac{\lambda naff-4\lambda nage}{f}$, and if the latter Quote be called $D$; $D$ will be the Area of a Curve whoſe Ordinate is the firſt Quote $z^{\theta+n-1}R^{\lambda-1}$. And after the ſame way by putting all the Terms of the Ordinate except the firſt equal to nothing, the Area of a Curve may be found whoſe Ordinate is $z^{\theta-1}R^{\lambda-1}$. Let that Area be called $C$, the ſame way that the Areas $C$ and $D$ are found from the Areas $A$ and $B$, two other $E$ and $F$ may be found from $C$ and $D$, agreeing to the Ordinates $z^{\theta-1}R^{\lambda-2}$ and $z^{\theta+n-1}R^{\lambda-2}$, and ſo on *in infinitum*: And by a contrary Analyſis one may proceed back again from the Areas $E$ and $F$ to the Areas $C$ and $D$, and thence to the

the Areas *A* and *B*, and others which follow in the Progreſſion. Therefore if the Index λ be encreaſed or diminiſhed by a continual addition or ſubduction of Unities; and of the Areas, correſponding to the Ordinates coming out in theſe Forms, two of the moſt ſimple be known, all others are given *in infinitum*. Q. E. D.

*Caſe* 3.

And by theſe two Caſes conjoined, if both the Index θ be any how increaſed or diminiſhed by the continual addition or ſubduction of *n*; and the Index λ, by the perpetual addition or ſubduction of Unity, the Areas correſponding to the ſeveral ariſing Ordinates, will be given.

*Caſe* 4.

And by a like encreaſe, if the Ordinate be expreſſed by 4 *Nomes* in the *Radical Vinculum*, and 3 of the Areas are given; or if it be expreſs'd by 5 *Nomes* and 4 of the Areas given, and ſo on: All the Areas will be given which can be generated by adding or ſubducting the Number *n* to or from the Index θ; or Unity, to or from the Index λ. And 'tis the ſame caſe with Curves whoſe Ordinates are expreſſed by Binomials and one Area of thoſe which are not Quadrable Geometrically, is given.

*Prop.* 8. *Theor.* 6.

If for $e+fz^n+gz^{2n}+$ &c. and $k+lz^n+mz^{2n}+$ &c. you put *R* and *S* as before, and in the Ordinate of any Curve $z^{\theta+n\sigma}R^{\lambda}\pm^{\tau}S^{\mu+\upsilon}$ the given Quantities θ, *n*, λ, μ, *e*, *f*, *g*, *k*, *l*, *m*, &c. remain; and that for σ, τ, and υ, any Integer Numbers be ſucceſſively written, and if the Areas of two of the Curves are given which are denoted by the Ordinates ſo ariſing, if the Quantities *R* and *S* are Binomials; or if the Areas of three of the Curves be given, if *R* and *S* conſiſt conjointly of 5 *Nomes*; or if the Areas of 5 Curves be given, when *S* and *R* conſiſt jointly of ſix *Nomes*, &c. and ſo on *in infinitum*: I ſay, the Areas of all the Curves will be given.

The Demonſtration is like that of the former *Propoſition*.

*Prop.* 9. *Theor.* 7.

*The Areas of theſe Curves are equal to one another whoſe Ordinates are as the Fluxions of the Abſciſſa.*

For the Rectangles under the Ordinates and the Fluxions of the *Abſciſſæ* are equal, and the Fluxions of the *Areas* are as thoſe Rectangles.

*Corol.* 1.

If any Relation between the *Abſciſſæ* of two Curves be aſſumed, and thence (by *Prop.* 1.) the Relation between the Fluxions of the *Abſciſſæ* be ſought, and the Ordinates be ſuppoſed reciprocally proportionable to the Fluxions; then innumerable Curves may be found, whoſe *Areas* ſhall be mutually equal to one another.

*Corol.* 2.

For ſo will every Curve whoſe Ordinate is $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\text{&c.}}|^{\lambda}$, by aſſuming any Quantity for *v*, and putting $\frac{n}{v}=S$ and $z^v=x$, change into another equal to it ſelf, whoſe Ordinate will be $\frac{v}{n}x^{\frac{v\theta-n}{n}}$ into $\overline{e+fx^v+gx^{2v}+\text{&c.}}|^{\lambda}$

*Corol.* 3.

And every Curve whoſe Ordinate is $z^{\theta-1}$ into $\overline{a+bz^n+cz^{2n}+\text{&c.}} \times \overline{e+fz^n+gz^{2n}+\text{&c.}}|^{\lambda}$, by taking any Quantity for *v* and putting $\frac{n}{v}=S$, and $z^v=x$, will change into another equal to it ſelf whoſe Ordinate ſhall be $\frac{v}{n}x^{\frac{v\theta-n}{n}}$ into $\overline{a+bx^v+cx^{2v}+\text{&c.}} \times \overline{e+fx^v+gx^{2v}+\text{&c.}}|^{\lambda}$

*Corol.* 4.

And every Curve whoſe Ordinate is $z^{\theta-1}$ into $a+bz^n+cz^{2n}+\text{&c.} \times \overline{e+fz^n+gz^{2n}+\text{&c.}}|^{\lambda} \times \overline{k+lz^n+mz^{2n}+\text{&c.}}|^{\mu}$, by taking any Quantity for *v* and putting $\frac{n}{v}=S$ and $z^v=x$, changes into another Curve equal to it ſelf, whoſe Ordinate is $\frac{v}{n}x^{\frac{v\theta-n}{n}}$ into $a+bx^v+cx^{2v}+\text{&c.} \times \overline{e+fx^v+gx^{2v}+\text{&c.}}|^{\lambda} \times \overline{k+lx^v+mx^{2v}+\text{&c.}}|^{\mu}$

*Corol.* 5.

And every Curve whoſe Ordinate is $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\text{&c.}}|^{\lambda}$ by putting $\frac{1}{z}=x$, changes into another equal to it ſelf, whoſe Ordinate is $\frac{1}{x\theta+1} \times \overline{e+fx^n+gz^{2n}+\text{&c.}}|^{\lambda}$ that is $\frac{1}{x\theta+1+n\lambda} \times \overline{f+ex^n}|^{\lambda}$, if there are two *Nomes* in the *Vinculum* of the Root, or $\frac{1}{x\theta+1+2n\lambda} \times \overline{g+fx^n+ex^{2n}}|^{\lambda}$ if there are three *Nomes*, &c.

*Corol.* 6.

And every Curve whoſe Ordinate is $z^{\theta-1}$ into $\overline{e+fz^n+gz^{2n}+\text{&c.}}|^{\lambda} \times \overline{k+lz^n+mz^{2n}+\text{&c.}}|^{\mu}$, by putting $\frac{1}{z}=x$, changes into another equal to it ſelf, whoſe Ordinate is $\frac{1}{x\theta+1} \times \overline{e+fx^n+gx^{2n}+\text{&c.}}|^{\lambda} \times \overline{k+lx^n+mx^{2n}+\text{&c.}}|^{\mu}$, that is $\frac{1}{x\theta+1+n\lambda+n\mu} \times \overline{f+ex^n}|^{\lambda} \times \overline{l+kx^n}|^{\mu}$ if there are two *Nomes* in the *Vinculum* of the Root, or $\frac{1}{x\theta+1+2n\lambda+n\mu} \times \overline{g+fx^n+ex^{2n}}|^{\lambda} \times \overline{l+kx^n}|^{\mu}$, if there be three *Nomes* in the *Vinculum* of the former Root, and two in that of the latter; and ſo in others.

*N. B.* The two equal Areas in theſe two laſt *Corollaries* lie on oppoſite ſides of the Ordinates: If the Areas in either Curve join to the Abſciſſa, the correſponding equal Area in the other Curve adjoins to the Abſciſſa produced.

*Corol.*

*Corol.* 7.

If the Relation between the *Ordinate y* of any Curve and its *Abſciſſa x* be expreſſed by any adfected Equation of this form, $y^{\alpha}$ into $e+fy^{n}z^{\delta}+gy^{2n}z^{2\delta}+hy^{3n}z^{3\delta}+$&c. $=z^{\beta}$ into $k+ly^{n}z^{\delta}+my^{2n}z^{2\delta}+$ &c. this Figure, aſſuming $S=\frac{n-\delta}{n}$, $x=\frac{1}{s}z^{s}$, and $\lambda=\frac{n-\delta}{\alpha\delta+\beta n}$, changes into another equal to it ſelf, whoſe *Abſciſſa x*, from the *Ordinate v* being given, is determined by an Equation not affected; as $\frac{1}{s}v^{\omega\lambda}\times\overline{e+fv^{n}+gv^{2n}+hv^{3n}+\&c.}|^{\lambda}\times\overline{k+lv+mv^{2n}+\&c.}|^{\lambda}=x$.

*Corol.* 8.

If the Relation between the Ordinate *y* of any Curve, and its Abſciſſa *z* be determined by any adfected Equation in this Form, $y^{\alpha}$ into $\overline{e+fy^{n}z^{\delta}+gy^{2n}z^{2\delta}}=z^{\beta}$ into $\overline{k+ly^{n}z^{\delta}+my^{2n}z^{2\delta}+\&c.}+z^{\gamma}$ into $p+qy^{n}z^{\delta}+ry^{2n}z^{\delta}+$ &c. then this Figure, aſſuming $S=\frac{n-\delta}{n}$ $x=\frac{1}{s}z^{s}$ $\mu=\frac{\alpha\delta+\beta n}{n-\delta}$ and $\nu=\frac{\alpha\delta+\gamma n}{n-\delta}$, changes into another equal to it ſelf, whoſe *Abſciſſa x*, from the given Ordinate *v* being given, is determined by an Equation leſs affected, as $v^{\alpha}$ into $e+fv^{n}+gv^{2n}+$&c. $=S^{\mu}x^{\mu}$ into $k+lv^{n}+mv^{2n}+$ &c. $+S^{\nu}+x^{\nu}$ into $p+qv^{n}+rv^{2n}+$ &c.

*Corol.* 9.

Every Curve whoſe Ordinate is $\pi z^{\theta-1}$ into $\overline{e+fz^{n}+gz^{2n}+\&c.}^{\nu}_{n}\times\overline{e+fz^{n}+gz^{2n}\&c.}|^{\lambda-1}\times\overline{|a+b|ez^{\nu}+fz^{\nu+n}+gz^{\nu+2n}+\&c.|^{\tau}}|^{\omega}$, if $\theta=\lambda\nu$ and there be aſſumed $x=\overline{ez^{\nu}+fz^{\nu+n}+gz^{\nu+2n}+\&c.}|^{\pi}$, $\sigma=\frac{\tau}{\pi}$, and $\vartheta=\frac{\lambda-\pi}{\pi}$, changes into another equal to it ſelf, whoſe Ordinate is $x^{\theta}\times\overline{a+bx^{\sigma}}|^{\omega}$. And obſerve that the former Ordinate in the *Corollary* becomes more ſimple by putting $\lambda=1$, or by putting $\tau=1$, and by effecting, that the Radix of the Dignity may be extracted, whoſe Index is $\omega$, or alſo by putting $\omega=-1$ and $\lambda=1=\tau=\sigma=\pi$, that I may paſs by other Caſes, *&c.*

*Corol.* 10.

For $ez+fz^{\nu+n}+gz^{\nu+2n}+$ &c. $vez^{\nu-1}+\nu fz^{\nu+n}+$ $+\nu+2n\,gz^{\nu+2n-1}+$ &c. $k+lz^{n}+mz^{2n}+$ &c. and $nlz^{n-1}+2nmx^{2n-1}+$ &c. let *R*, *r*, *S* and *s* be ſubſtituted reſpectively, and then every Curve whoſe Ordinate is $\pi Sr+\phi R^{r}$ into $R^{\lambda-1}S^{\mu-1}\times\overline{aSv+bR\tau}|^{\omega}$, if it be $\frac{\mu-\upsilon\omega}{\lambda}=\frac{\upsilon}{\tau}=\frac{\phi}{\pi}$, $\frac{\tau}{\pi}=\sigma$, $\frac{\lambda-\pi}{\pi}=\vartheta$, and $R^{\pi}S_{\phi}=x$, changes into another equal to it ſelf, whoſe Ordinate is $x^{\vartheta}\times\overline{a+bx^{\sigma}}|^{\omega}$. And obſerve, that the former Ordinate grows more ſimple, by putting Unities for $\tau$, $\upsilon$, $\lambda$ or $\mu$, and by effecting that the Radix of the Dignity may be extracted, whoſe Index is $\omega$, or by putting $\omega=-1$ or $\mu=0$.

*Prop.* 10. *Prob.* 3.

To find the moſt ſimple Figures with which any Curve may be Geometrically compared, whoſe *Ordinate Applicate y*, by an Equation not affected, is determined from having the *Abſciſſa z* given.

*Caſe* 1.

Let the Ordinate be $az^{\theta-1}$, and then the Area will be $\frac{1}{\theta}az^{\theta}$, as will eaſily be collected from *Prop.* 5. by putting $b=o=c=d=f=g=h$ and $e=1$.

*Caſe* 2.

Let the Ordinate be $az^{\theta-1}\times\overline{fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$ then if the *Curve* can be compared Geometrically with *Rectilineal Figures*, it may be ſquared by *Prop.* 5. by putting $b=o=c=d$. If not, let it be changed into another Curve equal to it, whoſe Ordinate ſhall be $\frac{a}{\theta}x\frac{\theta-n}{n}\times\overline{e+fx+gx^{2}+\&c.}|^{\lambda-1}$ by *Cor.* 2. *Prop* 9. Then if out of the Index of the Dignities $\frac{\theta-n}{n}$ and $\lambda-1$ (by *Prop.* 7.) you reject the Unities till thoſe Dignities become the leaſt poſſible, you will then come to the moſt ſimple Figures that can be by this means collected. Then every one of theſe, (by *Cor.* 5. *Prop.* 9.) gives another which is ſometimes yet more ſimple. And from theſe, by *Prop.* 3. and *Cor.* 9. and 10. of *Prop.* 9. compared one with another, ſome yet more ſimple Figures come out. And laſtly, by aſſuming theſe to be the moſt ſimple Figures; and by proceeding in a Reverſe or Inverſe Method, may the required *Area* be computed.

*Caſe* 3.

Let the Ordinate be $z^{\theta-1}\times\overline{a+bz^{n}+cz^{2n}+\&c.}\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$, then will this Figure, if ſquarable, be ſquared by *Prop.* 5. But if not, then the Ordinate muſt be diſtinguiſhed into the Parts, $v^{\theta-1}\times a\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}$, $z^{\theta-1}\times bz^{n}\times\overline{e+fz^{n}+gz^{2n}+\&c}|^{\lambda-1}$, &c. and by *Caſe* 2. the moſt ſimple Figures are to be found with which the Figures correſponding in thoſe Parts may be compared; for then the Areas of the Figures correſponding to thoſe Parts, and connected with their proper Signs $+$ and $-$, will compoſe the whole Area ſought.

*Caſe* 4.

Let the Ordinate be $z^{\theta-1}\times\overline{a+bz^{n}+cz^{2n}+\&c.}\times\overline{e+fz^{n}+gz^{2n}+\&c.}|^{\lambda-1}\times\overline{k+lz^{n}+mz^{2n}+\&c.}|^{\mu-1}$ and then if the Curve be Quadrable, it will be ſquared by *Prop.* 6. But if not, let it by *Cor.* 4. *Prop.* 9. changed into a more ſimple one, and then compared with the moſt ſimple Figures according

to *Prop* 8. and *Cor.* 6, 9, and 10, of *Prop.* 9 as was done in *Case* 2 and 3.

*Case* 5.

If the Ordinate consist of different Parts, then the several Parts are to be esteemed as the Ordinates of so many different Curves, and those Curves, as many as are Quadrable, are to be squared, and their Ordinates subducted from that of the whole Curve.

*Corol.* 1.

Hence every Curve whose Ordinate is the Square Root of its affected Equation, may be compared with the most simple Figures, whether Rectilineal or Curvilineal. For that Root always consists of two Parts, which considered severally, are not affected Roots of Equations. Let the Equation be proposed $aayy+zzyy=2a^3y+2x^3y-z^4$ its Root when extracted will be $y=\frac{a^3+z^3+a\sqrt{a4+2z^3-z^4}}{aa+zz}$ whose rational part $\frac{a^3+z^3}{aa+zz}$ and its Surd or Irrational Part $\frac{a\sqrt{a4+2az^3-z^4}}{aa+zz}$ are the Ordinates of Curves that may either be squared by this Proposition, or compared with the most simple Figures, with whom they admit a Geometrical Comparison.

*Corol.* 2.

And every Curve whose Ordinate is determined by any affected Equation, which by *Cor.* 7. *Prop.* 9. doth not go into an Equation not affected, is either, if squarable at all, squared by this Proposition, or else is compared with the most simple Figures possible. And by this means is every Curve squared, whose Equation consists of three Terms; for if that Equation be affected, 'tis changed into one not so by *Cor.* 7. *Prop.* 9. and then by *Cor.* 2. and 5. of *Prop.* 9. passing into a most simple one, either gives the Quadrature of the Figure, if it be squarable, or a most simple Curve, with whom it may be compared.

*Corol.* 3.

And every Curve whose Ordinate is determined by any adfected Equation, which by *Cor.* 8. of *Prop.* 9. passes into a Quadratick affected Equation; is either squared by this *Prop.* and its first *Corollary*, if quadrable at all, or else is compared with the most simple Figures, and with which it admits a Geometrical Collation.

*Scholium.*

When Figures are to be squared, it will be too troublesome always to have recourse to these General Rules: wherefore it is better once to *square* the most *simple* and *useful Figures*, and then to keep Tables of such Quadratures, to which to have recourse whenever such a kind of Curve is to be squared. Of this kind are the two following Tables; in which $z$ denotes the *Abscissa*, $y$ the *Rectangular Ordinate*, $e$ the *Area* of the Curve to be squared, and $d$, $e$, $f$, $g$, $h$ and $n$ represent given Quantities with their Signs + and —.

## *A* TABLE *of the more Simple Quadrable Curves.*

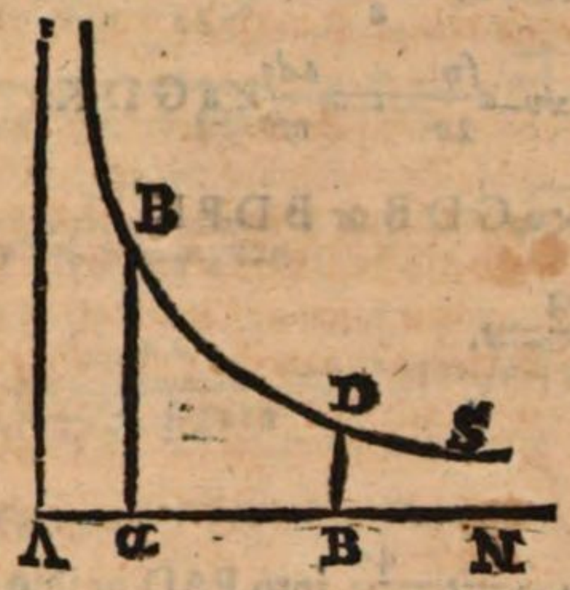
| *The Forms of the Curves.* | *The Areas of the Curves.* |
|---|---|
| Form 1. | |
| $dz^{n-1}=y$ | $\frac{d}{n}z^n=t.$ |
| Form 2. | |
| $\frac{dz^{n-1}}{ee+2efz^n+ffz^{2n}}=y.$ | $\frac{dz^n}{nee+nnfz^n}=t,$ or $\frac{-d}{nef+nnfz^n}=t.$ |
| Form 3. | |
| 1. $dz^{n}_{-1}\sqrt{e+fz^n}=y.$ | $\frac{2d}{3nf}R^3=t.$ supposing $R=\sqrt{e+fz^n}$ |
| 2. $dz^{2n}_{-1}\sqrt{e+fz^n}=y.$ | $\frac{-4e+6fz^n}{15nff}dR^3=t.$ |
| 3. $dz^{3n}_{-1}\sqrt{e+fz^n}=y.$ | $\frac{16ee-24efz^n+30ffz^{2n}}{105nf^3}dR^3=t.$ |
| 4. $dz^{4n}_{-1}\sqrt{e+fz^n}=y.$ | $\frac{-96e^3+144eefz^n-180effz^{2n}+210f^3z^{3n}}{945nf^4}dR^3=t.$ |
| Form 4. | |
| 1. $\frac{dz^{n-1}}{\sqrt{e+fz^n}}=y.$ | $\frac{2d}{nf}R=t.$ |
| 2. $\frac{dz^{2n-1}}{\sqrt{e+fz^n}}=y$ | $\frac{-4e+2fz^n}{3nff}dR=t.$ |

3. $dz^{3n-1}$

| | |
|---|---|
| 3. $\frac{dz^{3n-1}}{\sqrt{e+fz^n}}=y.$ | $\frac{16ee-8efz^n+6ffz^{2n}}{15nf^3}dR=t.$ |
| 4. $\frac{dz^{4n-1}}{\sqrt{e+fz^n}}=y.$ | $\frac{-96e^3+48eefz^n-36effz^{2n}+30f^3z^{3n}}{105nf^4}dR=t.$ |

## *A* TABLE *of those more Simple Curves which may be compared with the Ellipsis and the Hyperbola.*

Fig. 5.



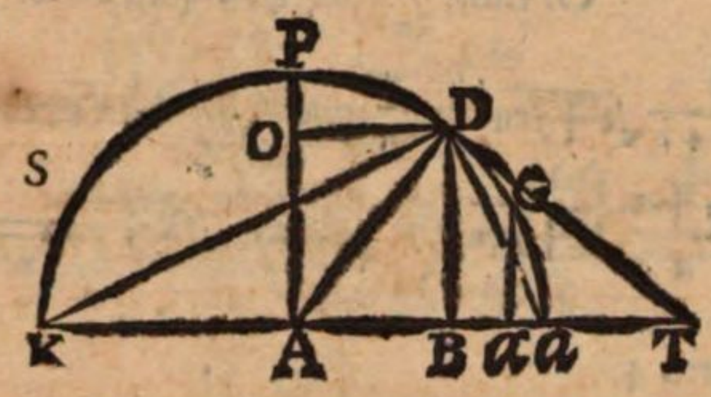
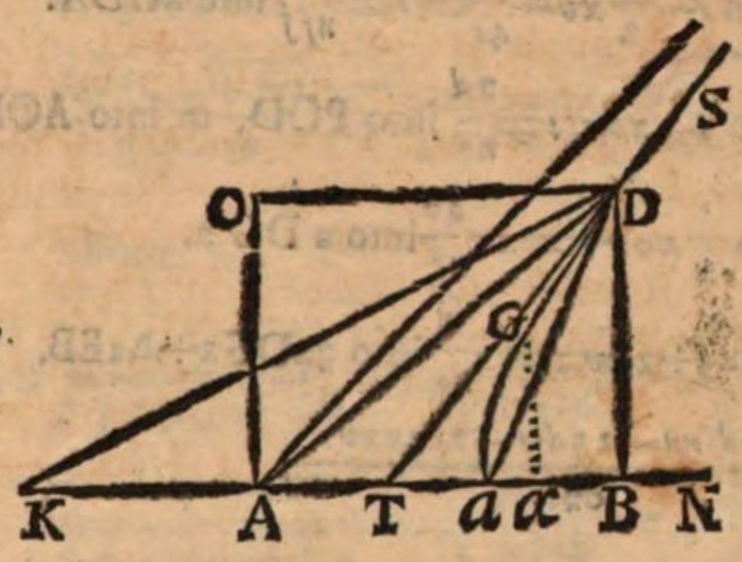




Fig. 6.

Fig. 7.



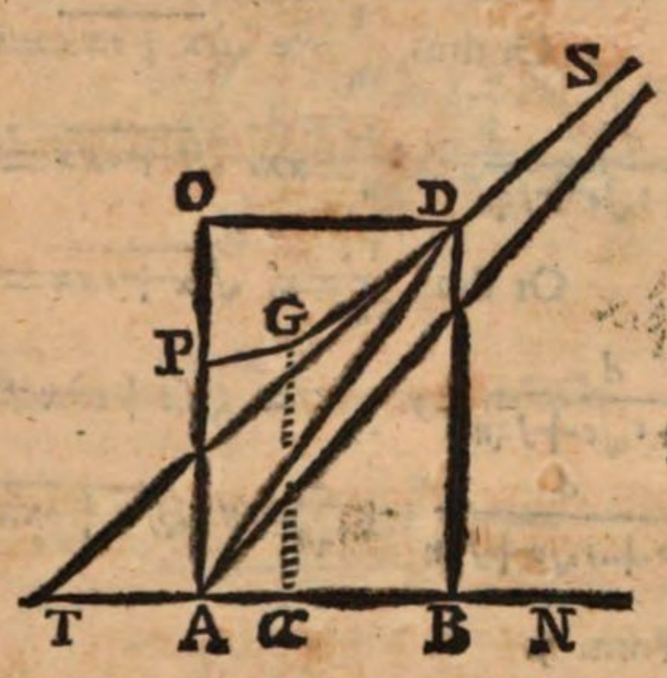




Fig. 8.

Let $a\,G\,D$ or $P\,G\,D$ or $G\,D\,S$ be a Conick Section whose Area is required to the Quadrature of a Curve proposed, and let its Centre be $A$, its Axis $K\,a$, its Vertex $a$, its Semi-Conjugate Axis $A\,P$, the given beginning of the Abscissa $A$, or $a$, or $\alpha$; the Abscissa $A\,B$, or $a\,B$, or $\alpha\,B=x$, the Rectangular Ordinate $B\,D=v$, and the Area $A\,B\,D\,P$ or $a\,B\,D\,G$ or $\alpha\,B\,D\,G=s$, the Ordinate $\alpha\,G$ being applied at the Point $\alpha$. Join $K\,D$, $A\,D$, $a\,D$, and let the Tangent $D\,T$ be drawn, meeting the Abscissa $A\,B$ in $T$, and then let the Parallelogram $A\,B\,D\,O$ be compleated. If then to the Quadrature of the Curve proposed the Areas of two Conick Sections are required; let the Abscissa of the latter be $\xi$, the Ordinate $\tau$, and the Area $\sigma$ And let this Character $\div$ stand for the difference of two Quantities, when 'tis uncertain which is the greater, and consequently which can be taken from the other.

| *The Forms of the Curves.* | *Of the Conick Section.* Abscissa. | Ordinate, | *The Area of the Curves.* |
|---|---|---|---|
| **Form 1.** | | | |
| Fig. 5. 1. $\frac{dz^{n-1}}{e+fz^n}=y.$ | $z^n=x.$ | $\frac{d}{e+fx}=v.$ | $\frac{1}{n}s=s=\frac{aGDB}{n}$ |
| 2. $\frac{dz^{2n-1}}{e+fz^n}=y.$ | $z^n=x.$ | $\frac{d}{e+fx}=v.$ | $\frac{d}{nf}z^n-\frac{e}{nf}s=t.$ |
| 3. $\frac{dz^{3n-1}}{e+fz^n}=y.$ | $z^n=x.$ | $\frac{d}{e+fx}=v.$ | $\frac{d}{2nf}z^{2n}-\frac{de}{nff}z^n+\frac{ee}{nff}s=t.$ |
| **Form 2.** | | | |
| Fig. 6, 7. 1. $\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$ | $\sqrt{\frac{d}{e+fz^n}}=x.$ | $\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$ | $\frac{2xv\div 4s}{n}=t=\frac{4}{n}ADGa$ |
| 2. $\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$ | $\sqrt{\frac{d}{e+fz^n}}=x.$ | $\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$ | $\frac{2de}{nf}z^{\frac{n}{2}}+\frac{4es-2exv}{nf}=t.$ |
| 3. $\frac{dz^{\frac{1}{2}n-1}}{e+fz^n}=y.$ | $\sqrt{\frac{d}{e+fz^n}}=x.$ | $\sqrt{\frac{d}{f}-\frac{e}{f}xx}=v.$ | $\frac{2de}{3nf}z^{\frac{3n}{2}}-\frac{2dee}{nff}z^{\frac{n}{2}}+\frac{2eexv-4ees}{nff}=t.$ |

**Form 3.**

Form 4.

Fig. 6, 7, 8. 1. $\frac{d}{z}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{4de}{nf}$ into $\frac{v3}{2ex}-s=s=\frac{4de}{nf}$ into a GDT, or APDB÷TDB

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{8dee}{nff}$ into $s-\frac{1}{2}xv.\ \frac{fv}{4e}+\frac{ffv}{4eex}=t=\frac{8dee}{nff}$ into aGDA$+\frac{ffv}{4eex}$

2. $\frac{d}{z^n+1}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{2d}{n}s=t=\frac{2d}{n}$ APDB, or $\frac{2d}{n}$ aGDB.

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{4de}{nf}$ into $s-\frac{1}{2}xv-\frac{fv}{2e}=t=\frac{4de}{nf}\times$ a G D K.

3. $\frac{d}{z^{2n+1}}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{d}{n}s=t=\frac{d}{n}\times$ a G D B or B D P K.

4. $\frac{z^{3n}+1}{d}\sqrt{e+fz^n}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{3dfs-2dv3}{6ne}=t.$

Form 4.

Fig. 6. 1. $\frac{d}{z\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=xx.\ \sqrt{fx+exx}=v.\ \frac{4d}{nf}$ into $\frac{1}{2}xv.\div=t=\frac{4d}{nf}$ into PAD or into aGDA

Or thus, $\frac{1}{z^n}=x\ \sqrt{fx+exx}=v.\ \frac{8de}{nff}$ into $s-\frac{1}{2}xv-\frac{fv}{4e}=t=\frac{8de}{nff}$ into aGDA.

2. $\frac{d}{z^{n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=xx.\ \sqrt{f+exx}=v.\ \frac{2d}{ne}$ into $s-xv=t=\frac{2d}{ne}$ into POD, or into AODG a.

Or thus, $\frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{4d}{nf}$ into $\frac{1}{2}xv\div s=t=\frac{4d}{nf}$ into a DG a.

3. $\frac{d}{z^{2n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{d}{ne}$ into $3\div 2xv=t=\frac{d}{ne}$ into 3aDGa÷ΔaEB.

4. $\frac{d}{z^{3n+1}\sqrt{e+fz^n}}=y.\ \frac{1}{z^n}=x.\ \sqrt{fx+exx}=v.\ \frac{10dfxu-15dfs-2dexxv}{6nee}=t.$

Form 5.

1. $\frac{dz^{n-1}}{e+fz^n+gz^{2n}}=y.\ \sqrt{\frac{d}{e+fz^n+gz^{2n}}}=x.\ \sqrt{\frac{d}{g}+\frac{ff-4eg}{4gg}xx}=v.\ \frac{xv-2s}{n}=t.$

Or thus, $\sqrt{\frac{dz^{2n}}{e+fz^n+gz^{2n}}}=x.\ \sqrt{\frac{d}{g}+\frac{ff+4eg}{4gg}xx}=v.\ \frac{xv-2s}{n}=t.$

2. $\frac{dz^{2n-1}}{e+fz^n+gz^{2n}}=y.\ \begin{cases}\sqrt{\frac{d}{e+f3n+z^{2n}}}=x.\\ fz^n+gz^{2n}=\xi.\end{cases}\ \begin{cases}\sqrt{\frac{d}{g}+\frac{ff+4eg}{4gg}}xx=v.\\ \frac{1}{e+\xi}=\Upsilon.\end{cases}\ \frac{d\sigma+2fs-fxv}{2ng}=t.$

Form 6. where $p$ is put for $\sqrt{ff-4eg}$.

1. $\frac{dz^{\frac{1}{2}n-1}}{e+fz^n+gz^{3n}}=y.\ \begin{cases}\sqrt{\frac{2dg}{e-p+2gz^n}}=x.\\ \sqrt{\frac{2dg}{f+p+2gz^n}}=\xi.\end{cases}\ \begin{cases}\sqrt{d+\frac{-f+p}{2g}xx}=v.\\ \sqrt{d+\frac{-f+p}{2g}\xi\xi\Upsilon.}\end{cases}\ \frac{2xv-4s-2\xi\Upsilon+4\sigma}{np}=t.$

2. $\frac{dz^{\frac{3}{4}n-1}}{e+fz^n+gz^{2n}}=y.\ \begin{cases}\sqrt{\frac{2dez^n}{fz^n-pz^n+2e}}=x.\\ \sqrt{\frac{2dez^n}{fz^n+pz^n+2e}}=\xi.\end{cases}\ \begin{cases}\sqrt{d+\frac{-f+p}{2e}xx}=v.\\ \sqrt{d+\frac{-f+p}{2e}\xi\xi}=\Upsilon.\end{cases}\ \frac{4s-^2nv-4\sigma+^2\xi\Upsilon.}{np.}=t.$

Form 7.

1. $\frac{d}{z}\sqrt{e+fz^n+gz^{2n}}=y.\ \begin{cases}z^n=x.\sqrt{e+fx+gxx}=v.\\ \frac{1}{z^n}=\xi.\sqrt{g+f\xi+e\xi\xi}=\Upsilon.\end{cases}\ \frac{4deex\Upsilon+2defx\Upsilon-2dffv-8deex\sigma+4dfgs}{4neg-nff}=t.$

Fig. 6, 7. 2. $dz^{n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\ \sqrt{e+fx+gxx}=v.\ \frac{d}{n}s=t=\frac{d}{n}$ into a G D F.

3. $dz^{2n-1}$

3. $dz^{2n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\sqrt{e+fx+gxx}=v.\ \frac{d}{3ng}v3-\frac{df}{2ng}s=t.$

4. $dz^{3n-1}\sqrt{e+fz^n+gz^{2n}}=y.\ z^n=x.\sqrt{e+fx+gxx}=v.\ \frac{6dgx-5df}{24^{n}gg}v3+\frac{5dff-4deg}{16ngg}s=t.$

Form 8.

Fig. 6. 1. $\frac{dz^{n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x\sqrt{e+fx+gxx}=v.\ \frac{8dgs-4dgxv-2dfv}{4neg-nff}=t=\frac{8dg}{4neg-nff}\times$ a GDB $\pm$ $\Delta$DBA.

2. $\frac{dz^{2n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.z^n=x.\sqrt{e+fx+gxx}=v.\ \frac{-4dfs+2dfxv+4dev}{4neg-nff}=t.$

3. $\frac{dz^{3n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.\ z^n=x.\sqrt{e+fx+gxx}=v.\ \frac{3dff_s-2dff\ xv-2defv}{4neg-4deg}=t.$

4. $\frac{dz^{4n-1}}{\sqrt{e+fz^n+gz^{2n}}}=y.z^n=x.\sqrt{e+fx+gxx}=v.\ \frac{36defg_s+8degg_{xxv}-28defg_{xv}+10deeg_v-15deff_s-2dffg_{xxv}+10deff_{xv}-16deef_v}{24neg3-6nffg}=t.$

Form 9.

1. $\frac{dz^{n-1}\sqrt{e+fz^n}}{g+bz^n}=y.\sqrt{\frac{d}{g+bz^n}}=x.\sqrt{\frac{df}{b}+\frac{eb-fg}{b}xx}=v.\ \frac{4fg_s-2fg_{xv}+\frac{2dfv}{x}}{4eb_s+2nb}=t.$

2. $\frac{dz^{2n-1}\sqrt{e+fz^n}}{g+bz^n}=y.\sqrt{\frac{d}{g+bz^n}}=x.\sqrt{\frac{df}{b}+\frac{eb-fg}{b}xx}=v.\ \frac{4egb_s-2egb_{xv}+\frac{2}{3}dbv3-2dfg\frac{v}{x}}{-4fgg_s+2fgg\frac{x3}{nfbb}x}=t.$

Form 10.

Fig. 6. 1. $\frac{dz^{n-1}}{g+bz^n\sqrt{e+fz^n}}=y.\sqrt{\frac{d}{g+bz^n}}=x.\sqrt{\frac{df}{b}+\frac{eb-fg}{b}xx}=v.\ \frac{2xv-4s}{nf}=t=\frac{4}{nf}$ ADGa.
7.

2. $\frac{dz^{2n-1}}{g+bz^n\sqrt{e+fz^n}}=y.\sqrt{\frac{d}{g+bz^n}}=x.\sqrt{\frac{df}{b}+\frac{eb-fg}{b}xx}=v.\ \frac{4gs-2gxv+\frac{2dv}{x}}{nfb}=t.$

Form 11.

1. $dz^{a-1}\sqrt{\frac{e+fz^n}{g+bz^n}}=y.$ $\left\{\begin{array}{l}\sqrt{g+bz^n}=x.\sqrt{\frac{eb-fg}{b}+\frac{f}{b}xx}=v.\\ \sqrt{b+gz^{-n}}=\xi.\sqrt{\frac{fg-eb}{g}+\frac{e}{g}\xi\xi}=\upsilon.\end{array}\right\}\ \frac{dxv3z^{-n}-4dfs-4deo}{nfg-neb}=t.$

2. $dz^{n-1}\sqrt{\frac{e+fz^n}{g+bz^n}}=y.\sqrt{g+bz^n}=x.\sqrt{\frac{eb-fg}{b}+\frac{f}{b}xx}=v.\ \frac{2d}{nb}s=t.$

3. $dz^{2n-1}\sqrt{\frac{e+fz^n}{g+bz^n}}=y.\sqrt{g+bz^n}=x\sqrt{\frac{eb-fg}{b}+\frac{f}{b}xx}=v.\ \frac{dbxv^3-3dfg_s-deb}{2nfbb}=t.$

In these Tables the Series of the Curves, of any Form, may be continued both ways *in infinitum*; *viz.* In the First Table, in the Numerators of the Areas of the 3d. and 4th. Form the Numeral Coefficients of the Initial Terms (2,—4, 16,—96, 868, *&c.*) are generated by multiplying the Numbers—2,—4,—6,—8,—10, *&c.* into one another continually; and the Co-efficients of the subsequent Terms are divided from the Initial ones, by multiplying them gradually. In the Third Form, by $-\frac{3}{2},-\frac{5}{4},-\frac{7}{6},-\frac{9}{8},-\frac{11}{10}$, *&c.* and in the Fourth Form, by $-\frac{1}{2},-\frac{3}{4},-\frac{5}{6},-\frac{7}{8},-\frac{9}{10}$, *&c.* and the Co efficients of the Denominators, 3, 15, 105, *&c.* are produced by multiplying the Numbers, 1, 3. 5, 7, 9, *&c.* into one another continually.

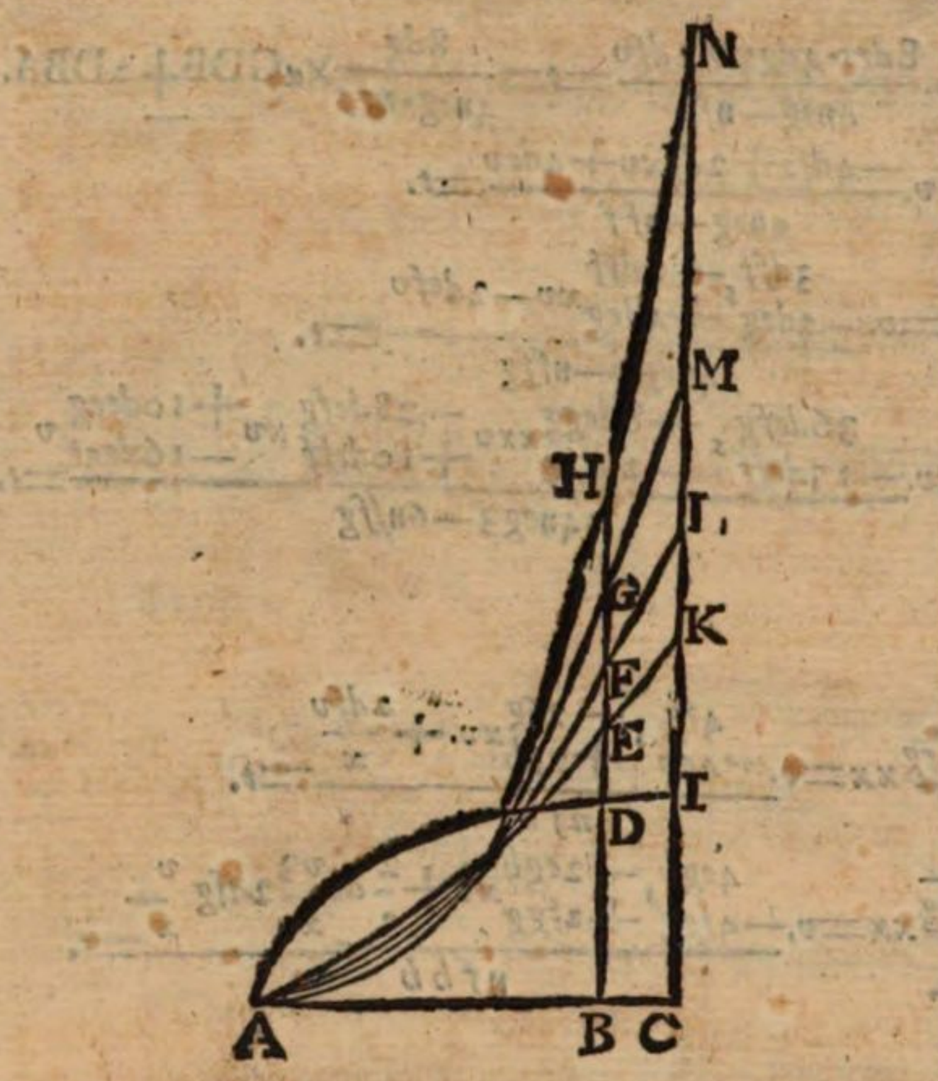
But in the Second Table, the *Series* of the Curves of the First, Second, Fifth, Sixth, Ninth and Tenth Form, are found by Division alone; and of the other Forms remaining, by help of *Prop.* the Third and Fourth, produced both ways *in infinitum.*

And as these Series may be varied by changing the Sign of the Number $n$: So, for instance, the Curve $\frac{d}{z}\sqrt{e+tz^n}=y$ becomes $\frac{d}{z^{\frac{1}{2}n}+1}\sqrt{fez^n}$.

*Prop.* 9. *Theor.* 8.

Let $ADIC$ be any Curve having its Abscissa $AB=z$ and its Ordinate $BD=y$; and let $AEKC$ be another Curve whose Ordinate $BE$ is equal to the Area of the former $ADB$ divided by Unity; and let $AFLC$ be a Third Curve, whose Ordinate $BF$, is equal to the Area of the Second $AEB$ divided by 1; and let $AGMC$ be a Fourth Curve whose Ordinate $BG$ is equal to the Area $AFB$ of the Third divided by Unity; and let $AHNC$

$AHNC$ be a Fifth Curve whose Ordinate $BH$ is equal to the Area of the Fourth $AGB$ divided by Unity, and so on *in infinitum*. And let $A$, $B$, $C$, $D$, $E$, &c. be the Areas of the Curves whose Ordinates are $y$, $zy$, $z^2y$, $z^3y$, $z^4y$, &c. and whose common Abscissa is $z$.




Let any Abscissa $AC=t$ be given, and let $BC=t-z=x$, and let $P$, $Q$, $R$, $S$, $T$, &c. be the Areas of Curves having for their Ordinates $y$, $xy$, $x^2y$, $x^3y$, $x^4y$, &c. and their common Abscissa $z$.

Let all these Areas terminate at the whole given Abscissa $AC$, and at the Ordinate given in Position and infinitely produced $CI$: And then shall the first of the Areas thus posited, $ADIC$ be $=A=P$: The Second $AEKC=tA-B=Q$. The Third $AFLC=\frac{ttA-2tB+C}{2}=\frac{1}{2}R$. The Fourth $AGMC=\frac{t^3A-3ttB+3tC-D}{6}=\frac{1}{6}S$. The Fifth $AHNC=\frac{t^4A+t^3B+6ttC-4tD+E}{24}=\frac{1}{24}T$.

*Corol.*

Whence if the Curves, whose Ordinates are $y$, $zy$, $z^2y$, $z^3y$, &c. or $y$, $xy$, $x^2y$, $x^3y$, &c. are squarable, the Curves $ADIC$, $AEKC$, $AFLC$, $AGMC$, &c. will also be squared; and the Ordinates $BE$, $BF$, $BG$, $BH$, will be proportionable to the Areas of the Curves.

*Scholium.*

That the Fluxions of Flowing Quantities may be considered as *First*, *Second*, *Third*, *Fourth* Fluxions, &c. hath been said above: And these Fluxions are as the *Terms of infinitely converging Series*. Thus, suppose $z^n$ a Flowing Quautity, and that by flowing it become $\overline{z+o}|^n$, then may it be resolv'd into this Converging Series $z^n+noz^{n-1}+\frac{nn-n}{2}oo z^{n-2}+\frac{n^3-3nn+2n}{6}o^3z^{n-3}+$ &c. In which *Series* the first Term $z^n$ is the Flowing Quantity it self; the Second $oz^{n-1}$ shall be the first *Increment* or the first Difference, to which considered as just *Nascent*, the *first Fluxion* is proportional. The Third Term $\frac{nn-n}{2}oz^{n-2}$ will be the *Second Increment* or *Difference* to which considered as now *Nascent*, the *Second Fluxion* is proportional. The Fourth Term $\frac{n^3-3nn+2n}{6}o^3z^{n-3}$ shall be the Fluents third *Increment* or *Difference*, and to which as Nascent, the Third Fluxion is proportional, &c. and so on infinitely.

These *Fluxions* may be expounded by $BD$, $BE$, $BF$, $BG$, $BH$, &c. considered as the Ordinates of Curves. As if the Ordinate $BE\left(=\frac{ADB}{1}\right)$ be a *Fluent* or flowing Quantity, the first Fluxion will be as the Ordinate $BD$: If $BF$ be the Fluent $\left(=\frac{AEB}{1}\right)$ the first Fluxion of it shall be as the Ordinate $BE$, and the second as the Ordinate $BD$. If $BH\left(=\frac{AGB}{1}\right)$ be the Flowing Quantity, its Fluxions, considered as First, Second, Third and Fourth, shall be respectively as the Ordinates $BG$, $BF$, $BE$, and $BD$. (*See the last Figure.*)

Hence, in Equations which involve only two unknown Quantities, of which one is a Quantity uniformly flowing, and the other is any Fluxion of another Flowing Quantity. That other *Fluent* may be found by the *Quadrature of Curves*: Let its Fluxion be expounded or expressed by $BD$; and if this be the first Fluxion, seek the Area $ADB=BE\times 1$: If it be the Second Fluxion, let the Area $AEB=BF\times 1$ be sought; if it be the Third Fluxion, let the Area $AFB=DG\times 1$ be sought; and the Area, when found, shall be the Exponent of the Flowing Quantity sought.

And also in Equations which involve a Fluent and its first Fluxion without any other Fluent; or two Fluxions of the same Fluent; suppose the First and Second, the Second and Third, the Third and Fourth, &c. still without any other Fluent, then the Fluents may be found by the Method of the *Quadrature of Curves*.

Let the Equation be $aav=\dot{a}v+v\dot{v}$; supposing $v=BE$ and $\dot{v}=BD$, $z=AB$ and $\dot{z}=1$. This Equation, by compleating the Dimensions of the Fluxions will become $aa\dot{v}=\dot{a}vz+v\dot{v}\dot{z}$, $\frac{aa\dot{v}}{\dot{a}v+v\dot{v}}=\dot{z}$. Suppose then $v$ to flow uniformly, and let its Fluxion be $\dot{v}=1$, then shall $\frac{aa}{\dot{a}v+v\dot{v}}=\dot{z}$; and by squaring the Curve whose Ordinate is $\frac{aa}{\dot{a}v+v\dot{v}}$ and Abscissa $v$, you will have the Fluent or Flowing Quantity $z$.

Again, let the Equation be $aa\dot{v}=\dot{a}\dot{v}+v\ddot{v}$, and let $v$ be $=BF$, $\dot{v}=BE$, $\ddot{v}=BD$, and $z=AB$: Then by the Relation between $\ddot{v}$ and $\dot{v}$ or $BD$ and $BE$, the Relation between $AB$ and $BE$ will be found as in the Example above: after which, by this Relation may the Relation between $AB$ and $BF$ be found, if the Curve $AEB$ be squared.

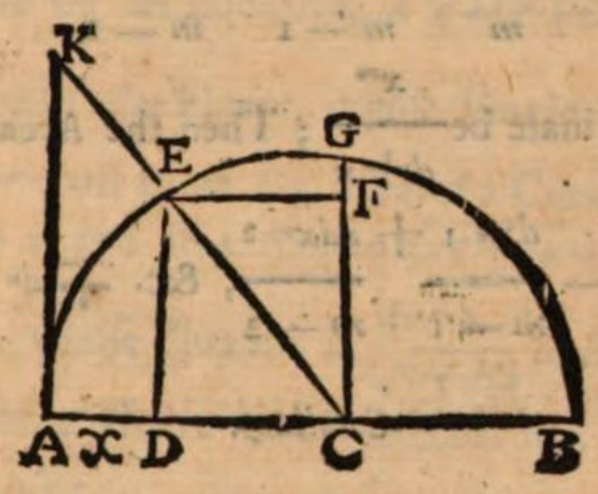
Such Equations as involve three unknown Quantities may sometimes be reduced to such as involve only two Unknown Quantities; in which Cases the Fluents will be found from the Fluxions,

*Corol.* 2.

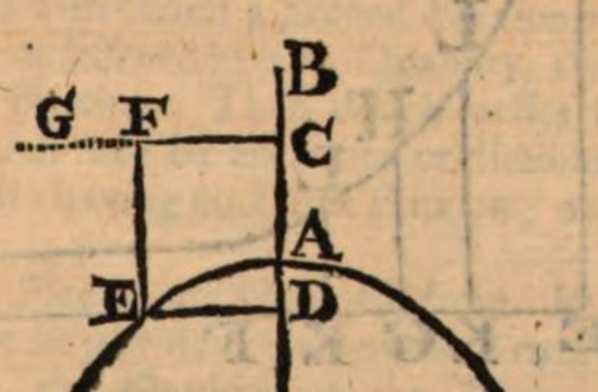
If $n$ be ſuppoſed equal to any Term in the following Series, 1, 2, 3, 4, 5, 6, 7, &c. Every Curve whoſe Ordinate is $\frac{x-n}{\sqrt{dx \pm xx}}$ will be ſquared by this *Series*, and come out in finite Terms.

*Corol.* 3.

If $m$ be equal to any Term in this Series, 0, 1, 2, 3, 4, 5, 6, 7, &c. Every Curve whoſe Ordinate is $\frac{x^m}{\sqrt{dx-xx}}$ depends upon the Quadrature of the Circle: But if the Ordinate be $\frac{x^m}{\sqrt{dx+xx}}$, on that of the *Hyperbola*: And if on the Centre $C$, with the Diameter $AB=d$, the Circle $AEB$ be deſcribed; and $AD$ be made $=x$, and $DE$ erected at Right-angles, and $CE$ drawn: Then will the Se-




ctor $AEC$ divided by $\frac{dd}{8}$, be equal to the Area of the Curve whoſe Ordinate is $\frac{x^0}{\sqrt{dx-xx}}$; after the ſame Manner if on the Centre $C$, and the Tranſverſe Axis $AB=d$, an Equilateral Hyperbola be deſcribed; as $AE$: Let $AD=x$ and $DE$ erected Normally, and $CE$ drawn: Then ſhall the Se-




ctor $ACE$ divided by $\frac{dd}{8}$ be equal to the Area of the Curve whoſe Ordinate is $\frac{x^0}{\sqrt{dx+xx}}$.

*Corol.* 4.

If $m$ be ſuppoſed equal to any Term not included within the former Limits; The Curve whoſe Ordinate ſhall be, $\frac{x^m}{\sqrt{dx \pm xx}}$ can neither be ſquared exactly, nor doth it depend on either the Circle or the Hyperbola; but yet is reducible to ſome more Simple Curve.

*Theorem* 3.

If $A$ be the Area of a Curve, whoſe Abſciſſa is $x$, and Ordinate $x^m \sqrt{xx-xx}$; Let $B$ be the Area of a Curve, whoſe Abſciſſa is the ſame $x$, and its Ordinate $x^{m-2n} \sqrt{rr-xx}$; and ſuppoſe $\sqrt{rr-xx}=y$. Then ſhall $A$ be equal to $r^{2n}B$ into $\frac{m-1}{m+2}$ into $\frac{m-3}{m}$ into $\frac{m-5}{m-2}$ into $\frac{m-7}{m-4}$, &c. $=P$.

$$-\frac{1}{m+2}x^{m-1}y^3=-Q.$$

$$-\frac{rr}{m}\text{ into }\frac{m-1}{m+2}x^{m-3}y^3=-R.$$

$$-\frac{r4}{m-2}\text{ into }\frac{m-2}{m+2}\text{ into }\frac{m-3}{m}x^{m-5}y^3=-S, \&c.$$

*Corol.* 1.

If $m$ be equal to any Term of the following Series 1, 3, 5, 7, 9, &c. The Quadrature of the Curve, whoſe Ordinate is $x^m \sqrt{rr \pm xx}$ will come out finite, and be expreſſed by the Theorem.

*Corol.* 2.

If $n$ be equal to any Term in this Series 2, 3, 4, 5, 6, &c. The Curve whoſe Ordinate is $x^{2n} \sqrt{rr \pm xx}$ will be exactly ſquared by this Theorem.

*Corol.* 3.

If $m$ be expounded by any Term different from thoſe above mentioned; the Curve whoſe Ordinate is $x^m \sqrt{rr \pm xx}$ is neither exactly quadrable, nor dependant on the Circle or Hyperbola; but yet is reducible to a more Simple Form.

*Theorem* 4.

If $A$ be the Area of a Curve whoſe Abſciſſa is $x$, and its Ordinate $\frac{x^m}{\sqrt{rr-xx}}$: Let $B$ be the Area of *another*; whoſe Abſciſſa $x$ is the ſame with the former; but its Ordinate $\frac{x^{m-2n}}{\sqrt{rr-xx}}$; Then I ſay,

$$A=r^{2n}B\text{ into }\frac{m-1}{m}\text{ into }\frac{m-3}{m-2}\text{ into }\frac{m-5}{m-4}\text{ into }\frac{m-7}{m-6}, \&c.=P.$$

$$-\frac{1}{m}x^{m-1}y=-Q.$$

$$-\frac{rr}{m-2}\text{ into }\frac{m-1}{m}x^{m-3}y=-R.$$

$$-\frac{r4}{m-4}\text{ into }\frac{m-1}{m}\text{ into }\frac{m-3}{m-2}x^{m-5}y=-S.$$

$$-\frac{r6}{m-6}\text{ into }\frac{m-1}{m}\text{ into }\frac{m-3}{m-2}\text{ into }\frac{m-5}{m-4}x^{m-7}y=-T, \&c.$$

*Corol.* 1.

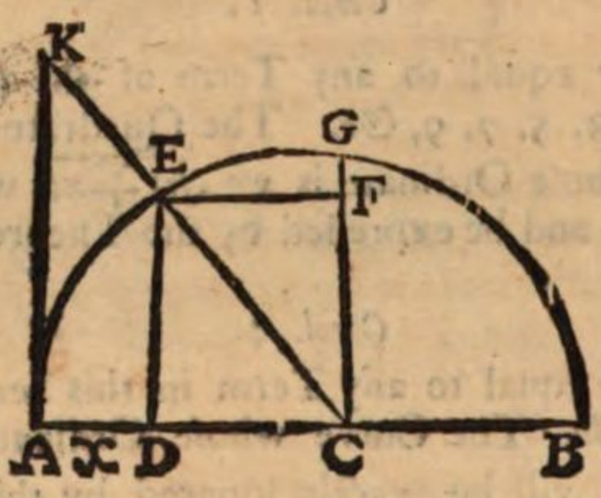
If $m$ be equal to any Term of this Series 1, 3, 5, 7, 9, &c. the Curve whose Ordinate is $\frac{x^m}{\sqrt{rr+xx}}$ will be found by this Theorem in finite Terms.

*Corol.* 2.

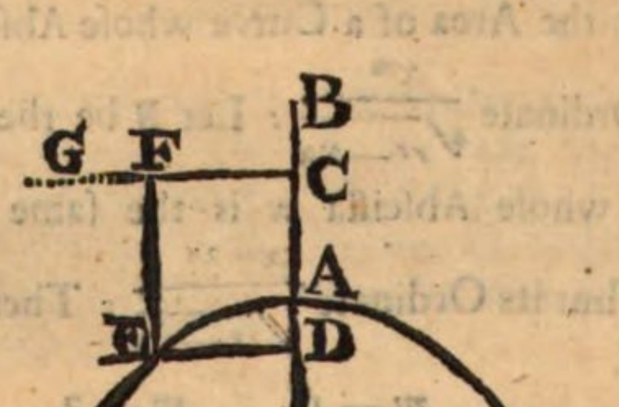
If $n$ be equal to any Term in the following Series 1, 2, 3, 4, 5, 6, &c. The Curve whose Ordinate is $\frac{x^{2n}}{\sqrt{rr+xx}}$ is exactly quadrable by this Theorem.

*Corol.* 3.

If $m$ be equal to any Term of this Series 0, 2, 4, 6, 8, 10, &c. The Quadrature of the Curve whose Ordinate is $\frac{x}{\sqrt{rr-xx}}$ depends upon the Quadrature of the Circle: For if from the Centre $C$ a Circle $AEG$ be described with the Radius $CA=r$; let $CD$ be taken equal to $x$, and $DE$ erected Normally in $D$; join $CE$. Then will the Sector $CAE$ divided by $\frac{1}{2}rr$, be equal to the Area of the Curve, whose Ordinate is $\frac{x}{\sqrt{rr-xx}}$




And after the same manner, if to the Centre $C$, and Semi-Transverse Axis $CA=r$, an Equilateral




Hyperbola be described as $EAM$; let $FC$ be drawn at Right-angles to $AC$, and equal $x$; then draw $FE$ parallel to the Axis $CA$, till it meet the Hyperbola in $E$, and join $EC$: I say, the Hyperbolick Sector $ACE$ divided by $\frac{rr}{2}$ is equal to the Area of the Curve whose Ordinate is $\frac{x^0}{\sqrt{rr+xx^0}}$

*Corol.* 4.

If $m$ be expounded by any other Term different from any of the Preceeding ones; Then will the Curve whose Ordinate is $\frac{x^m}{\sqrt{rr+xx}}$ be neither exactly squarable, nor dependant on the Circle, or Hyperbola; but yet is reducible to a more Simple Form.

*Theorem* 5.

Let $A$ be the Area of the Curve whose Abscissa is $x$, and its Ordinate $\frac{x^m}{d-x}$, and let $B$ be the Area of another Curve, having the same Abscissa $x$, and whose Ordinate is $\frac{x^{m-n}}{d-x}$; Then shall the Area,

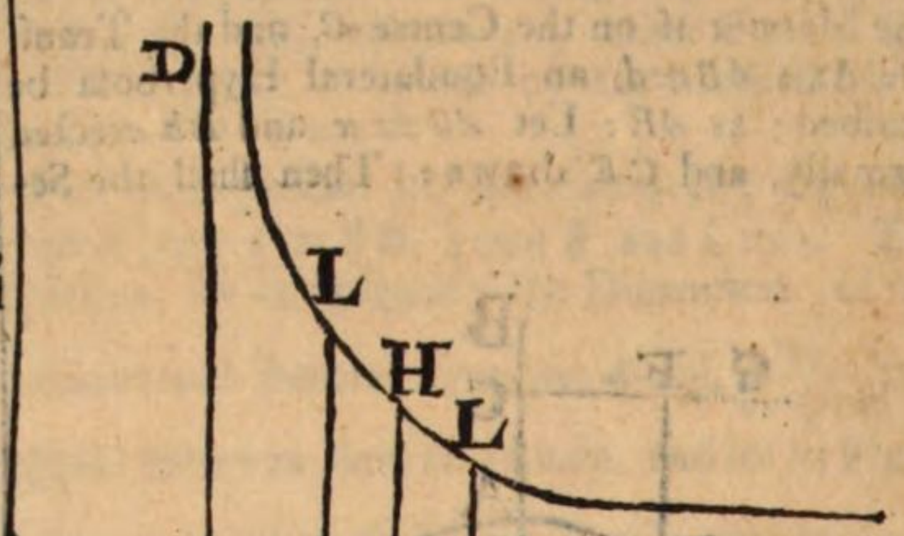
$$A = d^n B - \frac{x^m}{m} - \frac{dx^{m-1}}{m-1} - \frac{ddx^{m-2}}{m-2}, \text{ \&c. And}$$

if the Ordinate be $\frac{x^m}{d+x}$; Then the Area,

$$A = \frac{x^m}{m} - \frac{dx^{m-1}}{m-1} + \frac{ddx^{m-2}}{m-2}, \text{ \&c. } \mp d^n B.$$

*Corollary.*

If $m$ be equal to any Term in the following Series 0, 1, 2, 3, 4, 5, 6, &c. The Quadrature of the Curve, whose Ordinate is $\frac{x^m}{d+x}$, depends upon the Quadrature of the Hyperbola.




For drawing $DE$, $EF$ at Right-angles, let $EG$ be taken equal to $d$; and let $GH$ be drawn Normal and Equal to $EF$. Then between the Asymptotes $DE$, $EF$, let an Hyperbola be described passing thro' $H$; and taking $GK=x$, towards $E$ in the first Case, and towards $F$ in the latter, let the Ordinate $KL$ be drawn: Then shall the Area $HGKL$ divided by $dd$ be equal to the Area of the Curve, whose Ordinate is $\frac{x^0}{d+x^0}$. And from hence, supposing the Quadrature of the Hyperbola, will the Solid, generated by the Revolution of the Portion of a Cissoid round the Diameter of the Generating Circle, be given in Finite Terms.

*Theor.* 6.

as above. Let there be this Equation $a-bx^m=cxy^n\dot{y}+dy_{2n}\dot{y}\,\dot{y}$. Suppose $y_{n}\dot{y}=v$, and it will ſtand $a-bx^mcx\dot{v}+dv\,\dot{v}$. This Equation, by ſquaring the Curve whoſe Abſciſſa is $x$ and Ordinate $\dot{v}$, gives the Area $v$; and the other Equation $y_{n}\dot{y}=\dot{v}$, by working backward to the *Fluents*, will give $\frac{1}{n+1}\dot{y}^{n+1}=v$: whence the Fluent $y$ is found, and from hence, and even in ſuch Equations as involve Three unknown Quantities and which cannot be reduced to others which involve but two, the Fluents may ſometimes be found by *the Quadrature of Curves*.

Let there be this Equation $\overline{ax^m+bx^n}|^p=rex^{r-1}y^s+sexry^{s-1}\dot{y}-fy^s\dot{y}$: and let $x=1$. Then will the latter part $rex^{r-1}y^s+sex^ryy^{s-1}\dot{y}-fy^s\dot{y}$ by finding the Fluents in the Inverſe Method, will become $ex^ry^s-\frac{f}{s+1}y^{s+1}$; which therefore is as the Area of a Curve whoſe Abſciſſa is $x$ and its Ordinate $\overline{ax^m+bx^n}|^p$, and from thence the Fluent $y$ will be given.

Let there be an Equation, $\dot{x}\times\overline{ax^m+bx^n}|^p=\frac{dyy^{n-1}}{\sqrt{e+fy^n}}$, then the Fluent, whoſe Fluxion is $\frac{\dot{x}\,x}{ax^m+bx^n|^p}$ ſhall be as the Area of a Curve whoſe Abſciſſa is $x$ and its Ordinate $\overline{ax^m+bx^n}|^p$; Alſo the Fluent, whoſe Fluxion is $\frac{dyy^{n-1}}{\sqrt{e+fy^n}}$ ſhall be as the Area of a Curve whoſe Abſciſſa is $y$, and its Ordinate $\frac{dyy^{n-1}}{\sqrt{e+fy^n}}$; that is (in *Caſe* 1. by *Form* 4. in *Table* 1.) as the Area $\frac{2d}{nf}\sqrt{e+fy^n}$. Let therefore $\frac{2d}{nf}\sqrt{e+fy^n}$ be equal to the Area of a Curve whoſe Abſciſſa is $x$ and Ordinate $\overline{ax^m+bx^n}|^p$, and you will have the Fluent $y$.

And obſerve, that every *Fluent* wich is collected from the Firſt Fluxion may be increaſed or diminiſhed by any Quantity that is not a Fluent: That which ariſes from a Second Fluxion may be augmented or leſſened by any Quantity that hath no Second Fluxion: That which ariſes from a Third Fluxion may be encreaſed or diminiſhed by any Quantity having no Third Fluxion; and ſo on infinitely.

After the Fluents are obtained from the Fluxions, if there be any doubt about the Truth of the Concluſion, the Fluxions of the *Fluents* found, may be again gained, and compared with the Fluxions at *firſt* propoſed; for if they then come out equal to thoſe, you may ſuppoſe the Concluſion right; but if they are not thus equal, the *Fluents* muſt be corrected till they come out ſo. For both the Fluent may be aſſumed at pleaſure, and that aſſumption may be corrected by putting the Fluxion of the Fluent ſo aſſumed equal to the Fluxion propoſed, and then comparing the Homologous Terms among themſelves.

In *Phil.* Tranſ. 252 *p.* 708. You have a Method for the Quadrature of Figures, "*Geometrically irrational*; by Mr. *J. Craig*.

See alſo, the ſame Author's *Methodus Figurarum Lineis rectis & Curvis comprehenſarum Quadraturas determinandi*. *Lond.* 1685, 4°. And his Additions to it, in *Philoſ.* Tranſ. N. 235.

See alſo his *Tractatus Mathematicus de Figurarum Curvilinearum Quadraturis & Locis Geometricis*. *Lond.* 1693, 4°.

*Vera Circuli & Hyperbolæ Quadratura in propria ſua Proportionis ſpecie inventa & demonſtrata, per Jac. Gregory, Patavii*, 4.

*Le Grand & Fameux Probleme de la Quadrature du Circle reſolu Geometriquement par le Circle & la Ligne Droite. per M. Mallement de Meſſange.* Paris, 1686. 12*mo*. See *Phil. Tranſaction.* N. 185. where this Book is refuted by *Cluverius*, M. D. R. S. S.

*De Quadratura Circuli*, &c. *per T. Hobbs.* This Book Dr. *Wallis* hath twice refuted.

In *Philoſ. Collect.* N. 7. you have Mr. *Leibnitz*'s Method for the Quadrature of the Circle.

In *Philoſ. Tranſ.* N. 196. you will find Dr. *Wallis*'s Quadrature of the *Teſtudo veliformis*. And in N. 207. the ſame thing is ſolved by Dr. *Gregory*. Mr. *Caſwell Aſtr. Profeſſ.* of *Oxford* alſo in *Philoſ. Tranſ.* N. 217. gives a Quadrature of a Portion of the Epicycloid; and after this, in the next *Tranſactio.* Mr. *Halley*, Savilian Profeſſor of Geometry in *Oxon*, advances a general Propoſition for meaſuring all Cycloids and Epicycloids; which is this. *That the Area of any Cycloid or Epicycloid, whether Primary, Contracted or Prolate, is to the Area of the generating Circle, and the Areas of the Parts generated in the formation of thoſe Curves, are to the Areas of the Segment of that generating Circle; as the Summ of the double Velocity of the Centre, and of the Velocity of the* Motus Circularis, *is to the Velocity of that* Motus Circularis.

In *Philoſ. Tranſact.* N. 245. Mr. *Craig* gives us the Quadrature of the Logarithmick Curve.

In the Memoires *de L' Academie des Sciences*, there is (in the Year 1699) a Quadrature of the Infinity of Segments, Sectors and other Spaces in the Vulgar Cycloid by Mr. *Bernoulli*, Profeſſor of Math. at *Groningen*.

In the *Act. Erud. Lipſiæ* for *Octob.* 1683, you have a Method by Mr. *Tſchirnhauſe*, of determining either the *Quadrature* of any Geometrical Figures, or the Impoſſibility of the ſame. And in *May*, 1684, he publiſhed in the ſame *Acta* another Papet concerning the Quadrature of Curvilinear Figures.

In *Phil. Tranſ.* N. 284, there is a Specimen of a general Method for determining the Quadratures of Figures, by Mr. *J. Craig*.

And in N. 278. one of Mr. *de Moivre* for the ſquaring *of ſome kinds of Curves*, or reducing them to *more ſimple ones*. Thus, Let $A$ be the *Area* of a Curve whoſe *Abſciſſa* is $x$, and its *Ordinate Applicate* $x^m\sqrt{dx-xx}$. Let $B$ be the Area of a Curve whoſe Abſciſſa is the ſame as that of the former, but its Ordinate $x^{m-n}\sqrt{dx-xx}$; Let $\sqrt{dx-xx}=y$, then ſhall $A$ be $=d^nB$ into $\frac{2m+1}{2m+4}$ into $\frac{2m-1}{2m+2}$ into $\frac{2m-3}{2m}$ into $\frac{2m-5}{2m-2}$ into, &c. $=P$.

$-\frac{1}{m+2}x^{m-1}y^3=-Q\left[\frac{d}{m+1}\text{ into }\frac{2m+1}{2m+4}x^{m-2}y^3=\right.$
$\left.-R\right]-\frac{dd}{m}\text{ into }\frac{2m+1}{2m+4}\text{ into }\frac{2m-1}{2m+2}x^{m-3}y^3=-S.$
$\left[-\frac{d^3}{m-1}\text{into}\frac{2m+1}{2m+4}\times\frac{2m-1}{2m+2}\times\frac{2m-3}{2m}x^{m-4}y=-T,\&c.\right.$

Where obſerve,

1. That $n$ is ſuppoſed to be an Integer and Affirmative Number.

2. That the Quantity $d^nB$ in the Series deſign'd by $P$ is to be multiplied into as many of the Terms as there are Unites in $n$.

3. That ſo many following *Series* deſign'd by $-Q$, $-R$, $-S$, $-T$, &c. may be taken as there are Unites in $n$.

Which to illuſtrate by an Example or two.

If $n=1$, then I ſay $A=d^nB$ into $\frac{2m+1}{2m+4}-\frac{1}{m+2}$ $x^{m-1}y^3$. And if $n=2$, then $A=d^nB$ into $\frac{2m+1}{2m+4}$ into $\frac{2m-2}{2m+2}-\frac{1}{m+2}x^{m-1}y^3-\frac{d}{m+1}$ into $\frac{2m-1}{2m+4}$ into $x^{m-2}y^3$.

4. If $y$ be equal to $\sqrt{dx-xx}$; Then $A$ will be $=Q-R+S-T$, &c. $+P$.
$-$

*Corol.* 1.

If $m$ be put equal to any Term in the following *Series* $-\frac{1}{2}$, $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$, &c. The Quadrature of the Curve, whoſe Ordinate is $x^m\sqrt{dx-xx}$, or $x^m\sqrt{dx+xx}$, comes out finite and is exhibited by our Series; which that we may ſhew by an Example: Let the Area of the Curve, whoſe Ordinate is $x-\frac{1}{2}\sqrt{dx-xx}$ be to be inveſtigated: Imagine this Curve to be compared with another, whoſe Ordinate is $x-\frac{3}{2}\sqrt{dx-xx}$. Becauſe in this Caſe $n=1$. Therefore

$A=d^nB$ into $\frac{2m+1}{2m+4}+\frac{1}{m+2}x^{m-1}y^3$: But $m=-\frac{1}{2}$: wherefore $2m+1=0$; and therefore $A=-\frac{1}{m+2}x^{m-1}y^3=-\frac{2y^3}{3\sqrt{xxx}}$.

Here it is obſervable that the *Area*, thus found, ſometimes falls ſhort of, and ſometimes exceeds the true Area, by a given Quantity: And to know ſuch *Defect* or *Exceſs*, the Area thus found is to be ſuppoſed encreaſed or diminiſhed by a given Quantity as $q$; and then ſuppoſing $x=0$, let the Area ſo increaſed or diminiſhed, be ſuppoſed equal to Nothing; and ſo in the preſent Caſe $q$ will be found equal to $\frac{2}{3}d\sqrt{d}$: And therefore, $A=\frac{2}{3}d\sqrt{d}\,\frac{2y^3}{3\sqrt{x^3}}$.

*Corol.* 2.

If $n$ be ſuppoſed equal to any Term in the following *Series*, 3, 4, 6, 7, &c. The Quadrature of the Curve, whoſe Ordinate is $x^n\sqrt{dx-xx}$; or $x^n\sqrt{dx+xx}$, becomes finite; and will be exhibited by our *Series*. Thus for inſtance; let the *Area* of a Curve, whoſe Ordin. is $x^3\sqrt{dx-xx}$, be ſought.

Imagine it to be compared with the Area of a Circle, which call $A$. Then ſhall $m=0$, $n=3$; and conſequently $A=P-Q-R-S$: But ſince the Quantity $2m$, in the Denominator of the third Term, by which $d^nB$ is multiplied, is infinitely ſmall, or rather nothing; the Quantity deſigned by $P$, will be infinite; and for the ſame reaſon, the Quantity expreſſed by $-S$, is infinite alſo; and therefore the Quantities $A$, $-Q$, $-R$, will vaniſh: Wherefore $P=S$; and the Equation divided by $\frac{2m+1}{2m+4}$ into $\frac{2m-1}{2m+2}$ becomes $d^nB$ into $\frac{2m-2}{2m}=\frac{dd}{m}x^{m-3}y^3$: or $dB$ into $\frac{2m-3}{2}=dd\,x^{m-3}y^3$; and putting 0 and 3, inſtead of $m$ and $n$; it will come out thus, $dB$ into $-\frac{3}{2}=\frac{y^3}{x^3}$, or $B=\frac{2y^3}{3x^3}$.

*Corol.* 3.

If $m$ be ſuppoſed equal to any Term of the following Series $-2$, $-1$, 0, 1, 2, 3, 4, 5, &c. The Quadrature of the Curve whoſe Ordinate is $x^m\sqrt{dx-xx}$ depends upon the Quadrature of the Circle: But the Area of the Curve whoſe Ordinate is $x^m\sqrt{dx+xx}$ depends upon the Quadrature of the Hyperbola; and the Relation of that Curve to either the Circle, or Hyperbola will be exhibited in the *Series*, and in Finite Terms.

*Corol.* 4.

If $m$ be explained by any other Term *different* from thoſe above mentioned: Then the Curve whoſe Ordinate is $x^m\sqrt{dx+xx}$, can neither be exactly ſquared, nor doth it depend on either the *Circle* or the *Hyperbola*: But yet it may be reduced to a more Simple Curve by our *Series*.

*Theorem* 2.

Let $A$ be the Area of a Curve whoſe Abſciſſa is $x$, and ordinate $\frac{x^m}{\sqrt{dx-xx}}$. And Let $B$ be the Area of a Curve whoſe Abſciſſa is alſo $x$; but its Ordinate is $\frac{x^{m-n}}{\sqrt{dx-xx}}$. Let $\sqrt{dx-xx}=y$:

Then ſhall $A=d^nB$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}$ into $\frac{2m-7}{2m-6}$, &c. $=P.\left[-\frac{1}{m}x^{m-1}y=-Q.\right.$

$\frac{d}{-m-1}$ into $\frac{2m-1}{2m}x^{m-2}y=-R.$

$-\frac{dd}{m-1}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}x^{m-3}y=-S.$

$-\frac{d\,d\,d}{m-3}$ into $\frac{2m-1}{2m}$ into $\frac{2m-3}{2m-2}$ into $\frac{2m-5}{2m-4}$ $x^{m-4}y=T.$

N. B. The Obſervations made above on Theorem 1. will be of Uſe here alſo.

*Corol.* 1.

If $m$ be ſuppoſed equal to any Term in this Series $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, $\frac{7}{2}$, $\frac{9}{2}$, &c. Then the Quadrature of the Curve whoſe Ordinate is $\frac{x^m}{\sqrt{dx+xx}}$ will be finite, and will be exhibited by this Series.

*Corol.* 2.

rel, &c. (7) *Mus Domeſticus, Major & Minor*: The common *Ratt* and *Mouſe*; *Mus major Aquaticus*, the Water-Rat; the *Musk Rat*. *Mus Avellanarum Major & Minor*. The Dormouſe or Sleeper, *Mus Noricus, Cricetus, Alpinus ſeu Marmotta*. (7) The *Cavia Cobaya*, or *Cuniculus Americanus*; the Guinea Pig: The *Agati* and *Paca* of *Braſile*: The *Mus Norwegicus* or *Leming*: The *Glis Geſneri* or the *Roll*: The *Mus Indicus*, &c,

To theſe ſeveral Kinds of Quadrupeds the following Anomalous ones muſt alſo be added;

1. Such Four-footed Viviparous Animals as have a longiſh Snout, with their Feet divided into many Claws or Toes, and having Teeth; as (1) the *Echinus Terreſtris*, or common Urchin or Hedge-hog. (2) The *Erinaceus Indicus albus*. Car. Muſ. Leyden. (3) The *Tatu* or *Armadillo prima* of *Marcgrave*. (4) The *Tatuete* of Braſile; or the ſecond Species of the *Armadillo*, according to *Marcgrave*. (5) *Tatu Apara*; his third Species of the *Armadillo*. (6) *Tatu Muſtelinus*, Soc. Reg. Muſ. The Weeſel headed *Armadillo*. (7) *Talpa*, the Mole, Want, or Moldwarp. (8) The *Mus Araneus*, Shrew, hardy Shrew, Shrew mouſe.

2. Quadrupedous and Viviparous Animals with a longiſh Snout, having their Feet divided into many Claws or Toes, but *without Teeth*, are theſe:

(1.) The *Tamandua-guacu* of Braſile, *Marcgr. Urſus Formicarius Cardani*; the great Ant-Bear. (2) The *Tamanduais* of *Braſile*, or *Marcgrave's* leſſer Ant-Bear.

3 Anomalous Flying Quadrupeds with a ſhorter Snout, with their Feet divided as above, and are the *Bat-kind* or *Flitter-mice*: Of which there are ſeveral Sizes, and different Forms.

4. There is one very odd anomalous Animal, which hath but 3 Claws on each Foot; and that is the *Aſs*, or *Ignavus* of *Marcgrave*; the *Sloth* or *Sluggard*.

5. Viviparous and Sanguineous Quadrupeds breathing with Lungs, but having only one Ventricle in their Heart, are Theſe. (1) *Rana aquatica*, the *Frog*, or *Froſh*. *Rana Arborea ſeu Ranunculus Viridis*, the ſmall Tree or green Frog. (2) *Bufo, ſive Rubeta*, the Toad. (3) *Teſtudo*, the Tortoiſe, Gr. χελώνη; of theſe there are Land and Water ones; and many different Species in Foreign Parts.

6. Oviparous Quadrupeds with a long Tail, ſtretcht out horizontally; are the *Lizard Kind*: As (1) *Lacertus omnium Maximus*; The *Crocodile*. (2) *Cordylus, ſive Caudiverbera, Uromaſtix Græcis*, larger than the green Lizard. (3) *Tapayaxin Novæ Hiſpaniæ*. The *Lacertus Orbicularis* of *Hernandez*, Ch. 9. c. 16. *Lacertus Vulgaris*, the common Eft, Swift, or Newt. (4) *Lacertus Viridis*, the green Lizard. (5) *Lacertus Fucetanus Aldrovand*; at *Rome* and *Naples* called *Tarantola*. (6) *Lacertus Indicus*; called *Senembi*, and *Inguana*. (7) *Lacertus Braſilienſis*, called *Tejuguacu* and *Temapara*, by *Marcgrave*. (8) The *Taraguira, Ameira, Taraguico Aycuraba, Americima, Curapopepa, Teiunham*, &c. of *Marcgrave*; the *Lacertus Indicus*, &c. (9) *Scincus, ſeu Crocodilus Terreſtris*. (10) *Seps, ſive Lacerta Chocidica*, a Kind of footed Serpent. (11) *Stellio*, the ſwift or ſpotted Lizard. (12) *Salamandra Terreſtris, Salamandra Aquatica*, the Water-Eft. (13) *Lacerta volans Indica*. (14) *Chamæleo*, the *Chamelion*.

QUÆRENS *non invenit Plegium*, in the Law, is a Return made by the Sheriff on a *Writ* directed to him, with this condition inſerted. *Si A fecerit B Securum de Clamore, &c.*

QUÆSTA, was the Term for an Indulgence or Remiſſion of Penance, expoſed to Sale by the Popes; who by this notorious Cheat got great Summs: The Retailers of theſe Indulgences, were called *Quæſtuarii*, and I believe *Quæſtionarii*, vid. *Matt. Weſt.* in Anno, 1279.

QUANTITAS *Acceleratrix* of any *Vis* or *Force*, is the Meaſure of the Velocity generated in a given Time, by that Force.

QUANTITY *of Motion*: Sir *Iſ. Newton* in his *Principia*, ſhews that this, which is found by taking the Summ of Motions tending the *ſame* Way, on their *Difference*, if they tend towards contrary Parts; is not at all changed by the Action of Bodies on one another.

For *Action* and *Re-action* are always equal and contrary, by his *Third Law* of Nature: And therefore by the *Second Law*, muſt make Equal Mutations in Motions towards contrary Parts.

If therefore the Motions tend the ſame Way, whatever is added to the proceeding Body, or that ſtruck forward, is ſubducted from the following Body; ſo that the Summ of the Motions will be the ſame as before. If the Bodies meet, there will be an *Equal Subduction* of the Motion of either: And therefore the *Difference* of the Motions made towards the contrary Parts, will remain the ſame.

As ſuppoſe a Spherical Body *A*, to be thrice as great as the Spherical one *B*; and let *A* have *Two* Degrees of Velocity any way, and let *B* follow it in the ſame right Line with *Ten* Degrees of Velocity: So that the *Motion* of *A*, to that of *B*, will be as Six (3×2) to Ten. Wherefore the *Summ* of the Motions of both of them will be 6 + 10, or ſixteen Parts. Now after *B* hath overtaken *A*, and ſtruck againſt it, if *A* gain by the Stroke any Degree of Motion, as ſuppoſe 3, 4 or 5 Parts; *B* muſt loſe as much: And therefore after the *Concourſe*, *A* will move on accordingly with 9, 10, or 11; and *B* will follow with 7, 6, or 5 Parts: So that the Summ of the Motions of both, will be ſtill 16 as at firſt before the *Concourſe*, or Shock.

But if the Body *A* be ſuppoſed to gain by the Stroke 9, 10, 11, or 12 Parts of Motion; and therefore to move forward with 15, 16, 17, or 18 Parts, after the Concourſe: Then will the Body *B*, by loſing juſt ſo many Degrees as *A* gains, either move forward, with one Part, having loſt 9; or will be perfectly at *reſt*, loſing all its 10 Degrees of Velocity; or laſtly will move backwards with one or two Parts of Motion: So much being deducted out of the 11, or 12 Parts of the Progreſſive Motion, or forwards. And thus the *Summs* of the Motions the *ſame* Way forward; as 15 + 1, or 16 + 0. And the *Differences* of the Motions *contrary* Ways; as 17 — 1, or 18 — 2; will always be the ſame, *viz.* = 16 Parts, as before Concourſe and Reflexion. And the Motions with which Bodies go on after Reflection being known, the *Velocity* of Each may be found; by ſuppoſing *That* to be to the Velocity before the Reflection :: as the Motion afterwards to the Motion before. Thus in the laſt Caſe, where the Body *A* had ſix Parts of Motion *before* the Reflection, and 18 afterwards; and the Velocity of two Parts before the Reflection: Its Velocity after the Reflexion will be found to be Six; by ſaying, as the Motion of ſix Parts before the Reflection, to *That* of

of 18 afterwards: So is the Velocity of two Parts before, to that of Six afterwards.

QUARREL, in the Law is *Quærela, à quærendo:* And it extends not only to Actions perſonal, but alſo to *mixt*; and the Plaintiff is then called *Quærens:* And in moſt of the Writs it is ſaid, *Quæritur*: So that if a Man releaſe all *Quarrels*, (ones Deed being taken moſt ſtrongly againſt ones ſelf) it is as beneficial as all *Actions*; for by it all Actions Perſonal and Real are releaſed. *Cowell's Interp.*

QUARENTINE, is a Benefit allowed by the Law of *England*, to the Widow of one dying ſeized of Land; and whereby She may challenge to ſtay in his Capital Meſſuage, or Chief Manſion-Houſe (ſo it be not a Caſtle) for 40 Days after his Deceaſe; and if She be moleſted by the Heir at Law, or any other; She may claim a Writ *De Quarentina habenda.*

QUARENTINE alſo ſignifies a Furlong, from the French *Quarente*, Forty: Becauſe 'tis a Quantity of Land containing 40 Perches. 'Tis uſed alſo for that Space of forty Days, wherein any Perſon coming from Foreign Parts, and infected with the Plague, is not permitted to Land, or come on Shore, till that Term is expired.

QUARTER-*Seſſions*, is a Court held by the Juſtices of Peace in every County, once in every Quarter of the Year. How far the Juriſdiction thereof extends: See *Lamb. Eirin. Lib.* 4. and *Smith de Republ. Anglic. Lib.* 2. *c.* 19. The Holding theſe Seſſions was firſt Ordained by the Statute of 25 *Ed.* III. Statut. 1. *c.* 18.

QUARTER-*Wheeling*, in the Military Art, is turning the Front of a Body of Men round where the Flank was. If it be done to the *Right*, the Man in the Right-angle keeps his Ground, and faces about while the Reſt wheel.

QUARTER-*Wind*, at Sea, is ſuch a Wind as comes in abaft the Main-maſt Shrouds, even with the Quarter of the Ship.

QUARTERS, (in Architecture) are thoſe ſlight upright Pieces of Timber which are placed between the Punchions and Poſts, they are uſed to *Lath* upon.

QUASI-*Modo Sunday*, is that called *Low Sunday*, or the Next after *Eaſter*; ſo called from the firſt Words of the *Introit*, or Hymn, for Maſs on that Day; it occurs often in the Date of Old Records —*Charta Gilberti Prioris de Eynſham Priori de Sherburn dat. Poſtridie Feſti Quaſi-Modo Geniti*: And this Solemn Time is in ſome Old Deeds expreſſed only thus, *Q. M. G.* by the Initial Letters of the Words, *Quaſi Modo Geniti.*

QUEEN-*Gold*, *Aurum Reginæ*, is a Royal Revenue belonging to every Queen of *England*, during her Marriage to the King, both by Law, Cuſtom and Preſcription; and payable by divers Perſons in *England* and *Ireland* (on divers Grants from the Crown) by way of Fine or Oblation, amounting to Ten Marks or upwards, *viz.* one full Tenth-part above the Entire Fine; as Ten Pounds on every Hundred Pound Fine, on Pardons, Contracts and Agreements: This becomes a Real Debt to the Queen Conſort by the Name of *Aurum Reginæ.*

QUICK-*Silver*: The Way and Manner how this ſtrangely Fluid Mineral is gained; you have a good Account of by Dr. *Pope* in *Phil. Tranſ.* N. 2. Thus: It is found in the Mines of *Friuli*, a Territory belonging to the *Venetians*, about a Days Journey and a half from *Goritia* Northwards; and at a Place called *Idria*, ſituated on a Valley of the *Julian Alps.* They have been for 160 Years ſubject to the Emperour, and all the People ſpeak *Sclavonian.* In going thither we travell'd ſeveral Hours thro' ſome of the fineſt Woods I ever ſaw; full of Firs, Oaks, and Beeches of an Extraordinary Thickneſs, Straitneſs and Height. The Town, like others in the *Alps*, is built all of Wood but the Church; and one Houſe, in which the Over-ſeer of theſe Mines lived. The Valley and the Mountains too, out of which the Mercury was dug, were of a pleaſant Verdure, which they attributed to the Moiſture of the Mercury. The beſt and greateſt of their Mines, we went into, is dedicated to St. *Barbara*; as the other Mines are to other Saints.

At the Beginning of the Entrance, the Way was not difficult, nor the Deſcent great; but in many Places you cannot ſtand upright; this way of going down holds not long, before you deſcend by Perpendicular Ladders, all the way down; and the Bottom, where there are ſeveral Lanes cut out in the Mountains, is lined and propt with ſeveral great Pieces of Firr-Trees as thick as they can be ſet: They dig the Mineral with Pick-Axes, following the Veins: 'Tis for the moſt part hard as a Stone, but more weighty; of a Liver-Colour, or that of *Crocus Metallorum.* There is alſo ſome ſoft Earth in which you plainly ſee the Mercury in little Particles. Beſides this, there are often found in the Mines round Stones like Flints, of ſeveral Bigneſſes; very like thoſe Balls of Hair, which I have ſeen in *England* taken out of the Stomachs of Oxen. There are alſo ſeveral Marchaſites, and Stones, which ſeem to have Specks of Gold in them; but on trial they ſay, they can find none. Some of theſe Stones are very ponderous, and well impregnated with Mercury: But others are light having little or none in them.

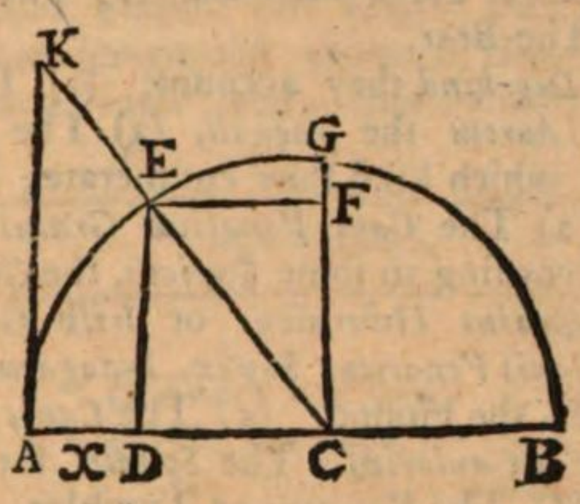
The manner of getting the *Mercury* is this: They take of the *Earth*, brought up in Buckets, and put it into a *Sieve*, whoſe bottom is made of *Wires* at ſo great a Diſtance, that you may put your Finger between them; 'tis carried to a ſtream of Running Water, and *waſhed* as long as any thing will paſs through the *Sieve.* That *Earth* which paſſeth not, is laid aſide upon an Heap; that which paſſeth, is reſerved in a *Hole*, and is taken up again, and put into a *ſecond Sieve*; and ſo on to about 10 or 12 *Sieves* proportionably leſs. It often happens in the *Firſt Hole*, that there is *Mercury* at the bottom; but towards the farther End, where the Intervals of the *Wire* are leſs, it's found in very great Proportion. The Waſte Water is ſo much impregnated with *Mercury*, that it cureth *Itches* and other *ſordid Ulcers.* The *Earth* laid aſide, is Pounded, and the ſame Operation repeated. The fine ſmall *Earth*, that remains after this, and out of which they can *waſh* no more *Mercury*, is put into *Iron Retorts*, and the *Fire* forces the *Mercury* into the *Receivers*: The Officer unluted ſeveral of them; and I obſerved in all that he firſt poured out *Perfect Mercury*, and after that came a *Black Duſt*, which being Wetted with Water, diſcovered it ſelf to be *Mercury*, as the other was. They take the *Caput Mortuum* and Pound it, and Renew the Operation. There are 16 *Furnaces* for this

*Theorem 6.*

Let $A$ be the Area of the Curve whoſe Abſciſſa is $x$, and Ordinate $\frac{x^m}{rr+xx}$; Let $B$ be the Area of another Curve whoſe Abſciſſa is the ſame $x$: Let its Ordin. be $\frac{x^{m-2n}}{rr+xx}$. I ſay its Area $A = \frac{x^{m-1}}{m-1} - \frac{rrx^{m-3}}{m-3} + \frac{r^4x^{m-5}}{m-5}$, &c. $\mp r^{2n} B$.

*Corollary.*

If $m$ be equal to any Term in this Series 0, 2, 4, 6, 8, &c. The Quadrature of the Curve, whoſe Ordinate is $\frac{x^m}{rr+xx}$, depends upon the Rectification of the Circular Arch. For if with the Radius




$CA = r$, and on the Centre $C$, the Circle $AEG$ be deſcribed: Let the Tangent $CK$ be erected equal to $x$, and join $CK$ meeting the Periphery in $E$. Then I ſay that $AE$ divided by $rr$, ſhall be equal to the Area of the Curve whoſe Ordinate is $\frac{x^0}{rr+xx}$.

*A General Corollary to all the 6 Theorems.*

Every Mechanick Curve whoſe Quadrature depends on any of the infinitely many Curves, whoſe Ordinates put on any of the following Forms, *viz.*

$\frac{x^m}{x^m\sqrt{dx+xx}}$; $\frac{x^m}{\sqrt{dx+xx}}$; $\frac{x^m}{x^m\sqrt{rr+xx}}$; $\frac{x^m}{\sqrt{rr+xx}}$; $\frac{x^m}{d+x}$; $\frac{x^m}{rr+xx}$; may be ſquared by this Series; as will ſufficiently appear from this one Example.

Suppoſe the Cube of the Circular Arch correſponding to any Verſed-ſine be made the *Ordinate* of the Curve, whoſe *Abſciſſa* ſhall be that very Verſed-ſine: The Area of the Curve is required to be inveſtigated.

Let the Abſciſſa be $x$, the circular Arch $v$; the Fluxion of the Area is $v^3\dot{x}$; Let the Area be $v^3x - q$. Then $v^3\dot{x} + 3v^2\dot{v}x - \dot{q} = v^3\dot{x}$; wherefore $\dot{q} = 3v^2\dot{v}x$: But $\dot{v} = \frac{d\dot{x}}{2\sqrt{dx-xx}}$; there-

fore $\dot{q} = \frac{3\,dv^2\,x\dot{x}}{2\sqrt{dx-ux}}$: but by Theorem 2. $\frac{x\dot{x}}{\sqrt{dx-xx}} = \frac{d\dot{x}}{2\sqrt{dx-xx}} - \dot{y} = \dot{v} - \dot{y}$: and therefore $\dot{q} = \frac{3}{2}dv^2\dot{v} - \frac{3}{2}dv^2\dot{y}$; and therefore $q = \frac{1}{2}dv^3 - \frac{3}{2}dv^2y$: Where we can find the *Fluent*, whoſe Fluxion is $\frac{3}{2}dv^2\dot{y}$. Let this Quantity be $\frac{3}{2}dv^2y - r$. Then $\frac{3}{2}dv^2\dot{y} + 3dv\dot{v}y - \dot{r} = \frac{3}{2}dv^2\dot{y}$. And therefore $\dot{r} = 3dv\dot{v}y = \frac{3}{2}ddvx$. Let $r = \frac{3}{2}ddvx - s$. Then $\frac{3}{2}ddv\dot{x} = \frac{3}{2}ddv\dot{x} + \frac{3}{2}dd\dot{x}\dot{v} - \dot{s}$; and conſequ. $\dot{s} = \frac{3}{2}dd\dot{x}\dot{v} = \frac{3d^3\dot{x}x}{4\sqrt{dx-xx}} = \frac{3}{4}d^3\dot{v} - \frac{3}{4}d^3\dot{y}$; by Theor. 2. wherefore $s = \frac{3}{4}d^3v - \frac{3}{4}d^3y$; and therefore the Area ſought is $v^3x - \frac{1}{2}dv^3 + \frac{3}{2}dv^2y - \frac{3}{2}ddvx + \frac{3}{4}d^3v - \frac{3}{4}d^3y$.

And becauſe of Solids generated by the Rotation of Curves, the Surface is generated the ſame way; the Longitude of Curves, and all their Centres of Gravity, do depend on the Quadratures of Curves: Theſe will eaſily be computed if they depend on the aforeſaid Curves.

QUADRUPEDS, are perfect hairy Viviparous Animals, having but four Feet. And theſe Animals according to Mr. *Ray* in his *Synopſis Animalium* are thus divided.

Into ſuch as are *Hoofed* (*Ungulata*;) or *Clawed*, or *Digitate* (*Unguiculata*.)

(1.) The *Hoofed* Animals with four Feet, are either *Whole Hoofed*; *Solidipeda*, Μονόχηλα, Μόνυχα, *Solidungula*: As, The *Horſe*, *Aſs*, the *Onager*, or *Wild Aſs*: The *Mule* and the *Zebra* of *Africa*, or the fine ſtriped *Indian* or *African Aſs*, almoſt like a Mule in Form and Stature.

Of this *Whole Hoofed Kind*, *Ariſtotle* has obſerved; that no one hath two Horns, (he might have ſaid any) no one hath the *Talus* or *Aſtragalus*; nor have the Males any appearance of Breaſts.

(2.) *Cloven-footed*; and that either into *Two Diviſions* only: As the Δίχηλα or *Biſulcate* Kind, which are again ſubdivided into ſuch as are

1. *Ruminant*, Μηρυκάζοντα, *i. e.* Such as *Chew the Cud*; and theſe either have hollow and *perpetual* Horns as the *Ox*, *Sheep*, and *Goat Kind*: Or *Deciduous*, as the *Hart* and *Deer Kind*; which uſually ſhed their Horns annually. (See *Ruminant* in this Vol.)

Of the *Bull Kind*, they reckoned theſe: The common *Bos*; of which the Male is *Taurus*, the Female *Vacca*: (2) The German *Urus*, *Urochs* or *Aurochs*, (3) The *Biſon*, (4) The *Bonaſus*, (5) The *Bubalus*, or *Bufalo*, (6) The *Bos Africanus* of *Bellonius*; Obſ. *l.* 2. *c.* 50. which he takes to be the *Bubalus* of the Ancients.

Of the *Sheep Kind*; beſides the common Sort; they reckon, (2) The Arabian *Ovis Laticauda*, whoſe Tails ſometimes are of 30*l.* Weight: (3) The *Ovis Strepſiceros Cretica Bellonii*: (4) The *Ovis Africana*, with ſhort Hairs inſtead of Wool. (5) The *Ovis Guineenſis*, or *Angolenſis* of *Marograve*, (Hiſt. *Braſil.* l. 6. c. 10.)

Of the *Goat Kind*, are beſides the common *Capra domeſtica*; (2) The *Ibex*, or German *Steinbock*; found in the Tops of the *Alps*. (3) The *Rupicapra*, French *Chamois*, German, *Goms*. (4) The *Gazella Africana*, or *Antilope*. (5) The *Gazella Indica*. (6) The *Gazella*

*Gazella Africana.* (7) The *Capra Sylveſtris Africana Grimmii.* (8) The *Capra Mambrina* or *Syriaca* of *Geſner.* (9) The *Buſelaphus* or *Moſchelaphus Caii*, in *Geſner.* (10) The *Tragelaphus Caii*, in *Geſner.* (11) The *Tragelaphus Bellonii.*

Of the *Hart* or *Deer Kind*: As, (1) The *Cervus*, Ἔλαφος, the *Red Deer.* (2) The *Cervus Platyceros* or *Palmatus*; the *Fallow Deer.* (3) *Alce* or the *Elk.* (4) *Rangifer*, the *Rain Deer.* (5) The *Axis Plinii*, according to *Bellonius.* (6) The *Caprea Plinii.* (7) The *Cuguacu-etc* and *Cuguacu-zapara* of *Marcgrave.* (8) The *Caprea Groenlandica.*

2. Of the *Cloven-footed* Animals into Two Parts only, and which do not chew the Cud: There is only the *Hog* and *Swine Kind*; and under this Head, beſides the common Swine; they reckon, (2) The *Wild Boar* or *Swine.* (3) The *Porcus Guineenſis Marcgravii.* (4) The *Porcus Indicus*, called *Babyrouſſa.* (5) The *Tajaca* or *Aper Mexicanus Moſchiferus* of Dr. *Tyſon*, called by *Marcgrave Tajaca Cunigoara*; by others *Quauhtla Coymalt* and *Quapizotl*; and by *Acoſta* and ſome others, *Zaino.* See a moſt accurate Deſcription of this Animal, in *Philoſ. Tranſ.* N. 153.

3. There are ſome Four-footed Animals whoſe Hoof is cloven into *Four Diviſions*; and theſe ſeem to be not *Ruminants* As the *Rhinoceros*, the *Hippopotamus*, the *Tapijerete* of *Braſile*, the *Capy-Bara* of *Braſile*, the *Animal Moſchiferum.*

II. *Clawed* or *Digitate* (*Unguiculata*) Four-footed Animals. Of this kind there is one Sort whoſe Claws are not divided or ſeparated, but adhering one to another, covered with one common Skin, but with obtuſe Nails ſticking out round the Margin of the Foot; as the *Elephant*, which is *anomalous*, and not clearly referrable to this Kind, or that of Cloven footed *Quadrupeds.*

(2) There is another Species of this Digitate Kind of Quadrupeds, which hath only two *Claws*, as that of *Camels*; and tho' theſe have no Horns, they do both Ruminate; and have alſo the four Stomachs of Horned Ruminant Animals.

Of the *Camel*, or *Dromedary*, there are two Sorts; one having but one Bunch on the Back, the other two. To this Kind belongs the *Peruvian Glama*, which ſome have reckoned among the Sheep-kind. As alſo the *Pacos*, the *Ovis Indica* or *Peruviana vuigo*, much leſs than the *Glama.*

3. A third Species of this *Unguiculate* Kind of Quadrupeds includes ſuch Animals as the Greeks called, Πλατυώνυχα, and Ἀνθρωπόμορφα; which have the Foot divided into many *Claws* with broad Nails on them: As the *Ape* and *Monkey* Kind. Of theſe ſome have no Tails, and are called *Simiæ* or *Apes.* Others have Tails, and are called *Monkeys*, *Cercopitheci*; and ſuch as have either long or ſhort Tails, if they are of a large Size, are called *Papiones* or *Baboons.* There are great Numbers and Varieties of this Species of Quadrupeds; of which Naturaliſts have deſcribed theſe. (1) The *Ourang-Outang*, or *Homo Sylveſtris* of Dr. *Tyſon*, deſcribed by him in a particular Diſcourſe. (2) The *Guarita* of *Braſile*, *Marcgravii.* (3) The *Cagui* of *Braſile*, greater and leſſer. (3) The *Cay* of the ſame Region, deſcribed by *Lerius.* (5) The *Caitaia* of the ſame Country. (9) The *Cercopithecus Angolenſis major.* (7) The *Cercopithecus Barbatus Guineenſis*, 2 or 3 Sorts of it. (8) The *Cercopithecus non Barbatus Cluſii.* (9) *Cercopithecus Cluſ.* called *Sagouin*; and, if Apes and Monkeys have their Snouts very prominent like Dogs, they are called *Cynocephali.*

4. A fourth Species of this Unguiculate Kind of Quadrupeds is, when though the Claws are many, yet they are not covered at the Ends with *broad flat* Nails, like Monkeys or Apes; but are rather like the Talons of Hawks, *&c.* Crooked and Sharp-pointed. And theſe in reſpect of their Teeth may be divided into ſuch as have many *Dentes Primores, aut Inciſores*, (*i. e.* cutting Teeth) in each Jaw; of which there are two Sorts, a *Greater*, which either have a ſhort round Head, as the *Cat kind*; or a longiſh Snout as the *Dog-kind*; or a *Leſſer Sort*; having a long ſlender Body with very ſhort Legs, as the *Weaſel* or *Vermine Kind.* There are ſome of this Species of Quadrupeds, which have only Two large remarkable Teeth in each Jaw: and theſe are of the *Hare Kind*, and live only upon Herbs, Graſs, *&c.*

Of the *Cat-kind* of Quadrupeds they reckon to be (1) The *Lion*, (2) The *Tiger*, (3) The *Pardalis*, whoſe Male is *Pardus*, Female *Panthera*, the *Leopard.* (4) The *Lupus Cervarius* or *Lynx.* (5) The *Catus Pardus* or *Cat-a-mountain.* (6) The common *Cat.* (7) The *Bear.*

Of the *Dog-kind* they account, (1) The *Wolf*, (2) *Lupus Aureus* the *Jackall*, (3) The common *Dog.* Of which kind they enumerate; (1) The *Maſtive*, (2) The *Canis Venaticus Graius* or *Græcus*; or according to ſome *Scoticus*, the *Grey hound.* (3) The *Graius Hybernicus* or *Iriſh Grey-hound.* (4) The *Canis Venaticus Sagax, Indagator, Sectator ferarum, &c.* the Hound. (5) The *Canis Venaticus Hiſpanicus* or *aviarius*: The *Spaniel* for Land or Water. (6) The *Vertagus* or Tumbler. (7) The *Canis Οἰκουρός, Domeſticus*, the Houſe-dog. (8) The *Canis Melitæus* or Lap dog. (9) The *Canis Getulus* or *Iſlandicus*; the *Shock*: And of all theſe Sorts there are many Varieties of Mongrels and Hebridous Breeds.

Another Sort of the Dog-kind is (4) The *Fox.* (5) The *Animal Zibethicum*, the *Civet-Cat*, as 'tis corruptly called; but by its Teeth and Snout is plainly of the Dog-Tribe. (6) The American *Coati*, or *Rackoon* or *Rattoon.* (7) The *Yzquiepate.* (8) The *Carigueya, Maritucaca, Carigoy, Ropoza*, or *Poſſum*, (9) The *Taxus*, or *Meles.* The *Badger*, *Grey*, or *Pate* (in the North) (10) The *Lutra* or *Otter.* (11) The *Phoca* or *Sea-Calf*, or *Seale.* (12) The *Equus Marinus*, or Morſe, or Sea-Horſe, miſtaken by ſome for the *Hippopotamus.* The *Dutch* call him *Walras*; the *Danes* and *Iſlanders*, *Roſmarus.* (13) *Manati ſeu Vacca Marina*; the *Sea-Cow.*

Of the *Vermin* or *Weeſel-kind* of Quadrupeds, is firſt, The *Muſtela vulgaris* the Weeſel; in *Yorkſhire*, *Foumart* or *Fitcher*, (γαλέη) (2) *Viverra Indica*, called *Quel* and *Quirpele*; and another Sort called *Mungo* and *Mungathia* of a reddiſh Grey. (3) The *Muſtela*, the *Ermine* or *Stoat*, if white; and the *Muſtela Sylveſtris*, the Ferret. (4) *Putorius*, the Pole-cat, (5) *Martes*, *Foyna* (whence our word, a *Gown* of *Foins*) the Marten or Martlet. (6) *Muſtela Zibellina*, the *Sable.* (7) The *Genetta.* (8) The *Ichneumon Bellonii.*

Of the *Hare Kind* of Quadrupeds, are firſt *Lepus*, the common Hare: (2) *Cuniculus*, the Rabbit or Coney. (3) The *Tapeti* or Braſile Coney, and the *Aperea* of Braſile. (4) The *Hyſtrix*, or Porcupine; and the *Hyſtrix Americanus*, or *Cuanda* of Braſile. (5) The *Caſtor*, *Fiber*, or the Beaver. (6) The *Sciurus vulg.* or *Squirrel.* The *Virginian*, *Zeylandick*, the *Barbary*, the *American* Flying Squirrel, *&c.*

this Uſe, each of them carrying 24 *Retorts*; in all 384 *Retorts*.

All the *Mercury* got without the uſe of *Fire*, whether by *Waſhing*, or found in the *Mines* (for in the Digging ſome, the Particles get together, ſo that in ſome places you might take up two or three *Spoonfuls* of *pure Mercury*) is called by them *Virgin Mercury*, and eſteemed above the reſt. The Officer told me, that making an *Amalgama* of *Gold* and *Virgin Mercury*, and putting it to the Fire, that *Mercury* would carry away all the *Gold* with it, which *Common Mercury* would not do.

The *Engines* for drawing the Water, are all moved by Water, brought thither in no Chargeable *Aqueduct* from a Mountain 3 *Miles* diſtant. The Water *Pumpt* from the bottom of the *Mine* by 52 *Pumps*, 26 on a ſide, is contrived to move other Wheels, for ſeveral other Purpoſes.

The Labourers (being 280 always employed) work for a *Julio* a Day, which is not above 6 or 7 pence, and Endure not long: For although None ſtay under-ground above 6 *Hours*; all of them in time (ſome later, ſome ſooner) become *Paralytick*, and die *Hectick*. We ſaw a Man who had not been in the *Mines* for above *half a Year before*, ſo full of *Mercury*, that putting a piece of *Braſs* in his *Mouth*, or rubbing it in his *Fingers*, it immediately became as *White*, as if he had rubbed *Mercury* upon it. Thoſe alſo that Work upon the Back-ſide of *Looking Glaſſes*, are very Subject to the *Palſey*.

They convey their Wood thus. About 4 *Miles* from the *Mines* on the ſides of Two Mountains, they cut down the Trees, and draw them into the Interjacent Valley. Higher up in the ſame Valley they make a *Lock* or *Dam*; when the Water is ready to run over it, they open the *Flood-Gates*, and the Water carries all the Trees impetuouſly to *Idria*, where the Bridge is built very ſtrong, and at very Oblique Angles to the Stream, on purpoſe to ſtop them, and throw them on ſhore near the *Mines*.

Thoſe *Mines* heretofore Coſt the Emperor 70000 or 80000 *Florins* yearly; but now they Coſt him not above 28000. They produced

| *Anno* 1661. | | *Anno* 1662. | *Anno* 1663. |
|---|---|---|---|
| | *ll.* | *ll.* | *ll.* |
| *Ordinary Mercury.* | 198481 | 225066 | 244119 |
| *Virgin Mercury.* | 6194 | 9612 | 11862 |
| in all | 204675 | 234678 | 255981 |

2. The Town of *Idria* in the County of *Goritia* and Province of *Friuli*, is ſeated low, and encompaſſed with Hills on all ſides. A *River* of the ſame Name runs by it, and proves ſufficient upon plentiful Rains to convey down the *Firr-Trees* and other Wood required in the Service of the *Mines*: And to this End there is an handſome Work of *Piles* made ſloaping athwart the *River* (after the ſame manner as I obſerved in *Newſol* in *Upper Hungary*, croſs the River *Gran*) to ſtop the Trees.

The Entrance into theſe *Mines* is not high, or upon an Hill, but in that Town it ſelf. The deepeſt part of the *Mine* from the Entrance, is between 120 and 130 *Fathoms*.

The *Virgin Quick-ſilver*, which they call *Jungfraw*, is that which diſcovers it ſelf without the help of *Fire*. Sometimes it is plainly ſeen in the *Ore*, or falls down in *Drops*, and ſometimes *Streams* out in good quantity; as about Seven *Years* ago it ran out of the Earth at firſt in a *Stream* as ſmall as a Thread, and afterwards as big as a Packthread, but ceaſed in 3 or 4 Days. That alſo is accounted *Virgin Quick-ſilver*, which is ſeparated only by *Water*.

*Plain Quick-ſilver* they obtain by *Fire* out of the *Ore*, and out of the *Cinnabar* of *Mercury*, which they dig out of this *Mine*. The *Ore* of this *Mine* is of a *Dark Colour*, mixed with *Red*.

The *Quick ſilver Ore* of this *Mine* ordinarily contains half, and ſometimes $\frac{2}{3}$ of *Quick ſilver*.

I went into the *Mine* by the Pit of St. *Agatha*, and came up again by that of St. *Barbara*, deſcending and aſcending by Ladders. I aſcended at one of 639 Staves, or 89 Fathoms. It has been wrought 200 *Years*, about the ſame ſpace of time with *Newſol Mine*, but comes much ſhort in time of the *Silver Mine* at *Schemnitz*; and much ſhorter yet of the notable *Lead Mines* in *Upper Carinthia*.

In a *Laboratory*, where the *Quick-ſilver* is ſeparated by *Fire*, I ſaw an Heap of 16000 *Retorts* of *Iron*; every one of which coſts a *Crown* at the beſt Hand from the *Iron Furnaces* in *Carinthia*. There are 800 *Retorts*, and as many *Recipients*, employed together, in drawing over the *Quick-ſilver* in 16 *Furnaces*; 50 in each *Furnace*, 25 of a ſide; 12 above, and 13 below of each ſide.

*June* 12. 1669, when I was there, they carried out 40 *Saumes* of *Quick ſilver* into Foreign Parts, each *Saume* containing 315 pound Weight, to the value of 4000 *Ducats* of *Gold*. Some of it is ſent as far as *Cremnitz* in *Hungary*, for the Uſe of the *Gold Mines*: And very much carried away Southward; for they are not far from the *Sontius*, or *Lyſonzo*, a conſiderable River, which runs into the *Gulf* of *Trieſte* in the *Adriatick Sea*.

In the Caſtle, I ſaw 3000 *Saumes* of *Quick-ſilver* together in Barrels, the *Quick-ſilver* being firſt made up in double Leather: And in another Houſe as much *Ore* as can be diſtilled in 2 *Years*, except they have great Plenty of *Rain* to bring down the *Wood*.

The Country is well ſtored with ſtately *Firs*, *Larches*, *Pines*, *Pinaſters*, *Picea*'s, and that nobly criſped and well grain'd kind of *Acer*, whereof *Viols* and *Violins* are made: Whereof there is alſo Plenty in the Country of *Saltzburg* and *Carniola*.

Travelling ſometimes in the Night, we had continually about us a great number of large *Glow-worms*, which put into Papers, gave a dimm Light like Candles in Lanthorns; and the Air alſo

was full of *Flaming Flies*, affording ſome delight unto us.

The way to this Place from *Croatia* I found difficult; and coming from it to *Aidoſchini* and *Croatia*, I paſſed over *Swartzenburg*, or the *Black Mountain*, from whence I deſcended 10 *Miles* in a Rocky Country, and far more Stony than the *Craw*, or *Campus lapidoſus*, in *Provence*.

In the Valley of *Lancy*, which runs between the Mountains of *Turin*, grows a Plant like the *Doronicum*, (ſo alſo called by the Inhabitants and *Botaniſts*,) near the *Roots* whereof you may find *Pure Quick-ſilver*, running in ſmall Grains like *Pearls*; the *Juice* of which Plant being expreſſed, and expoſed to the Air of a Clear Night, there will be found as much *Mercury*, as there is loſt of *Juice*.

QUIETUS, was formerly a Writ of Diſcharge granted to thoſe Barons and Knights, who perſonally attended the King in his Wars, or any Foreign Expedition; by which they were exempted from the Claim of *Scutage*, or a Tax on every Knights Fee.

QUINQUAGESIMA; See *Quadrageſima*.

QUINTAL, or *Quintan*, was an old Sportive Exerciſe, practiſed uſually at Weddings, and was either ſo dangerous or ludicrous as to be forbid often by Eccleſiaſtical Authority; The manner of it was thus: A Poſt was erected perpendicularly in the Ground, on the Top of which was a ſlender Beam turning round on a Spindle: At one of whoſe Ends was a Sloap or flat Board; and at the other a Bag of Sand or Dirt. And the Sport was with a long Staff or wooden Launce to ride a Tilt at the Board, and to be either ſo skilful or lucky to eſcape the Blow which the Sand Bagg would be likely to give the Runner at this Quintan, by the turning round of the Beam. This ſeems to have been the ſame with that Sport called *Arietum Levatio*, which is frequently prohibited in our Old Synods and Epiſcopal Conſtitutions. *Kennet Par. Antiquities.*

QUINTAL, alſo was formerly uſed for a Weight of Lead, Iron and common Metals, of uſually an Hundred Pounds; at Six-ſcore to the Hundred.

QUINQUE-*Portus*, the *Cinque* or *Five Ports* of the Kingdom of *England*, were ſo called formerly by way of Eminence: They are *Haſtings*, *Dover*, *Romney*, *Hithe*, and *Sandwich*. There belongs to them alſo, two Ancient Towns, which are *Winchester*, and *Rye*; and ſeveral other Places which are called their *Members*; as *Seaford*, *Feverſham*, *Folkſtone*, &c.

Theſe had formerly, and have ſtill, great Privileges allowed them on the account of finding the King a certain Number of Ships of War, on occaſion: The Numbers of which are theſe. *Haſtings* is bound to find twenty one Ships, each carrying twenty one Men and a Boy. *Romney* is to find Five Ships, with 24 Men and a Boy in each. *Hithe* alſo muſt find Five Ships, and in each 21 Men and a Boy. *Dover* is to find 21 Ships, in each 21 Men and a Boy. *Sandwich* ſhould find Five Ships, each carrying 21 Men and a Boy. The Ships and Boys are 57. The Men 1188. The Service, which the Barons of theſe Cinque-Ports owe the Crown, is to attend with theſe Ships at their own Charges for fifteen Days, and to ſet out to thoſe Places whither they are to go, and to ſtay as long as the King pleaſes, at his Charge. See *Somner's* Treatiſe of *Rom.* Forts and Ports in *Kent*.

QUIRK, is a Term in Architecture for a Piece of Ground whether Square or Oblong, taken out of a Corner, or any Place elſe of a Ground-plat, to make a Court or Yard, &c.

QUOINS are the Stones and Bricks placed in the Corner of any Building; and if any ſtick without the Brick-work (their Edges being Cypher'd off) they are called *Raſtick Quoins*.



RACHAT, *Rachetum*, from the French *Racheter*, to redeem, was formerly uſed for the ſame as *Theft-boote*, viz. the Compenſation or Redemption of a Thief. *Skene de verb. ſignif.*

RADECHENISTORS in Dooms-day book, is uſed for *Liberi-Homines*; and *Spelman* thinks it to be what *Bracha* calls *Rade-knights*.

RADIAL-*Curves* are Curves of the Spiral kind, whoſe Ordinates, if they may be ſo called, do all terminate in the Centre of the including Circle, and appear like ſo many *Radii* or Semi-diameters of that including Circle. See *Spiral*.

RADMAN is a word often uſed in Dooms-day, and ſeems to be the ſame with *Rade-knight* or *Rad-knight*. Others think it comes from *Read*, Counſel, and then *Read-man*, is a Counſellor.

RAFTERS, in any Building, are thoſe Pieces of Timber, which ſtand by pairs upon the *Reaſon*, meet in an Angle at the Top, and help to compoſe the Roof of a Building: They ſhould not ſtand farther than 12 Inches from one another.

RAGEMAN, is a *Statute* ſo called, of Juſtices aſſigned by K. *Edw.* 1. and his Counſel, to go a Circuit through all *England*, and to hear and determine all Complaints of Injuries done within 5 Years next before *Michaelmas*, in the fourth Year of his Reign. *Cowel.*

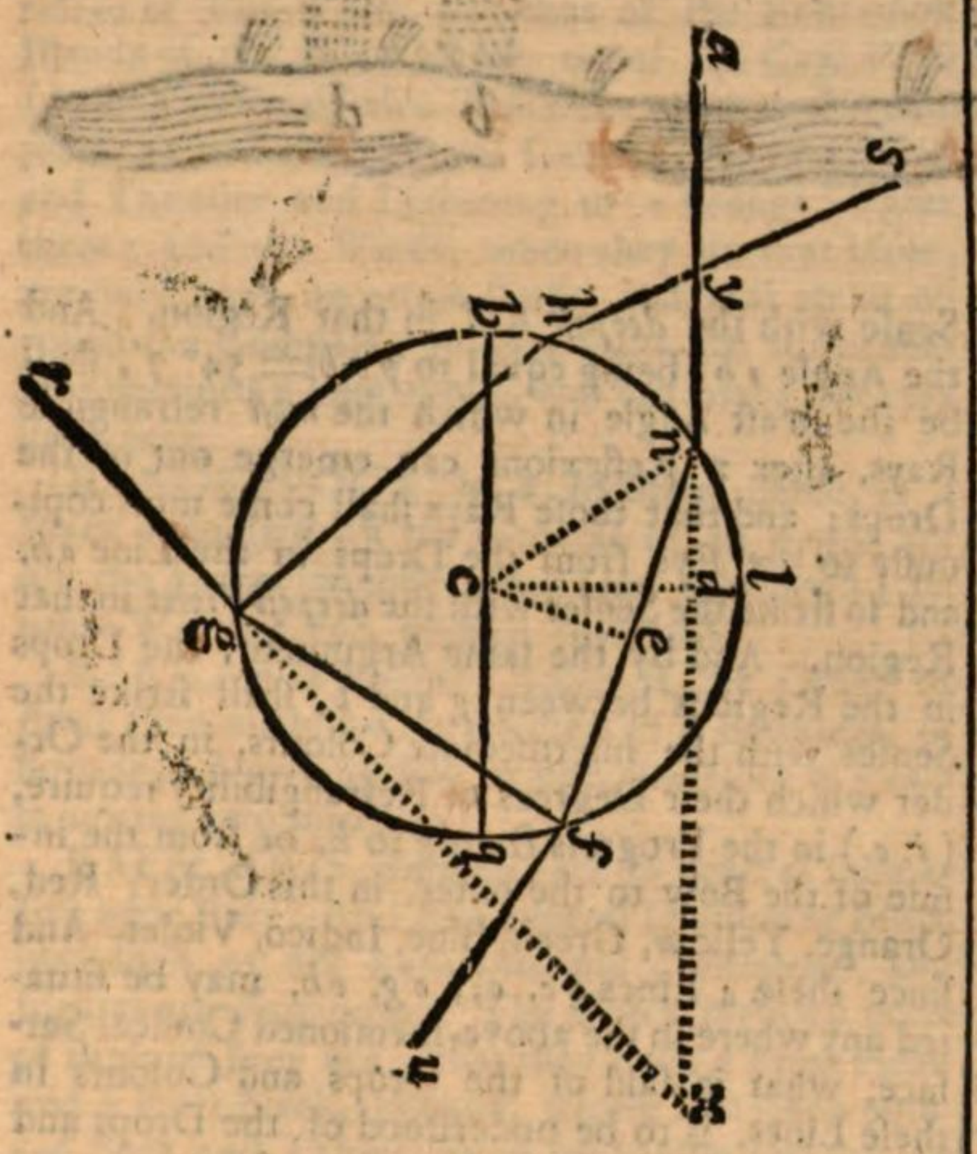
RAIN-BOW. In order yet further to explain the *Phænomena* of the Rain-bow; Sir *Iſaac Newton* in his Excellent Treatiſe of Opticks, *p.* 126. advances this Propoſition.

*By the Properties of Light (diſcovered by his New Experiments) to explain the Colours of the Rain-bow.*

This Bow never appears but where it rains in the Sun-ſhine; and it may be artificially made by ſpouting out Water, which by breaking aloft ſhall ſcatter into Drops, and fall like Rain; for the Sun on theſe Drops certainly cauſes the Bow to appear to an Eye duly poſited to the artificial Rain, and

the Sun. And hence it is now agreed, that this Bow is made by the Refraction of the Sun's Light in Drops of falling Rain. This was understood by some of the Ancients, and of late more fully discovered and explained, by *Antonius de Dominis*, A. Bp. of *Spalato in Libro de Radiis visus & lucis:* Printed at *Venice*, A. D. 1611. and written above 20 Years before. He shews there, how the Interior Bow is made in round Drops of Rain by a Refraction of the Sun's Light, and one Reflexion between them; and the Exterior by two Refractions and two Sorts of Reflexions between them in each Drop of Water: And he proves his Explications by Experiments made with a Phial full of Water; and with Globes of Glass filled with Water, and placed in the Sun, to make the Colours of the two Bows appear in them. The same Explication *Des Cartes* hath pursued in his Meteors, and mended that of the Exterior Bow. But since they understood not the true Origin of Colours, its necessary to pursue it here a little further.

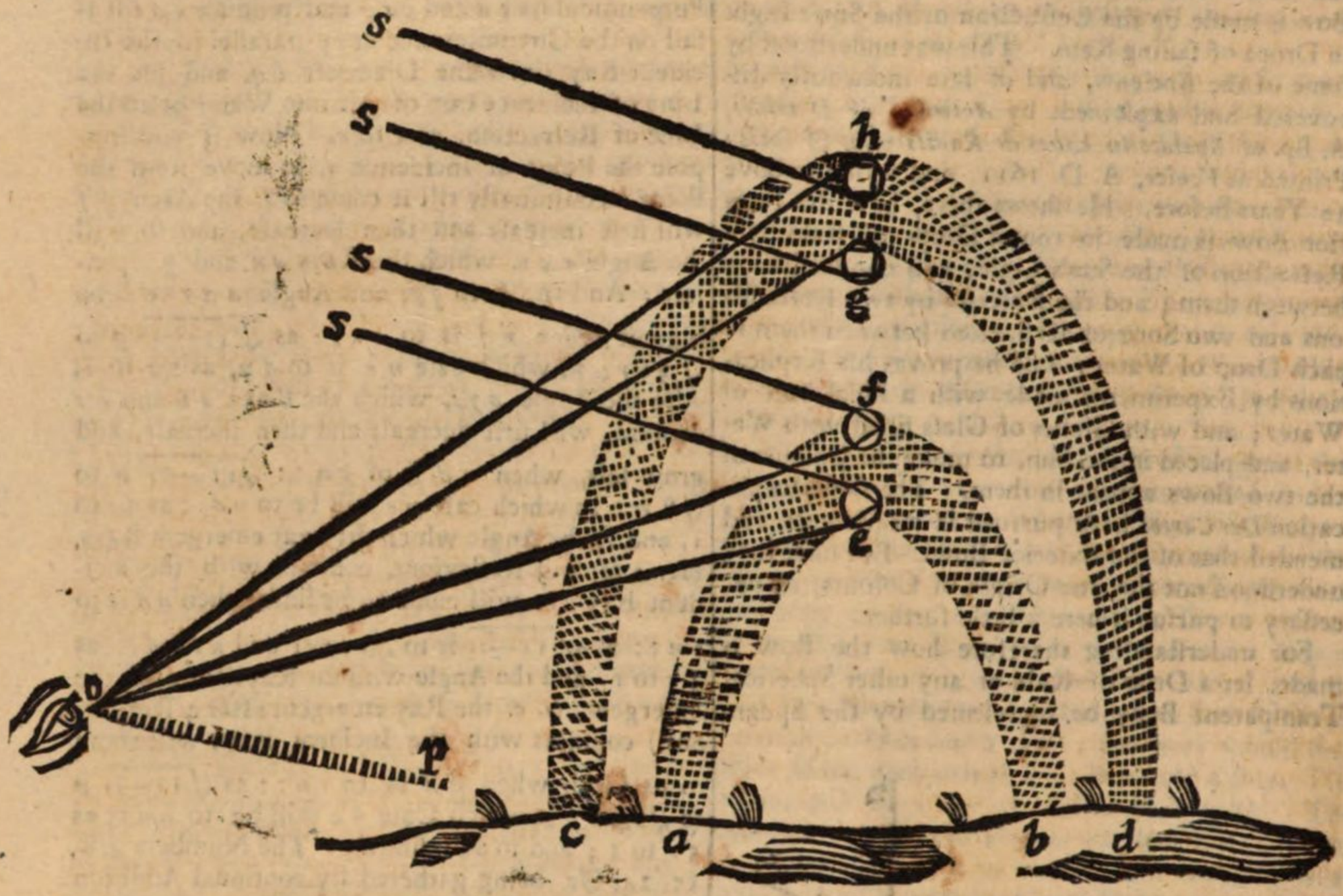
For understanding therefore how the Bow is made, let a Drop of Rain or any other Spherical Transparent Body be represented by the Sphere




*b n f o* described with the Centre *c*, and Radius *c n*, and let *a n* be one of the Sun's Rays incident upon it at *n*, and thence refracted to *f*; where let it either go out of the Sphere by refraction towards *u*, or be reflected to *g*; and at *g* let it either go out by Refraction at *r*, or be reflected to *b*; and at *b* let it go out by Refraction towards *s*, cutting the Incident Ray in *y*: Produce *a n* and *r g* till they meet in *x*; and on *a x* and *n f* let fall the Perpendiculars *c d* and *c e*; and produce *c d* till it fall on the Circumference at *l*; parallel to the Incident Ray draw the Diameter *b q*, and let the Line of Incidence out of Air into Water be to the Line of Refraction, as 1 to *r*. Now if you suppose the Point of Incidence *n*, to move from the Point *b* continually till it come to *l*, the Arch *q f* will first increase and then decrease, and so will the Angle *a x r*, which the Rays *a n* and *g r* contain: And the Arch *q f*, and Angle *a x r* will be biggest when *n d* is to *c n*:: as $\sqrt{11-rr}$ is to $\sqrt{3rr}$; in which case *n e* is to *d n*, as 2 *r* to 1. Also the Angle *a y s*, which the Rays *a n* and *h s* contain, will first decrease and then increase, and grow less, when *n d* is to *c n* :: $\sqrt{11-rr}$ is to $\sqrt{8rr}$: In which case *n e* will be to *n d*:: as 3 *r* to 1, and so the Angle which the next emergent Rays, *viz.* *y* after 3 Reflexions, contains with the incident Ray *a n*, will come to its limit when *n d* is to *c n*:: as $\sqrt{11-rr}$ is to $\sqrt{15rr}$; and *n e* to *n d*:: as 4 *r* to 1, and the Angle with the Ray next after the emergent, (*i. e.* the Ray emergent after 4 Reflexions) contains with the Incident Ray, will come to its Limit when *n d* is to *c n*:: as $\sqrt{11-rr}$ is to $\sqrt{24rr}$; in which Case *n e* will be to *n d*:: as 5 *r* to 1; and so on infinitely: The Numbers 3, 8, 15, 24, *&c.* being gathered by continual Addition of the Terms of the Arithmetick Progression 3, 5, 7, 9, *&c.* The Truth of all which Mathematicians will easily examine.

Now it is to be observed, that as when the Sun comes to his Tropicks, the Days increase and decrease but a very little for a great while together; so when by increasing the Distance *c d*, these Angles come to their Limits, they vary their Quantity but very little for some time together; and therefore a far greater Number of the Rays which fall upon all the Points *n*, in the Quadrant *b l*, shall emerge in the Limits of these Angles, than in any other Inclinations. And 'tis to be observed farther, that the Rays which differ in Refrangibility will have different Limits of their Angles of Emergence, and consequently according to their different Degrees of Refrangibility, emerge most copiously in different Angles, and being separate from one another, appear each in their proper Colours. And what these Angles are, may be easily gathered from the foregoing Theorem, by Computation.

For in the least refrangible Rays the Sines 1 and *r* (as was found above) are 108 and 81, and thence by Computation the greatest Angle *a x r* will be found 42° 2′, and the least Angle *a y s* 50° 57′. And in the most refrangible Rays, the Sines 1 and *r*, are 109 and 81; and thence by Computation the greatest Angle *a x r* will be found to be 40° 17′; and the least Angle *a y s* 54° 7′.




Suppoſing now then *o* be the Spectator's Eye, and *op* a line drawn parallel to the Sun's Rays, and let *p o e*, *p o f*, *p o g*, and *p o h*, be Angles of 40° 17′: 42° 2′: 50° 57′, and 54° 7′ reſpectively; and theſe Angles turned about their common ſide *o p*, ſhall with their other ſides *o e*, *o f*, *o g*, and *o h*, deſcribe the Verges of 2 Rain-bows *a f b e*, and *c h d g*: For if *e*, *f*, *g*, *h*, be Drops placed any where in the Conical Superficies deſcribed by *o e*, *o f*, *o g*, *o h*, and be illuminated by the Sun's Rays *s e*, *s f*, *s g*, *s h*: The Angle *s e o* being equal to the Angle *p o e* = 40° 17′, ſhall be the greateſt Angle in which the moſt refrangible Rays can after one Reflexion be refracted to the Eye: And therefore all the Drops in the Line *o e*, ſhall ſend the moſt refrangible Rays moſt copiouſly to the Eye, and thereby ſtrike the Senſes with the *deepeſt violet Colour* in that Region. And in like manner the Angle *s f o* being = to the Angle *p o f* = 42° 2′, ſhall be the greateſt in which the leaſt refrangible Rays after one Reflexion can emerge out of the Drops; and that theſe Rays ſhall come moſt copiouſly to the Eye from the Drops in the Line *o f*, and ſtrike the Senſes with the *deepeſt red Colour* in that Region. And by the ſame Argument, the Rays which have intermediate Degrees of Refrangibility, ſhall come moſt copiouſly from Drops between *e* and *f*, and ſo ſtrike the Senſes with the intermediate Colours, in the Order which their Degrees of Refrangibility require: *i. e.* in the Progreſs from *e* to *f*, or from the Inſide of the Bow to the Outſide in this Order; Violet, Indico, Blue, Green, Yellow, Orange, Red. But the Violet, by the mixture of the white Light of the Clouds, will appear faint, and incline to a Purple.

Again, the Angle *s g o* being equal to the Angle *p o g*, or 50° 51′, ſhall be the leaſt Angle in which the then *leaſt* refrangible Rays can, after 2 Reflexions, emerge out of the Drops; and that the leaſt refrangible Rays ſhall come moſt copiouſly to the Eye from the Drops in the Line *o g*, and ſtrike the Senſe with the *deepeſt Red* in that Region. And the Angle *s h o* being equal to *p o h* = 54° 7′, ſhall be the leaſt Angle in which the *moſt* refrangible Rays, after 2 Reflexions can emerge out of the Drops; and that thoſe Rays ſhall come moſt copiouſly to the Eye from the Drops in the Line *o h*, and ſo ſtrike the Senſes with the *deepeſt Violet* in that Region. And by the ſame Argument, the Drops in the Regions between *g* and *h*, ſhall ſtrike the Senſes with the intermediate Colours, in the Order which their Degrees of Refrangibility require, (*i. e.*) in the Progreſs from *g* to *h*, or from the inſide of the Bow to the outer, in this Order: Red, Orange, Yellow, Green, Blue, Indico, Violet. And ſince theſe 4 Lines *o e*, *o f*, *o g*, *o h*, may be ſituated any where in the above-mentioned Conical Surface, what is ſaid of the Drops and Colours in theſe Lines, is to be underſtood of the Drops and Colours every where in theſe Superficies.

Thus ſhall there be made two Bows of Colours, an interior and ſtronger, by one Reflexion in the Drops, and an exterior and fainter by two; for the Light becomes fainter by every Reflexion: And their Colours ſhall lie in a contrary Order to one another, the Red of both Bows bordering upon the Space *g f*, which is between the Bows. The Breadth of the interior Bow *f o e*, meaſured a-croſs the Colours ſhall be 1° 45′, and the breadth of the exterior *g o h*, ſhall be 3° 10′; and the Diſtance between *g o f*, ſhall be 8° 55′. The greateſt Semidiameter of the innermoſt, (*i. e.*) the Angle *p o f* being 42° 2′; and the leaſt Semidiameter of the outermoſt *p o g* being 50° 57′. Theſe are the Meaſures of the Bows, ſuppoſing the Sun to be a Point; but by the breadth of his Body, the breadth of the Bows will be increaſed, and their Diſtance decreaſed by half a Degree.

This Explication of the Rain-bow is yet farther confirmed, by the known Experiment of hanging up in the Sun-ſhine a Glaſs-globe filled with Water; and then viewing it in ſuch a Poſture, that the

the Rays which come from the Globe to the Eye may contain with the Sun's Rays an Angle of either 42 or 50 Degrees: For if the Angle be about 42 or 43 Degrees, the Spectator ſuppoſe at *o* (in the preced. Fig.) ſhall ſee a full red Colour in that ſide of the Globe which is oppoſed to the Sun, as is repreſented at *f*. And if that Angle become leſs (ſuppoſe by depreſſing the Globe to *e*) there will appear other Colours, Yellow, Green and Blue ſucceſſively, in the ſame ſide of the Globe. But if the Angle be made about 50 Degrees, (as ſuppoſe by lifting up the Globe to *g*,) there will appear a red Colour in that ſide of the Globe which is towards the Sun: And if the Angle be made greater, (ſuppoſe by lifting up the Globe to *h*) the Red will turn ſucceſſively to the other Colours, Yellow, Green, Blue, *&c.* The ſame thing may be done (as the Author tried) letting the Globe reſt, and only raiſing and depreſſing the Eye, or moving it ſo, as to make the Angle of a juſt Magnitude.

RAINS: Our Seamen call that Tract of the Sea to the Northwards of the Equator betw. 4 and 10 Degrees of Latitude, and lying between the Meridian of *Cape Verde*, and that of the Eaſtermoſt Iſlands of the ſame Name, or of the *Cape Verde* Iſlands, they call this Tract the *Rains*: Becauſe there are almoſt continual Calms, conſtant Rains, and Thunder and Lightning to a ſtrange Degree there; and the Winds, when they do ever blow, are only ſmall uncertain Guſts, and ſhift about all round the Compaſs; ſo that Ships are ſometimes here detained a long while, and can make but very little way.

RANDEZVOUS, in a Military Senſe, is a Place appointed by the General of an Army, for all the Forces to meet on a Day appointed; let what Weather, *&c.* happen that will.

RANK, in a Military Senſe is the Order or ſtrait Line made by the Soldiers of a Battalion, or Squadron drawn up ſide by ſide, *Doubling of Ranks* is putting two into one.

RAPACIOUS *Animals*, are in general ſuch as live upon Prey: And 'tis a general Diviſion of Birds, into ſuch as are *Rapacious and Carnivorous*, and ſuch as are *Frugivorous*. The Characteriſtick notes of Birds of Prey are; that they have a great Head and a ſhort Neck, hooked, ſtrong and ſharp pointed Beak and Talons, fitted for ravine and tearing of Fleſh; ſtrong and brawny Thighs for ſtriking down their Prey: A broad thick fleſhy Tongue like that of a humane Creature; 12 Feathers in their Train; and 14 flag Feathers in each Wing. The two *Appendices*, or blind Guts, are always very ſhort; They have a *Membranous* Stomach, and not a *Muſculous* one or a *Gizard*, ſuch as Birds have that live on Grain: They are very ſharp-ſighted, and are not *Gregarious*, but Solitary generally ſpeaking, though Vultures will fly 50 or 60 in a Company.

RAPHA, in Anatomy, is a Ridge or Line which runs along the Under ſide of the *Penis*, and reaching from the *Frænum* to the *Anus*, divides the *Scrotum* and *Perinæum* in two. This line is not uſually cut in the Grand Operation of cutting for the Stone, becauſe 'tis both harder than the reſt of the Skin there-abouts, and alſo becauſe you muſt then cut upon the Interſtices of the Muſcles, which will make the Re-union the more difficult.

RATE of a Ship of War is its diſtinction as to Bigneſs and Capacity; and this is uſually accounted by the Length and Breadth of the Gun-deck, the Number of Tuns they contain, and the Number of Men and Guns they carry. For ſuch Men of War as have their Gun-decks from 159 to 174 Feet in length, and from 44 to 50 Foot broad: That contain from 1313 to 1882 Tuns, that have from 706 to 800 Men, and carry from 96 to 110 Guns: We reckon of the *Firſt Rate*.

*Second Rate Ships*, have their Gun-decks from 153 to 165 Feet long; and from 41 to 46 broad: Contain from 1086 to 1482 Tuns; and carry from 524 to 640 Men, and from 84 to 90 Guns.

*Third Rates* have their Gun-decks from 142 to 158 Feet in length; from 37 to 42 Foot broad: They contain from 871 to 1262 Tuns; carry from 389 to 476 Men, and from 64 to 80 Guns.

*Fourth Rates* are in length on the Gun-deck from 118 to 146 Foot, and from 29 to 38 broad: They contain from 448 to 915 Tuns; carry from 226 to 346 Men; and from 48 to 60 Guns.

*Fifth Rates* have their Gun-decks from 100 to 120 Foot long, and from 29 to 31 Feet broad: Contain from 259 to 542 Tuns; carry from 145 to 190 Men; and from 26 to 44 Guns.

*Sixth Rates* have their Gun-decks from 87 to 95 Foot long, and from 22 to 25 Foot broad: They contain from 152 to 256 Tuns; carry from 50 to 110 Men, and from 16 to 24 Guns.

Our New-built Ships are much larger, as well as better, than the Old ones of the ſame *Rate*; and that is the Reaſon of the double Numbers all along; the larger of which expreſs the Proportions of the New-built Ships.

RATION, is now in the Army, a word in uſe for a certain Proportion of Ammunition-Bread or Forrage diſtributed to every Man in the Army, as his Portion for ſuch a Time.

RAVISHMENT *de Garde* was a Writ that formerly lay for the Guardian by *Knights Service*, or in *Soccage*, againſt him that took away from him the Body of his Ward.

RAYS *of Light* with Regard to Opticks, are by Sir *Iſ. Newton* conſidered, *as the laſt Parts of that wonderful Fluid; and that as well ſuch as are ſucceſſive in the ſame Lines as contemporary in ſeveral Lines*: For 'tis manifeſt that Light conſiſts of Parts both ſucceſſive and contemporary; becauſe in the ſame place you may ſtop that which comes one moment, and let paſs that which comes preſently after, and in the ſame Time you may ſtop it in any one place, and let it paſs in another. Wherefore the leaſt Light, or part of Light, which may be ſtopt alone without the reſt of the Light; or propagated alone, or do or ſuffer any thing alone, which the reſt of the Light does not, or ſuffers not, he calls a Ray of Light.

The Mathematicians indeed uſually conſider the Rays of Light to be *Lines* reaching from the luminous Body to that illuminated; which were juſt if Light were propagated in an inſtant, as ſome have ſuppoſed: But the Obſervations of the Eclipſes of *Jupiter's* Satellites made firſt by Mr. *Romer*, do ſhew that 'tis propagated in Time, and in particular that it takes up about 7 Minutes in moving from the Sun to the Earth.

The

The incomparable Sir *Is. Newton* in his Opt. Book 2. Part 3. *p.* 65. After having premiſed *p.* 50. that thoſe Surfaces of tranſparent Bodies *reflect* the greateſt Quantity of Light, which have the greateſt *Refracting* Power; and alſo that in the Confines of equally refracting Mediums there is no *Reflexion*; and at *pag.* 45. That the Tranſparent parts of Bodies according to their ſeveral Sizes muſt reflect Rays of one Colour, and tranſmit thoſe of another on the ſame Grounds, that thin Plates or Bubbles do tranſmit or reflect thoſe Rays; which he takes to be the ground of all their Colours: proceeds, in the Eighth Propoſition, to enquire into the Cauſe of the Rays of Lights being reflected, and he ſhews that the Cauſe of Reflexion is not the impinging of Light on the ſolid or impervious Parts of Bodies as hath commonly been believed, as appears from the following Conſiderations.

(1.) That in the Paſſage of Light out of Glaſs into Air, there is a Reflexion as ſtrong as in its Paſſage out of Air into Glaſs, and rather ſomething ſtronger, and much ſtronger than in its Paſſage out of Glaſs into Water: And it ſeems not probable that Air ſhould have more reflecting Parts than Water or Glaſs. But if that could be ſuppoſed it would not do, becauſe the Reflexion is as ſtrong or ſtronger when the Air is drawn away from the Glaſs (as ſuppoſe in the exhauſted Receiver of Mr. *Boyle*'s Air-pump) as when it is adjacent to it.

(2.) If Light in its Paſſage from Glaſs to Air be incident *more obliquely* than at an Angle of 40 or 41 *gr.* it is wholly reflected; but if *leſs obliquely*, it is in a great Meaſure tranſmitted. Now it is not to be imagined that Light at one Degree of Obliquity ſhould meet with Pores enough in the Air to tranſmit the greateſt Part of it, and at another Degree of Obliquity ſhould meet with nothing but Parts to *reflect* it wholly; eſpecially conſidering that in its Paſſage out of Air into Glaſs, how obliquely ſoever it falls, it finds Pores enough in the Glaſs to tranſmit the greateſt Part of it. If it be ſaid that it is not reflected by the Air but by the utmoſt Superficial Parts of the Glaſs; there is ſtill the ſame Difficulty: Beſides, that ſuch a Suppoſition is un-intelligible, and will alſo appear to be falſe by applying Water behind ſome part of the Glaſs inſtead of Air. For ſo in a convenient Obliquity of the Rays, as ſuppoſe of 45 or 46 *gr.* at which they are all reflected where the Air is adjacent to the Glaſs, they ſhall be in a great Meaſure tranſmitted where the Water is adjacent to it: Which argues, that their Reflexion or Tranſmiſſion depends on the Conſtitution of the Air and Water behind the Glaſs, and not on the ſtriking of the Rays upon the Parts of the Glaſs.

(3.) If the Colours made by a Priſm placed at the Entrance of a Beam of Light into a darkned Room, be ſucceſſively caſt on a ſecond Priſm placed at a greater Diſtance from the former, in ſuch manner that they are all alike incident upon it; the ſecond Priſm may be ſo inclined to the Incident Rays, that thoſe which are of a blue Colour ſhall all be reflected by it, and yet thoſe of a red Colour pretty copiouſly tranſmitted. Now if the Reflexion be cauſed by the Parts of Air and Glaſs, how comes the *Blue*, at the ſame Obliquity of Incidence, wholly to impinge on thoſe Parts ſo as to be all reflected, and yet the *Red* find Pores enough to be in a great Meaſure tranſmitted?

(4.) Where 2 Glaſſes touch one another, as he ſhews in the firſt Obſervation, there is no ſenſible Reflexion, yet why ſhould not the Rays of Light impinge on the Parts of Glaſs, as much when contiguous to other Glaſs, as when ſo to Air?

(5.) When the Top of a Bubble of Water in Obſ. 17. at laſt began to grow very thin, there was ſo very little Light reflected from it, that it appeared intenſely *black*; and yet round about where the Water was thicker, the Reflexion was ſo ſtrong as to make the Water to appear very *white*.

Nor is it only at the leaſt Thickneſs of Bubbles and thin Plates that there is no manifeſt Reflexion, but at many others continually greater and greater: For he found (in Obſer. 15.) that Rays of the ſame Colour were by turns tranſmitted at one Thickneſs, and reflected at another, for an indeterminate Number of Succeſſions; and yet in the Surface of the thinned Body, where it is of any one Thickneſs, there are as many Parts for the Rays to impinge on, as where it is of any other Thickneſs.

(6.) If Reflexion were cauſed by the Parts of reflecting Bodies, it would be impoſſible for thin Plates or Bubbles at the *ſame place* to reflect the Rays of one Colour and tranſmit thoſe of another, as by the 13 and 15 Obſervations 'tis plain they do: For it is not to be imagined that at one Place the Rays which (for inſtance) exhibit a *Blue*, ſhould have the Fortune to daſh upon the *Parts*; and thoſe which exhibit a *Red* ſhould fall upon the *Pores* of the Body: And then at another Place, where the Body is either a little thicker or thinner; that on the contrary, the *Blue* ſhould fall on its *Pores*, and the *Red* upon its *Parts* poliſhed.

(7.) Were the Rays of Light reflected by impinging on the ſolid Parts of Bodies, their Reflexions from theſe Bodies could not be ſo regular as they are. For in poliſhing with Sand, Glaſs, Putty, or Tripoly; it is not to be imagined that thoſe Subſtances can by grating and fretting the Glaſs, bring all its leaſt Particles to an accurate Poliſh, ſo that all their Surfaces ſhall be truly plane or truly ſpherical, and look all the ſame way, ſo as together to compoſe one even Surface. The ſmaller indeed the Particles of theſe Subſtances are, the ſmaller will the ſcratches be, by which they continually fret and wear away the Glaſs until it be poliſhed: But be they never ſo ſmall they can wear away the Glaſs no otherwiſe than by grating and ſcratching it, and breaking off the Protuberances; and they poliſh it no otherwiſe than by bringing its roughneſs to a very fine Grain, ſo that the Scratchings upon it become too ſmall to be viſible. And then if Light were reflected by impinging upon the ſolid Parts of the Glaſs, it would be ſcattered as much by the moſt poliſhed Glaſs as by the rougheſt: Wherefore it remains a Problem, how Glaſs poliſhed by fretting Subſtances can reflect Light ſo regularly as it doth; and this can't well be ſolved, unleſs the Reflexion of the Ray be effected, not by a ſingle Point of the reflecting Body, but by ſome Power of the Body which is evenly diffuſed all over its Surface, and by which it acts upon the Ray without immediate contact, for that the Parts of Bodies do act on Light at a diſtance, he ſhews in another Place. (See *Light.*) And if Light be reflected not by impinging on the ſolid Parts of Bodies but by ſome other Principle, 'tis probable that theſe Rays which do impinge on the ſolid Parts of Bodies, are not

*reflected*

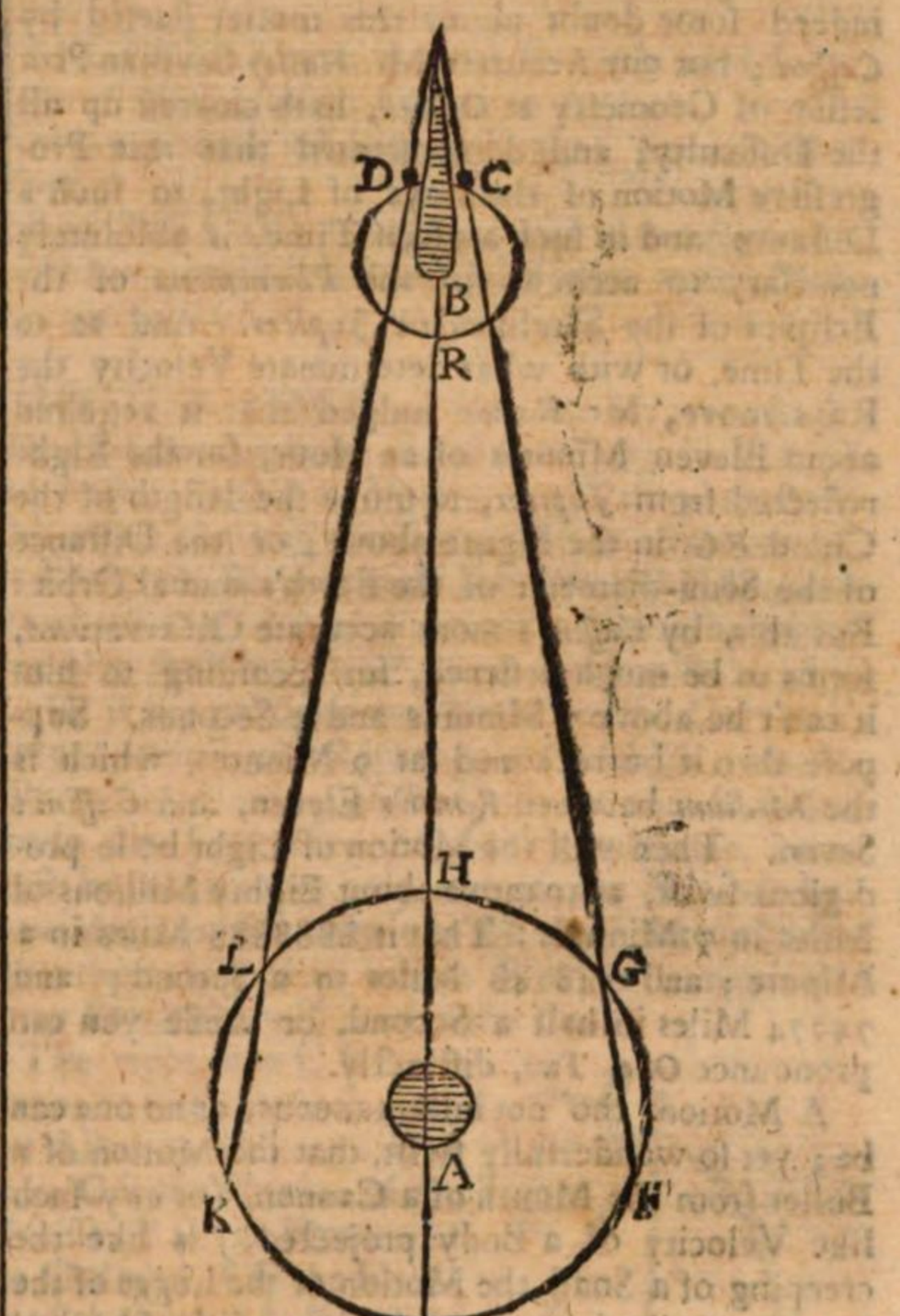
*reflected* but *ſtifled* and *loſt* in the Bodies; for otherwiſe two Sorts of Reflexions muſt be allowed. Should all the Rays be reflected which impinge on the Internal Parts of Water or Chryſtal, theſe Subſtances would rather have a cloudy, than a tranſparent Colour. To make Bodies look black many of the Rays muſt be ſtopt, retained and loſt in them, and it ſeems not probable that any Rays can be ſtopt and ſtifled in them, which do not impinge on their Parts. After this he ſhews in Prop. 9. *That Bodies reflect and refract Light by one and the ſame Power variouſly exerciſed in various Circumſtances*; as appears from ſeveral Conſiderations. 1. Becauſe when Light goes out of Glaſs into Air, as obliquely as it can poſſibly do, if its Incidence be made ſtill more oblique, it becomes totally *reflected*; for the Power of the Glaſs after it hath refracted the Light as obliquely as is poſſible, if the Incidence become ſtill more oblique, becomes too ſtrong to let any of its Rays go thro', and conſequently cauſe a *Total Reflexion.* 2. Becauſe Light is alternately reflected and tranſmitted by thin Plates of Glaſs for many Succeſſions, according as the Thickneſs of the Glaſs increaſes in Arithmetical Progreſſion; for here the Thickneſs of the Glaſs determines *whether the Power by which Glaſs acts upon Light*, ſhall cauſe it to be *reflected*, or permit it to be tranſmitted. And, 3. Becauſe thoſe Surfaces of Tranſparent Bodies, which have the greateſt refracting Power, reflect the greateſt Quantity of Light, as was ſhewn in the firſt Propoſition.

And in the Latin Edition of his Opticks towards the End, under the 21ſt Query, he ſhews that the Cauſe of *Reflexion* and *Refraction* both, is only the Attraction of the Part of the Body acting upon the Rays of Light at a little diſtance, as they paſs out of, or thro' the Surface of the Glaſs. (See *Light*.) For as the Rays paſs out of Glaſs into a *Vacuum* they are always inflected towards the Glaſs; and if they fall on the *Vacuum* too obliquely, they *will return again* to the Glaſs, and be totally reflected. Now this Phænomenon can't be attributed to the Reſiſtance of the *Vacuum*, (which is nothing) but muſt be attributed to ſome force in the Glaſs, which reduces or draws back the Rays after they are gotten out of the Glaſs into the *Vacuum*. For if the hinder Surface of the Glaſs be covered with clear Water, Oil, pellucid and liquid Honey, a Solution of ſublimate, *&c.* Then the Rays which otherwiſe would have *reflected*, will *paſs into* that Liquor. And this ſhews plainly that the Rays are not reflected, till after they have paſs'd the hinder Surface of the Glaſs, or are beginning to go out of it. For if as they are going out, they fall into any of the Liquors above-mentioned, they then go on in the Courſe they were in before: becauſe the Attraction of the Glaſs is balanced by the Attraction of the Parts of the Liquor.

And this appears yet plainer, by the Compreſſion of two Priſms, or Object Glaſſes of a long Teleſcope, together, when one is *plain*, and the other a little *Convex*; for then they will neither exactly touch, not yet be at any conſiderable diſtance one from another, as it may be not above the $\frac{1}{2000000}$ part of an Inch.

For then the Rays which, at paſſing out of the hinder Surface of the firſt Glaſs, would have been reflected and turn again to it, if the Diſtance of the 2° Glaſs had been conſiderable, will now all readily in that part, paſs through the Second Priſm or Object Glaſs, juſt as if there were a hole thro' it. See Sir *Iſ. Newt.* Obſerv. 1. 4. and 8th. of Part 1. Book 2. of his Opticks.

It hath been diſcovered by that Excellent *Daniſh* Aſtronomer, Mr *Romer*: that tho' the Motion of the Rays of Light coming from us to the Sun be amazingly ſwift, yet it is by no means inſtantaneous. And the Velocity of that Motion may be thus determined in the Figure annexed; let the Circle *HLKEFG* repreſent the Earths annual Orbit, deſcribed by its Revolution round the Sun, which ſuppoſe placed in *A*. Let the Point *B* repreſent the Planet *Jupiter*, caſting a Shadow backwards towards thoſe Parts which lie behind him in reſpect to the Sun. Let the little Circle *DRC* denote the Orbit of any one of the Satellites of *Jupiter*, revolving round that Planet placed in *B*. And let the Chord *GF* be in length equal to the Semi-diameter of the Earth's annual Orbit *AE*, or *AH*: As let alſo *LK* be, on the other hand.




All this ſuppoſed, 'tis plain that thoſe *Immerſions* of *Jupiter*'s Satellites into his Shadow, and thoſe only which happen from their Conjunction to their Oppoſition with that Planet, can be viſible to the Inhabitants of the Earth, which live within the Semi-circle *HGFE*: And thoſe *Emerſions* out of his Shadow, and thoſe only which happen from the Satellites Oppoſition to their Conjunction with *Jupiter* again, can be viſible to ſuch as live under the Semi-circle *HLKE*: Becauſe the Interpoſition of the Body of *Jupiter*, hinders *both* from being viſible. 'Tis apparent alſo, that an Obſerver placed in *F*, if the Motion of Light were inſtantaneous, would ſee the Immerſion of a Satellite into the Shadow at the ſame Moment of abſolute Time, as another would do if placed in *G*; and it would be the ſame thing on the other ſide with regard to the Points *K* and *L*.

But

But if the Propagation of Light take up any ſenſible Time, 'tis plain that the Obſervers poſited in *G* and *L*, being nearer to *Jupiter* by an entire Semidiameter of the *Magnus Orbis*, than thoſe in *F*, and *K*; muſt needs ſee the Immerſions and Emerſions a little ſooner than thoſe can do; and from the Space of Time which is proportionable to that Semi diameter of the Earth's Annual Orbit, may Eſtimation be made of the Velocity of the Rays of Light; and ſo the thing is in Fact: For whenever the Earth is in that part of its Orbit which is neareſt to *Jupiter*, the Immerſions of the *Satellites* into his Shadow do anticipate the mean Time which they ſhould happen in, according to Calculation; as when the Earth is in the oppoſite Parts of the Orbit, they do really appear later than by Calculation they ſhould do. And ſo they will appear later to an Obſerver placed in *F*, than to one placed in *G*; and the Emerſions later to one in *K*, than to one in *L*: As Mr. *Romer* firſt found, and is now agreed on by all Aſtronomers. There was indeed ſome doubt about this matter ſtarted by *Caſſini*; but our Accurate Mr. *Halley* Savilian Profeſſor of Geometry at *Oxford*, hath cleared up all the Difficulty; and demonſtrated that this Progreſſive Motion of the Rays of Light, to ſuch a Diſtance, and in ſuch a given Time, is abſolutely neceſſary to account for the *Phænomena* of the Eclipſes of the Satellites of *Jupiter*. And as to the Time, or with what determinate Velocity the Rays move, Mr. *Romer* judged that it required about Eleven Minutes of an Hour, for the Light reflected from *Jupiter*, to move the length of the Chord *FG* in the Figure above; or the Diſtance of the Semi-diameter of the Earth's annual Orbit: But this, by *Caſſini*'s more accurate Obſervations, ſeems to be much leſſened, for according to him it can't be above 7 Minutes and 5 Seconds. Suppoſe then it be reckoned at 9 Minutes, which is the *Medium* between *Romer*'s Eleven, and *Caſſini*'s Seven. Then will the Motion of Light be ſo prodigious ſwift, as to move about Eighty Millions of Miles in 9 Minutes: That is 8888888 Miles in a Minute; and 148148 Miles in a Second; and 74074 Miles in half a Second, or while you can pronounce *One*, *Two*, diſtinctly.

A Motion, tho' not inſtantaneous, as no one can be; yet ſo wonderfully ſwift, that the Motion of a Bullet from the Mouth of a Cannon, (or any ſuch like Velocity of a Body projected,) is like the creeping of a Snail, the Motion of the Leggs of the *Ignavus*, or the imperceptible Pace of the Hand of a Clock, when compared with it: Nay, the Motion of the Earth it ſelf in the Annual Orbit, which yet is pretty ſwift, (*viz.* at the Rate of $3\frac{1}{2}$ *Engliſh* Miles in a Second) is not the Ten Thouſandth part of the Velocity of the Rays of Light.

From which very ſurpriſing Propoſition, the Ingenious Mr. *Whiſton* deduces theſe Corollaries.

1. That the Eclipſes of the Sun, Moon, or Satellites of *Jupiter*, do not happen at the ſame moment of Time, that they appear to us to do.

2. That the more remote any Planets are from us, the longer will be the Diſtance between the *true* and *apparent* Time of their Eclipſes: Thus, tho' the Moon's Eclipſes will appear to us to be nearly at the ſame Time, at which they really happen; yet thoſe of the Sun muſt appear later, thoſe of the Satellites of *Jupiter*, later yet; and thoſe of *Saturn*'s Satellites, lateſt of all.

3. The apparent Places of the Sun, and the Planets in the Heavens, are not their true and real ones at any Time of Obſervation.

4. Suppoſing the Diſtance of the fixed Stars from us to be ſo immenſely great, as we have all the reaſon in the World to conclude it to be; and to which the Diſtance of the Sun from us hardly bears any ſenſible Proportion; 'tis plain that the Light of the fixed Stars cannot come to us in many Hours, nor in many Days nor Weeks; perhaps, not in ſome Months Time. So that, as that Excellent Mathematician the Honourable Mr. *Francis Roberts*, was once in Diſcourſe ſuggeſting to me; if the Author of Nature ſhould pleaſe to annihilate *Syrius*, or any other fixed Star; it might be 3 Months Time before we ſhould miſs him, and find his Place vacant in the Heavens.

REACTION: See *Repulſe*.

REACTION; The Naturaliſts ſay, that Reaction is directly contrary and equal to Action, in Bodies. Or the mutual Actions of two Bodies ſtriking one againſt another are exactly equal, but made with contrary Directions. Or yet in other words by the Action and Reaction of Bodies one on another, there are produced equal Changes in each; and thoſe *Changes* are *impreſſed* towards (directly) *contrary Parts, or ways*. This will be beſt underſtood by Inſtances: For, whatever Body preſſes or draws another, is equally preſſed or drawn by it again. If any one preſs a Stone with his Finger, his Finger is as much preſſed by the Stone: If a Horſe by a Rope, *&c.* draw a Stone, the Horſe ſhall equally be drawn by the Stone; for the Rope being ſtretched both ways, endeavours to relax it ſelf again, and by that means will draw the Horſe towards the Stone; and will as much *hinder* the Progreſſion of the Horſe, as it forwards the Proceſſion of the Stone. If any Body lighting againſt another doth by its force any way change its Motion; it ſelf will undergo the ſame Change in its own proper Motion, but towards contrary Parts, from the Reaction of that Body, and the Equality of its mutual Preſſion. By theſe Actions are produced equal Changes, not indeed of the *Velocities*, but of the *Motions* of Bodies; (*i. e.* in ſuch Bodies as have no Impediment any other way) for the Changes of their Velocities, being made towards contrary Parts, (becauſe the Motions are equally changed) are reciprocally proportional to the Bodies themſelves.

REAFFORESTED is uſed, where a Foreſt hath been *Diſafforeſted*, and then made a Foreſt again: As the Foreſt of *Dean*, by 20 *Car.* 2.

REAP-*Towel*, or *Rip-Towel*, was formerly a Gratuity or Reward given to Cuſtomary Tenents, when they had reaped their Lord's Corn.

REAR-*Half-Files*, are the 3 hindermoſt Ranks of a Battalion when it is drawn up 6 deep.

REAR-*Line* of an Army encamped; is the ſecond Line: this lies about 400 or 500 Yards diſtant from the firſt Line, which is called the *Front-Line*. Sometimes there is a Third, which is called the *Reſerve-Line*.

REAR-*Rank*, is the laſt Rank of a Battalion when drawn up.

REA-

REASON or *Reſon*, and, as ſome ſeem to write it more truly, *Raiſing Pieces*, are thoſe Pieces of Timber which lie under the Beams on the Brick or Timber in the Side of a Houſe.

REASONABLE-*Aid*, was a Duty claimed by the Lord of Fee of his Tenants, holding in Soccage or Knights Service to marry his Daughter, or to make his Son Knight.

REBATE, is a Difference between a certain Quantity of Money, due at a certain Day, and the preſent Value or Worth of it; or in other words, how much *leſs* a Man ought to pay, who pays at the preſent, a Summ of Money not due till a certain Number of Years, *&c.* are expired. On this ſee an Act both from Equity and a Mathematical *Calculus* in the *Acta Eruditorum Lipſiæ*, from *October*. 1683, by *G. G. Leibnitz*.

REBELLIOUS *Aſſembly*, is a gathering together of Twelve or more Perſons, intending or going about, practiſing or putting in Ure unlawfully, and of their own Authority, to change any Laws, Statutes, *&c.* to deſtroy Encloſures, break down Banks of Fiſh ponds, *&c.* unlawfully to get common; to deſtroy Deer in Parks, Coneys in Warrens, Doves in Dove Houſes, Fiſh in Ponds, to burn Stacks of Corn, or to abate Rents or Prizes of Victuals, *&c.* See *Ch.* 1. Mar. 12. and 1 *Eliz.* 17.

REBELLUM in ſome of our old Charters ſignifies the ſame as a Rejoinder, Replication, or *Anſwer* in a Court of Equity.

RECEIVER is commonly uſed in the Civil Law in an ill Senſe, for one that receives ſtolen Goods, and conceals them; but when annexed to other Words, 'tis uſed in a very good one; as the

RECEIVER *of the Fines*, which is an Officer that receives the Money of all ſuch as compound with the Crown upon an Original Writ in the Court of Chancery. There is alſo the

RECEIVER *General of the Dutchy* of *Lancaſter*, which gathers in all Fines, Forfeitures, Aſſeſments, *&c.* within that Dutchy.

RECEPTACLE *of the Chyle*, was known and deſcribed by *Bartholomæus Euſtachius* many Years before the Diſcovery of the Lacteal Veins, *vid. Keil's* Anatom. *p.* 47, 48. In living Bodies this Receptacle is eaſily found, but with greater difficulty in ſuch as are dead. It lies about the deſcending Trunk of the great Artery, between the *Celiack* and *Emulgent* Arteries, ſurrounded by ſeveral Lymphatick Glands, which are called *Glandulæ Lumbares*, which diſcharge their *Lympha* into it. It appears to be only a large Bag formed by the Union of the ſecond Order of Lacteals, and many Lymphæducts which open into it; it will contain about an Ounce of Water. Sometimes in Brutes as well as in Men, it is divided into two or three Parts, which at laſt unite into one Duct about the Bigneſs of a Gooſe-quill.

RECLINATION *of a Plane*, is the Number of Degrees which any Dial Plane lies or falls backward from the Zenith. This is found eaſily by the means of long Rules, and a Quadrant; for having drawn an Horizontal Line on the Plane, by a Level or Quadrant, and to it another Line at Right-angles, to which apply a Ruler ſo, that one End of it may hang over or reach beyond the Plane: Then will a Quadrant applied to the under Edge of that Ruler, ſhew you the Degrees and Minutes of the Plane's Reclination; accounting from that Side of the Quadrant that is contiguous to the Edge of the Ruler.

RECLUSE, is one that by reaſon of his or her Order in Religion is ſhut up, and cannot ſtir out of a Cloyſter, *&c.* See *Littleton*, Sect. 434.

RECOGNITIO is the Impannel of a Jury or the Inqueſt of 12 or more legal Men, who were therefore called *Recognitores*. So, *habere Recognitionem*, was to have a Trial or Verdict of Jurors; for Liberty of which a Fine was formerly paid to the King. *Recognitio Novæ Aſſiſæ*, is a new Trial.

RECTA *Directrix*, is a Line in Conicks made by the mutual Interſection of the Vertical Plane, with the Plane of the Baſe. *De la Hire.*

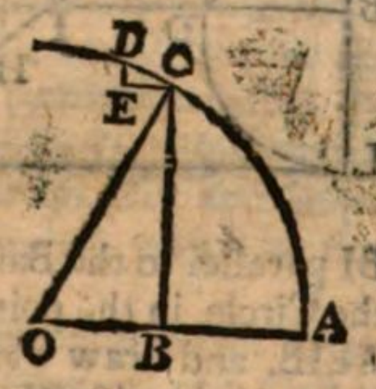
RECTA *Priſa Regis*, was formerly a Right the King claimed of taking out of every Ship laden with Wines, *One* Butt or Pipe, before the Maſt, and *Another* behind it, as a Cuſtom or Duty due to the Crown. K. *Edw.* 1. in his Charter of Privileges to the Barons of the Cinque Ports, among other things, diſcharges them particularly from this Duty.

RECTATIO, was a word formerly uſed for a *Claim of Right*; or an Appeal to the Law, for the recovery of ſuch a Claimed Right. So alſo the Word,

RECTITUDO was then uſed for a *Right* or *Legal Due*; and Oblations and Tithes were called *Rectitudines Dei.*

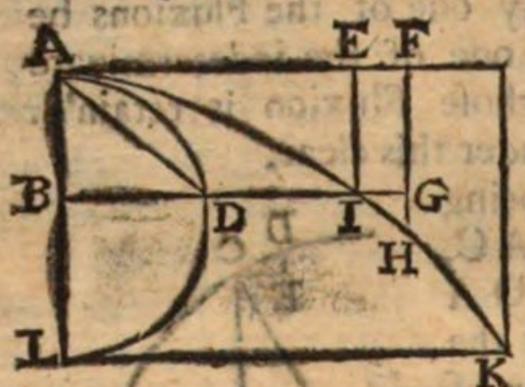
RECTIFICATION of Curves. To what hath been ſaid on this Point under *Rectifying* in Vol. 1. and under *Cycloid* in Vol. 2. 'twill be proper to add, what the ingenious Mr. *Moivre* advances in his Illuſtrious Specimens of the Uſe and Advantages of the Doctrine of Fluxions: Where he ſaith, that the *Rectification of Curve Lines* will be obtain'd, if we conſider the Fluxion of the Curve as a Hypothenuſe of a Rectangular Triangle, whoſe ſides are the Fluxions of the Ordinate and Abſciſſe. But in the Expreſſion of this Hypothenuſe, care muſt be taken that only one of the Fluxions be remaining, as alſo only one of the indeterminate Quantities, *viz.* that whoſe Fluxion is retain'd. Some Examples will render this clear,

The right Sine C B being given, to find the Arch A C. Let A B $= x$. C B $= y$. O A $= r$. C E the Fluxion of the Abſciſſe, E D the Fluxion of the Ordinate, C D the Fluxion of the Arch C A. From the Property of the Circle $2rx - xx = yy$, whence $2rx - 2xx = 2yy$, and therefore $\dot{x} = \frac{\dot{y}\dot{y}}{r - x}$. But $CD^2 = yy + xx = yy + \frac{y^2 yy}{rr - 2rx + xx} = yy + \frac{y^2 yy}{rr - yy} = \frac{rryy}{rr - yy}$, therefore $CD = \frac{r\dot{y}}{\sqrt{rr - yy}} = r\dot{y} \times rr - yy^{-\frac{1}{2}} = \frac{1}{2} \times r\dot{y} \times rr - yy^{-\frac{1}{4}}$. And conſequently

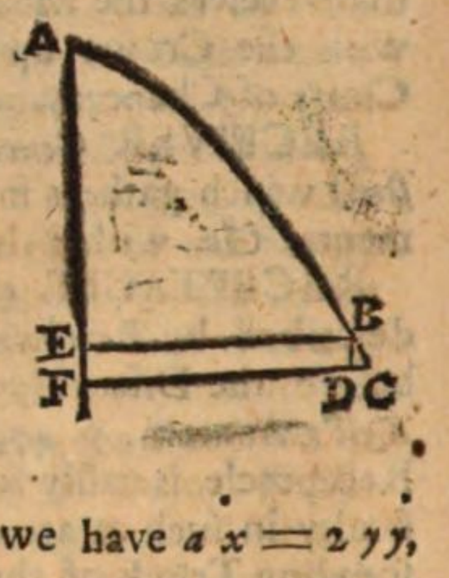


if $rr - yy$ be thrown into an infinite Series, and the several Members of it be multiplied into $\dot{r}\,\dot{y}$, and then the flowing Quantity of each be taken, we shall have the length of the Arch A C. After the same manner, giving the versed Sine, the same Arch may be found. For resuming the Equation found above $2r\dot{x} - 2x\dot{x} = 2y\dot{y}$, we have $\dot{y} = \frac{r\dot{x} - x\dot{x}}{\sqrt{2rx - xx}}$, but $CD^q = xx + yy = \frac{rrxx - 2rxxx + x^3x}{yy}$ $\frac{}{}$ $xx + \frac{rrxx - 2rxxx + x^3x}{2rx - xx}$, that is, (reducing all to the same Denominator, and expunging contradictory Terms) $\frac{rrxx}{2rx - xx}$, whence $CD = \frac{r\dot{x}}{\sqrt{2rx - xx}}$, and consequently the length of the Arch AC may be easily found from what is said already.

The Fluxion of the Curve Line is sometimes more easily found by comparing the two similar Triangles CED, CBO, for this Proportion arises. CB : CO :: CD, that is for the Circle $\sqrt{2rx - xx}$ : $r$ :: $\dot{x}$ : $\frac{r\dot{x}}{\sqrt{2rx - xx}}$.




The Curve of the Cycloid may be determin'd by the same Method too. Let ALK be a Semi-Cycloid, whose generating Circle is ADL. Having any point as B in the Diameter AL, draw BI parallel to the Base LK meeting the Peripheus of the Circle in the point D; compleat the Rectangle AEIB, and draw FH parallel to EI and infinitely near to it, as also BI cutting FH in G, and the Curve AK in H. Put $AL = d$. $AB\,(= EI) = x$. $GH = \dot{x}$. It is known that the right Line BG is every where equal to the Summ of the Arch AD and the right Sine BD: whence 'tis manifest, that the Fluxion I G is also the Aggregate of the Fluxions of the Arch AD and the right Sine BD. But the Fluxion of the Arch AD was found $= \frac{\frac{1}{2}d\dot{x}}{\sqrt{dx - xx}}$ and the Fluxion of the right Sine BD will be found to be $\frac{dx - 2xx}{2\sqrt{dx - xx}}$; therefore I G $= \frac{dx - xx}{\sqrt{dx - xx}}$ and therefore I H$^q$ (= I G$^q$ + G H$^q$) $= \frac{ddxx - dxxx}{dx - xx}$; from whence $IH = \frac{x\sqrt{dd - dx}}{\sqrt{dx - xx}} = x\sqrt{d} = d^{\frac{1}{2}}x^{\frac{1}{2}}$, and consequently AI $= 2d^{\frac{1}{2}}x^{\frac{1}{2}} = 2\sqrt{dx} = 2AD$. This Conclusion may also be very easily deduc'd from the known Property of the Tangent. For since the little part of it, as I H, is always parallel to the Chord AD, the Triangles IGH, ABD are similar, whence AB : AD :: GH : IH, that is, $x : \sqrt{dx} :: x : x\sqrt{dx}$, therefore $IH = \frac{x\sqrt{dx}}{x} = \frac{d^{\frac{1}{2}}x^{\frac{1}{2}}}{x} = d^{\frac{1}{2}}x^{-\frac{1}{2}}x$. By the help of the Fluxion IH also, we may investigate the Area of the Cycloid. The Fluxion of the Area AEI, is the Rectangle $EIG = \frac{dxx - x^2x}{\sqrt{dx - xx}}$ $x\sqrt{dx - xx}$. But the Fluxion of the Portion ABD is the same; therefore the Area AEI and the correspondent Portion (of the Circle) ABD, are always equal.




Let AB be the Curve of the Parabola, whose Axis is AF, Parameter $a$; let $AE = x$, $EB = y$, $AB = z$, $BD = \dot{x}$, $DC = \dot{y}$, $BC = \dot{z}$. The Equation expressing the Nature of the Parabola, being $ax = yy$, we have $a\dot{x} = 2y\dot{y}$, whence $\dot{x} = \frac{2y\dot{y}}{a}$; but $BC^q = BD^q + CD^q$, that is $\dot{z}\dot{z} = \dot{x}\dot{x} + \dot{y}\dot{y} = \frac{4y^2\dot{y}\dot{y}}{aa} + \dot{y}\dot{y} = \frac{4y^2\dot{y}\dot{y} + aa\dot{y}\dot{y}}{aa}$, and therefore $\dot{z} = \frac{y\sqrt{4y^2 + aa}}{a} = y\sqrt{y^2 + \frac{1}{4}aa}$. If now by this Expression $\frac{y}{\frac{1}{2}a}$ $\sqrt{y^2 + \frac{1}{4}aa}$ be thrown into an infinite Series, the Curve AB will easily be known. It appears farther, that giving an *Hyperbolical Space*, this Curve is

is also given, and *vice versa*. For $\frac{1}{2} a z = y \sqrt{y^2 + \frac{1}{4} aa}$, and consequently $\frac{1}{2} a z$ is the Space whose Fluxion is $y \sqrt{y^2 + \frac{1}{4} aa}$. But such a Space is no other than the Exteriour (Equilateral) Hyperbola A B E G, whose Semi-axis A B $= \frac{1}{2} a$, its Abscisse A E $= y$, and its Ordinate E G $= x$.

For the Mensuration of *a Surface described by the Conversion of a Curve round its Axis*; we are to assume for the Fluxion of it, a Cylindrick Superficies, whose Altitude is the Fluxion of the Curve, and whose distance from the Axis is the Ordinate Applicate corresponding to that Fluxion. *Ex. gr.* Let AC be the Arch of a Circle, which turning round the Axis AD, generates a spherical Superficies, which we would measure. Now D C the Fluxion of the Arch is already found to be $= \frac{r\,x}{\sqrt{2rx - xx}}$, which if we multiply by the Periphery belonging to the Radius BC, that is, by $\frac{c}{r}$ $\frac{c}{r} \sqrt{2rx - xx}$ (putting $\frac{c}{r}$ the Ratio of the Circumference to the Radius) we shall have $cx$ for the Fluxion of the spherical Superficies, and consequently that Superficies it self, is $cx$.

REGTUM, was used formerly for a *Trial*: *Commune Rectum* was a Trial at Law; or in common Course of Law: And *Stare ad Rectum*, was to stand Trial.

REDUNDANT *Hyperbola* is one so called, because it exceeds the Conical Sections, in the Number of its Hyperbolical Legs; being a Triple Hyperbola with six Hyperbolical Legs: See Curves.

RED *Book of the Exchequer* is a MS. Vol. of several Miscellany Treatises, in the keeping of the Queen's Remembrancer in that Office; in it are the Number of the Hides of Land, in many Counties, before the Conqueft, &c. See Bp. *Nicholson's Hist. Library*.

RED *seer*, when a Piece of Iron in a Smith's Fire of his Forge is heated too much, it will *Red-seer*, as they call it, that is, break or crack under the Hammer, while it is working between hot and cold. Some call this *Red-shire*.

RE-*Extent* in the Law, is a *Second Extent* made on Lands or Tenements, on a Complaint made that the former *Extent* was partially performed.

REEVE of a Church is the Guardian of it; or the Church-Warden; as *Shire Reeve* is the *Sheriff* or Guardian of a County; and *Port-Reeve* the Warden of a Port, or Haven.

REFECTORY was that Place in a Monastery where the Monks, Friars, Nuns, &c. usually Di ne d and Supped.

REFERENDARY, *Referendarius*, was a Term used by the Old *Saxons*, as appears by *Grants and Charters*, for such a Person as a *Master of Requests* was to the King or Queen, amongst us before the Court of Requests was taken away by 16. 17. Car. 1. *See Court of Requests, in Vol.* 1.

REFINING is the Art of separating all other Bodies from *Gold* and *Silver*, and this is performed four Ways.

The End of *Refining* is the *Separation* of all other Bodies from *Gold* and *Silver*, which is performed 4 ways, *viz.* by *Parting*; by the *Test*; by the *Almond Furnace* or the *Sweep*; and by *Mercury*. 1. *Parting* is done with the *Aqua-fortis*. Some *Refiners*, to make the *Aqua fortis*, take *Salt Peter* 3 *pound*, and *Dantzick* (not *English*) *Vitriol* 2 *pound* (for the *English Vitriol* makes a weaker Water, and Dirty Colour'd *Verditer*, and wholly spoils it.) After they are well Bruised and Mixed in a *Mortar*, they *Distill* 100 *pound* of the Materials, put into a *Cast-Iron* Pot, after this manner.

Build a *Furnace* 2 Yards high or more; and at the top place in your *Iron Pot*: To which fit a *Head* of Earth, like the *Head* of a large *Distillation* for *Chymical Oyls*, which must have a large Belly, branching it self out 8 *Inches* from the *Iron Pot*, into 3 *Branches*; one whereof in the midst comes directly straight forward, two other Lateral ones come Obliquely: All which Branches are 4 or 5 *Inches* hollow in Diameter, and 5 or 6 long. To these *Branches* are fitted *Glass Bodies*, Narrow and Hollow at both Ends, Large and Globous in the Midst. These must be exceedingly well *Luted* on with *Colcothar*, *Rags*, *Flour* and *Whites* of *Eggs*. To the first *Glass Body* is *Luted* on another *Glass*, of the same Figure and Size, and in order 8. alike in all, till they come to the *Receiver*, which is an Ordinary *Gallon Glass*. All These Rows of *Glasses* lie on Boards shelving from the *Head* to the *Receiver*. The two Upper *Receivers* or *Glass Bodies* need Exceeding good *Luting*, for the rest Ordinary *Lute* will serve.

The *Lute* is made of good *Lome*, some *Horse-dung*, and a little *Colcothar*; although the two former do well.

A little *Fire* and that of *Newcastle Coals* does the Work. And you need never Break or *Unlute* any of the *Receivers*, but the Lowermost.

The *Aqua-fortis* being *Distilled* off, is put into a large Earthen Pot, and there is added of *Fine Silver*, *one* or *two Penny weight* (which is called *Fixes*) to every *Pound* of *Aqua-fortis*, which within 4 *hours*, will purge it from all Dirt and Impurity, and make it fit for *Parting*, which is thus done.

If their *Silver Gilt* be *Fine* enough for *Wire*, they only *Melt* it in a *Wind Furnace*, and Cast it, *Melted*, into a large Tub of Water, that they may have it in small Pieces; but if it be but *Standard*, they first *Fine* it on the *Test*. These small Pieces taken from the Water, being well Dryed, are put into a Glass Taper-fashion'd, a *Foot* High, and 7 *Inches* at the Bottom; and then the *Glasses* are Charged with *Aqua-fortis* about 2 *thirds* of it, and set in a *Range* of *Iron* covered 2 *Inches* deep with *Sand*, and a *Gentle Charcoal-Fire* is made under it.

Small *Bubbles* will soon arise, and the Water also run over. If so, they take off the *Glasses*, and hold them till it doth *Defervescere*, or else pour out some of it into a Vessel which is at Hand.

If *Lead* be Mixed with it, they cannot keep it from Running over.

When the *Water* hath been once *Quieted* from this *Ebullition*, it will Riſe no more.

The *Greenneſs* of the *Water*, manifeſteth the Quantity of *Copper* contained in it.

If the *Water* Boil over, 'twill *Penetrate* the *Bricks* and *Wood*.

They commonly let it ſtand a Night on the *Iron-Range*, with a *gentle Heat* under it, and in the Morning ſoftly pour off the *Water* impregnated with all the *Silver*; all the *Gold* lying like black Dirt at the bottom; which being waſhed out is put into ſmall *Parting-glaſſes*, and ſet over the *Sand* with their *Conduit Water* for an *hour*, and then the Water poured off. This is repeated 5 or 6 times, to *Separate* the *Salt* from the *Gold*, which is now fit to be *melted*, and *caſt* into *Ingots*.

To regain the *Silver*, they have large Round *Waſhing Bowls*, lined within with melted Roſin and Pitch (for otherwiſe the *Water* would eat the Wood, and penetrate the ſides of the *Bowl*) covered with *Copper Plates* 10 *Inches* long, 6 wide, and *Half* or more thick. Into which *Bowls* they pour good ſtore of Water (the more, the better the *Verditer*) and then the *Silver Water*, which working on the ſofter Metal of *Copper*, leaves all the *Silver* in moſt fine Sand at the Bottom, and Sides of the *Bowl*, and *Plates* of *Copper*; which being taken out, is Waſhed, Dryed and Melted for any Uſe.

If any *Braſs* or *Shroffe Metal* be in the *Plates*, they gather very little of the *Silver*; the Latter mixing with the *Silver*.

With the *Copper-water*, poured off from the *Silver*, and *Whiting*, *Verditer* is made thus. They put into a Tub a *Hundred Pound* weight of *Whiting*, and thereon pour the *Copper-water*, and ſtir them together every Day, for ſome *Hours* together. And when the Water grows pale, they take it out, and ſet by for farther Uſe, and pour on more of the *Green Water*; and ſo continue till the *Verditer* be made; which being taken out, is laid on large Pieces of *Chalk* in the *Sun*, 'till it be dry for the Market.

The Water mention'd to be taken from the *Verditer*, is put into a *Copper*, and boiled till it comes to the Thickneſs of Water-Gruel, now principally conſiſting of *Salt-Peter* deduced, (moſt of the *Spirit* of *Vitriol* being gone with the *Copper* into the *Verditer*,) a Diſh full whereof being put into the other Materials for *Aqua-fortis*, is Re-diſtilled, and makes a *Double-water*, almoſt Twice as good as that without it.

2. By the *Teſt*, all *Metals* are *ſeparated* from *Silver*, except *Gold*, becauſe they ſwim over it, when they are all *melted* together.

The *Teſt* is thus made. They have an *Iron Mould*, Oval, and two *Inches* Deep. At the Bottom hereof are 3 *Arches* of *Iron*, ſet at Equal Diſtances, 2 Fingers wide, if the great Diameter of it be 14 *Inches* long; and ſo proportionable in Greater or Leſſer *Teſts*. This Cavity they fill with fine Powder of *Bone-Aſhes*, moiſtened with *Lixivium*, made with *Soap-Aſhes*. Some uſe Cakes of *Pot-Aſhes*, or other *Aſhes* well cleanſed, and ſo preſſed well together with a *Muller*, that it becomes very cloſe and ſmooth at the Top. There is left above, a *Cavity* in the Midſt of it, to contain the *melted Silver*. This *Cavity* is made greateſt in the Middle; for the *Bone-Aſhes* come up parallel to the Circumference of the *Mould*; only a ſmall *Channel* in that End, which is moſt remote from the *Blaſt*, for the Running off of the *Baſer Metals*, and ſo is made *Declive* to the Center of the *Teſt*, where 'tis not above half an *Inch* deep.

The *Teſt* thus made, is ſet *Annealing* 24 *Hours*, and then 'tis ſet in a *Chimney* a Yard High, parallel almoſt to the Noſe of a great Pair of *Bellows*; and then therein is put the *Silver*. Which being covered all over with *Billets* of *Barked Oak*, the *Blaſt* begins, and continues all the while ſtrongly. The *Lead*, purify'd from all *Silver*, (which they call the *Soap* of *Metals*) firſt put in, *melts* down with the *Silver*, and then the *Lead* and *Copper* ſwim at the Top, and run over the *Teſt*. Whoſe Motion the *Refiner* helps with a long Rod of *Iron* drawn along the Surface of the *Silver* towards the fore mention'd *Slit*; and often ſtirring all the Metal, that the *Impurer* may the better riſe; and by continuing this Courſe, *Separation* is made in 2 or 3 *Hours*.

The greateſt part of the *Lead* flies away in *Smoak*.

If the *Lead* be gone before all the *Copper*, 'twill riſe in ſmall Red fiery Bubbles; and then they ſay the *Metal Drives*, and muſt add more *Lead*. The force of the *Blaſt* drives the Higher *Metals* to the lower ſide of the *Teſt*, and helps its running over.

When the *Silver* is fully *Fined*, it looks like moſt pure *Quick-ſilver*; and then they take off their *Sogs* and let it *Cool*. In the *Cooling*, the *Silver* will frequently from the Middle, ſpring up in ſmall *Rays*, and fall down again. If *moiſt Silver* be put into that which is *melted*, 'twill ſpring into the Fire.

A good *Teſt* will ſerve two or three *Firings*.

So ſoon as the *Silver* will hold together, they take it out of the *Teſt*, and beat it on an *Anvil* into a round Figure, for the *Melting-Pot*; which being ſet in a *Wind-Furnace*, ſurrounded with *Coal*, and covered with an *Iron-Cap* that no *Charcoal* fall into it, is then *melted*.

If any *Droſs* or *Filth* be in the *Melting-Pot*, they throw in ſome *Tincal*, which gathers the *Droſs* together, that it may be ſeparated from it.

Theſe *Melting-Pots* are never *Burned*, but only *Dryed*, and laſt a whole *Day*, if they be not ſuffered to *Cool*; but if they once *Cool*, they infallibly *Crack*.

3. In the *Almond Furnace* or *Sweep*, all ſorts of *Metals* are *ſeparated* from *Cinders*, parts of *melting Pots*, *Teſts*, *Brick*, and all other harder Bodies; which muſt be firſt beaten into ſmall Pieces with a *Hammer* on an *Iron Plate*.

Thoſe which ſtick but ſuperficially to the *Silver*, they *Waſh* off thus; they have a Wooden round Inſtrument 2 *Foot* wide, ſomewhat hollow in the Middle, with a Handle on each ſide. On this they put the Materials, and hold them in a Tub of Water below the Surface, and ſo waving it to and fro, all the *lighter* and *looſer* matter is *ſeparated* from the *Metal*.

The *Furnace* is 6 *feet* High, 4 *feet* Wide, and 2 *feet* Thick, made of Brick; having a Hole in the Midſt, at the Top 8 *Inches* over, growing Narrower towards the Bottom of it, where on the Fore-part, it ends in a ſmall Hole, environed with a Semi-circle of *Iron*, to keep the *Molten Metal*. About the Middle of the Back, there is another Hole to receive the Noſe of a great Pair of *Bellows*.

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When the *Furnace* is *Annealed* with Charcoal and Hot, they throw two or three Shovels of Coal, to one of the fore-mention'd Stuff, and ſo proceed during the whole Work, which continues three *Days* and *Nights*, without Intermiſſion. After Eight or Ten *Hours* the *Metal* begins to run; and when the Receiver below is pretty full, they lade it out with an Iron Ladle, and caſt it into *Sows* in Cavities, or Forms, made with *Aſhes*.

They frequently ſtop the *Paſſage Hole* with *Cinders* to keep in the Heat; and when they think a Quantity of *Metal* is *melted*, they Unſtop the *Hole* to paſs it off.

If the Stuff be hard to *Flux*, they throw in ſome *Slag* (which is the *Recrement* of *Iron*) to give it *Fuſion*.

A ſtinking blue *Smoak* proceeds from the *Furnace*, and all By-ſtanders put on the *Colour* of *Dead Men*.

To get the *Silver* from thoſe *Metals*, and to *Refine* their *Copper* from the *Litharge*, they now uſe no other Art than that of the *Teſt*.

4. By *Quick ſilver* the *Filings* of *Gold* and *Silver* are *ſeparated* from *Duſt*, *&c.* This *Duſt* is put into a Hand Mill with *Quick ſilver*, and being continually Turned upon that and the *Metals*, an *Amalgama* is made of them, and Fair Water poured in, carries off the *Duſt* as it runs out again by a ſmall Quill.

This *Amalgama* is put into an Iron, with a *Bolt-head* ſet into the *Fire*, having a long Iron *Neck* 3 *Feet* long, to which is fitted a *Receiver*. The Fire *Diſtills* off the *Mercury* into the *Receiver*, and the *Gold* and *Silver* remains in the *Bolt head*.

REFLECTED *Dialling* is the Art of deſcribing Hour lines, Azimuths, Parallels of Declination, or of Altitude, *&c.* and all the Furniture of Dials; on ſuch Places as the Suns direct Rays can never come to directly, but only by the help of ſome reflecting Surface; as ſuppoſe on the Ceiling of a Room, *&c* where the Beams may be reflected by a piece of Looking Glaſs placed on the Board, Stool or Tranſome of a Window; or other convenient place: And this may be done either by a Glaſs placed Horizontally, or at oblique Angles to the Horizon.

1. If the Glaſs be placed Horizontally, you may, by the following Method, upon any Wall or Ceiling of a Room, where that Glaſs can reflect a Spot of Light, draw *true Hour* Lines, *Furniture*, &c. tho' the Surface be never ſo irregular, as convex, concave, or of any form whatſoever.

Firſt, draw on Paſt board or other Material, or get made in Braſs an Horizontal Dial for the Latitude propoſed.

Then by the help of the Azimuth, or at the time when the Sun is in the Meridian; or by knowing the true Hour of Day, whereby may be drawn ſeveral Lines on the Ceiling, Floor, and Wall of the Room; ſo as in reſpect of the Centre of the Glaſs they may be in the true Meridian-circle of the World: For if right Lines were extended from the Centre of the ſaid Glaſs by any Point, though elevated in any of thoſe Lines ſo drawn, it would be directly in the Meridian circle of the World.

Now all reflective Dialling is performed from that Principle in *Opticks*, which is, *That the Angle of Incidence is equal to the Angle of Reflection.* And as any direct Dial may be made by help of a Point found in the direct Axis, ſo may any reflected Dial be alſo made by help of any Point found in the reflected Axis.

And in regard the reflected Axis for the moſt part will fall above the Horizon of the Glaſs without the Window, ſo that no Point there can be fixed, therefore a Point muſt be found in the ſaid reflected Axis continued below the Horizontal of the ſaid Glaſs, until it touch the Ground or Floor of the Room in ſome part of the Meridian formerly drawn, which Point will be the Point in the reverſed Axis deſired, and may be found, as followeth.

One End of the Thred being fixed at or in the Centre of the ſaid Glaſs, move the other End thereof in the Meridian formerly drawn below the ſaid Glaſs, until the ſaid reverſed Axis be depreſſed below the Horizon, as the direct Axis was elevated above the Horizon, which may be done by applying the Side or Edge of a Quadrant to the Thred, and moving the End thereof to and fro in the ſaid Meridian, until the Thred with a Plummet cut the ſame Degree as the Pole is above the Horizontal Glaſs, and then that Point where the End of the Thred toucheth the Meridian either on the Floor or Wall of the Room, is the Point in the reflected reverſed Axis ſought for.

Now if the reverſed Axis cannot be drawn from the Glaſs by reaſon of the jetting of the Window or other impediment, that Point in the reverſe Axis may be found by a Line parallel thereto, by fixing one End of it on the Glaſs, and the other End in the Meridian, ſo as that it may be parallel to the Floor or Wall in which the reverſed Axis point will fall, and find the Axis point from that other End of the Lath: ſo if the ſame Diſtance be ſet from that Point backward in the Meridian on the Floor, as is the Lath, the Point will be found in the reverſed Axis deſired.

Thus having found a Point in the reflected reverſed Axis; it is not hard, by help whereof and the Horizontal Dial, to draw the reflected Hour-lines on any Ceiling or Wall, be it never ſo concave or convex.

To do which; Firſt note, that all ſtraight Lines in any projection or any Plane, do always repreſent great Circles in the Sphere, ſuch are all the Hour lines.

Place the Centre of this Horizontal Dial in the Centre of the Glaſs, the Hour lines of the ſaid Dial being horizontal; and the Meridian of the World, which may be done by Plumb lines, let fall from the Meridian on the Ceiling: Then fix the End of a Thread or Silk in the ſaid Centre of the Dial or Glaſs, and draw it directly over any Hour line on the Dial which you intend to draw at the further ſide of the Room, and there let one hold or faſten that Thread with a ſmall Nail.

Then in the Point formerly found on the reverſed Axis on the Floor, fix another Thread there (as formerly was done in the Centre of the Dial) then take that Thread, and make it juſt touch the Thread (on the Hour line of the Horizontal Dial extended) in any Point thereof, it matters not where abouts, and mark where the End of that Thread toucheth the Wall or Ceiling, and there make ſome Mark or Point.

Then again move the ſame Thread higher or lower at pleaſure, 'till it, as formerly, touch the ſaid ſame Hour Thread, and mark again where-abouts on the Wall or Ceiling, the End of the ſaid Thread

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alſo toucheth. In like manner may be found more Points at pleaſure, but any two will be ſufficient for the projecting or drawing any Hour-line on any Plane, how irregular ſoever. For if you move a Thread, and alſo your Eye to and fro, until you bring the ſaid Thread directly between your Eye and the Points formerly found, you may project thereby as many Points as you pleaſe at every Angle of the Wall or Ceiling, whereby the reflected Hour-line may be exactly drawn.

Again, in like manner remove the ſaid Thread faſtned in the Centre of the Horizontal Dial, (which alſo is the Centre of the Glaſs) on any other Hour-line deſired to be drawn, and as before faſten the other End of the Thread, by a ſmall Nail, or otherwiſe at the further Side of the Room, but ſo that the ſaid Thread may lie juſt on the Hour-line propoſed to be drawn on the Horizontal Dial. Then (as before) take the Thread faſtened in the Point on the reflected Axis, and bring it to touch the Thread of the Hour-line in any part thereof, and mark where the End of that Thread toucheth the ſaid Wall or Ceiling: Then again (as before) move the ſaid Thread ſo, as that it only touch the ſaid Thread of the Hour line in any other part thereof, and alſo mark where the End of that Thread toucheth the ſaid Wall or Ceiling: So is there found two Points on the Wall or Ceiling, being in the reflected Hour-line deſired, by help of which two Points the whole Hour-line may be drawn; for if (as before) a Thread be ſo ſituated, that it may interpoſe between the Eye and the ſaid two Points found, you may make many Points at pleaſure, whereunto the ſaid Thread may alſo interpoſe, which for more Conveniency may be made at every Angle or bending of the Wall or Ceiling, be they never ſo many: So that if Lines be drawn from Point to point, that ſaid reflected Hour-line will be alſo exactly drawn.

In like manner may the Hour-lines be drawn ſo, that the Reflex or Spot of the Sun from the ſaid Horizontal Glaſs ſituated in the ſaid Window (as before) ſhining amongſt the ſaid reflected Hour-lines drawn on the Wall or Ceiling, will exactly ſhew the Hour of the Day deſired.

Now if Lines be drawn round about the ſaid Room, equal to the Horizon of the ſaid Glaſs, it will ſhew when the Sun is in or near the Horizon.

*To draw the Æquator and Tropicks on any Wall or Ceiling to any Horizontal reflecting Glaſs.*

1. *To draw the reflected Æquator or Equinoctial line on the Wall or Ceiling, which repreſents a great Circle.*

Take the Thread fixed in the Centre of the Glaſs, and move the End thereof to and fro in the Meridian-line drawn on the Ceiling, until by help of a Quadrant the ſaid Thread be elevated equal to the Complement of the Latitude, (which will be always perpendicular to the reverſed Axis) marking in the Meridian where the end of that Thread falls; then on that Point and the ſaid Meridian line on the Ceiling erect a perpendicular Line, which Line may be continued on any Plane whatſoever, and is the reflected Equinoctial-line deſired.

Note that all great Circles are right Lines, and are always drawn or projected from a right Line.

2. *To draw the Tropicks. Note, that all Parallels of Declination are leſſer Circles, and are Conick Sections.*

Firſt, make or take out of ſome Book a Table of the Sun's Altitude for each Hour of the Day calculated for the Place of the Latitude propoſed, when the Sun is in either of the Tropicks. Then take the Thread fixed in the Centre of the Glaſs, and by applying one Side of a Quadrant to the ſaid Thread, and moving one End of it to and fro in the Hour-line propoſed, elevate the ſaid Thread anſwerable to the Suns height in that Hour, when he is in that Tropick you deſire to draw, and mark where the End of that Thread ſo elevated toucheth in that Hour-line propoſed. So may you in like manner find a ſeveral Point in each Hour-line for the Suns height in that Tropick, whereby a Line may be drawn on the Wall or Ceiling from Point to point formerly made in the ſaid Hour-lines, which is the Tropick deſired.

In like manner may any Parallel of Declination be drawn: If there be firſt calculated a Table of the Sun's Altitude at all Hours of the Day, when the Sun hath any Declination propoſed, whereby may be drawn either the Parallels of the Sun's place, or the Parallels of the Length of the Day.

*To draw the Parallels of Declination to any reflected Glaſs moſt eaſily, by help of a* Trigon *firſt made on Paſt-board or other Material.*

Fix the Trigon to the reflected reverſed Axis, ſo that the Centre of the Trigon may be in the Centre of the Glaſs, then will the Equinoctial on the Trigon be perpendicular to the ſaid Axis: Then take the Thread fixed in the Centre of the Glaſs, and lay it along either of the Tropicks, or other Parallels of Declination required, which is drawn on the ſaid Trigon, which Thread muſt be continued ſo, that the End thereof may touch any Hour-line, and on that Hour-line mark the Point of Touch, the Thread being ſtill laid on the ſame Parallel of Declination on the Trigon: In the ſame manner find a Point in each Hour-line. Laſtly, draw a Line by thoſe Points ſo found, which will be the Tropick-line or other Parallel of Declination, as the Thread was laid on, on the Trigon.

*To draw the Azimuth-lines on any Wall or Ceiling to any Horizontal reflecting Glaſs. Note, that all Azimuths are great Circles.*

Firſt, find a Vertible-point, either above to the Zenith, or below to the Nadir of the Glaſs (by ſome called a Perpendicular or Plumb-line) and mark in what Point it cuts the Floor of the Room, which Point I call the reflected Vertical-point, wherein the End of a Thread is to be fixed: For by a Point found in the reflected Axis of the Horizon the Azimuths may be drawn, as by a Point found in the reflected Axis of the Equinoctial the Hour-lines may be drawn.

Then on Paſt-board or other Material draw the Points of the Compaſs or other Degrees, and fix the Centre thereof in the Centre of the Glaſs, and the Meridian thereof in the Meridian of the World,

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as was ſhewn in drawing the Hour-lines, being careful to place it Horizontal.

Then take the Thread fixed in the place of the Glaſs, and draw it over any Azimuth, which is deſired to be drawn, and at the further ſide of the Room faſten that Thread with a ſmall Nail as it was in drawing the reflected Hour-lines: Then take the Thread whoſe End is faſtened in the ſaid reflected Vertical-point, and bring that Thread ſo as juſt to touch the ſaid Horizontal Thread, and augment it, until the End thereof touch the Wall or Ceiling, and there make a Mark or Point. In like manner, move the ſaid Thread, whoſe End is faſten'd in the ſaid Vertical-point, higher or lower at pleaſure, till as formerly it touch the ſaid Horizontal Thread, and mark again where-abouts the End thereof toucheth the ſaid Wall or Ceiling: Now by help of theſe two Points found in the reflected Azimuth-line, the whole Azimuth-line may be drawn; for if (as before in drawing the Hour-lines) a Thread be ſo ſituated, that it may interpoſe between the Eye and the ſaid two Points, you may make many Points at pleaſure to which the ſaid Thread ſo ſituated may alſo interpoſe, which may be made at every Angle or bending of the Wall or Ceiling (as before) whereby the reflected Azimuth line deſired may be drawn. In like manner may the other reflected Azimuth-lines be drawn.

Alſo there may be Lines drawn parallel to the Horizon round about the Room, by help of the Thread fixed in the Centre of the Glaſs, and a Quadrant for the Elevation thereof, which will ſhew the Sun's Altitude at any appearance thereof.

*Thus have I ſhewed the drawing of a reflected Dial from an Horizontal Glaſs, with all the uſual Furniture thereon, though the Wall or Place on which it is to be drawn, be never ſo gibbous or irregular, or in what ſhape ſoever.*

Now the Glaſs may be exactly ſituated Horizontal, if you draw a reflected Parallel for the preſent Day, and know alſo the true Hour, and ſo place the Glaſs, that the Spot or Reflex of the Sun may fall thereon on the Ceiling, for there is no way by an Inſtrument to do it, the Glaſs is ſo ſmall.

2. If the Glaſs be placed *obliquely*, and not parallel to the Horizon, it will *recline* with ſome Angle from the Zenith, and then to draw the reflected Dial true, theſe two Things are principally to be conſidered.

1. *The Reflected Horizon.*
2. *The Reflected Meridian.*

Note the Horizon and Meridian are two great Circles.

1. *To draw the reflected Horizon according to the Situation of any reclining Glaſs whatſoever.*

Firſt, let two Pieces of nealed Wire be faſtened on the Window on each ſide of the ſaid Glaſs, the Ends thereof being without the Room in the Air, at whoſe Ends let there be faſtened a Thread which may be pulled ſtraight at pleaſure, by bending of the Wire, then bend thoſe Wires upward or downward, until the Thread faſtened at the End of each Wire be exactly Horizontal with the Centre of the Glaſs, which may be tried by a Quadrant: Then I tie a String or Thread croſs the Room, in ſuch a Sort that I may from moſt part of the Thread ſee the reflecting Glaſs, and therein the ſaid Horizontal Thread without the Room: Then on the ſaid Thread croſs the Room, I tie a ſlipping Knot to move to and fro at pleaſure, which Knot I move to and fro on the ſaid Thread, until by looking in the ſaid Glaſs I find from my Eye the ſaid Knot and part of the Horizontal Thread without, all as it were in a right Line, the one interpoſing the ſight of the other. Then being careful to keep the Knot in that poſition, faſten one End of a Thread in the place of the Centre of the reclining reflecting Glaſs, and bring that Thread ſo, as juſt to touch the aforeſaid Knot, augmenting that Thread, until the End thereof touch the Wall or Ceiling, and there make a Mark or Point; ſo is there one Point found on the Wall or Ceiling in the reflected Horizon of the World. Then I begin again, and remove the poſition of that Thread (which went overthwart the Room) either higher or lower at pleaſure, ſtill having regard that I may from the moſt part of the ſaid Thread ſee the reflecting Glaſs, and therein the ſame Horizontal Thread without the Room. Then, as before, I move the ſaid Knot on the ſaid Thread to and fro, until (as before) by looking in the ſaid Glaſs I find from my Eye the ſaid Knot, and part of the Horizontal Thread both in one right Line, the one interpoſing the ſight of the other; and by the ſaid Knot I bring the Thread, whoſe End is faſtened in the Centre of the ſaid Glaſs, and keeping it juſt to touch the ſaid Knot, I continue it, until the End thereof touch the Wall or Ceiling, as before, and there I make another Mark or Point; ſo is there two Points found in the ſaid reflected Horizon on the Wall or Ceiling. By which ſaid two Points, if a Thread (as before) be ſo ſituated, that it may interpoſe between the Eye and the ſaid two Points, there may be many Points to be in the ſame Interpoſition of the Thread, which (as before) may be made at every bending or Angle of the Wall or Ceiling, whereby the reflected Horizon deſired may be drawn, by drawing a Line from point to point round about the Room; which will be the true reflected Horizon according to the Situation of the Glaſs.

2. *To draw the Reflected Meridian, according to the Situation of any Reclining Glaſs whatſoever.*

Firſt, take a Lath or thin Piece of Wood of any convenient Length at pleaſure, as ſome one and an half, or two Foot long, and at each End thereof make a Hole, the one to hang a Thread or Plummet, and the other is to put a ſmall Nail therein to faſten it in ſome part of the Window over the Centre of the Glaſs, ſo that the Thread and Plummet may hang without the Room: Then by help of the Sun's Azimuth you may draw the Meridian-line, (as before) as if the Glaſs were horizontal, and move the Lath with the Thread and Plummet at the End of it to and fro, until the Thread and Plummet be in the direct Meridian of the World with the Centre of the Glaſs. Then (as before) tie a Thread croſs the Room, in ſuch ſort that from or by ſome part of the ſaid Thread both the reclining Glaſs and the Thread to which the Plummet is faſtened may be ſeen at one Time. Then

(as

(as before) on the ſaid Thread, which croſſes the Room, I tie a ſlipping Knot, which I move to and fro on the ſaid String, until by looking in the ſaid Glaſs I find from my Eye the ſaid Knot and ſome part of the perpendicular Thread without, all as it were in one right Line, the one ſhadowing or interpoſing the ſight of the other; being then very careful to keep that Knot in the ſame Poſition, then take the Thread (the End whereof being faſtned in the ſaid Centre of the Glaſs) and bringing it juſt to touch the ſaid Knot, I augment that Thread, until the End thereof touch the ſaid Wall or Ceiling, and the ſaid Thread alſo touch the Knot, as before: Then in that place where the End of the ſaid Thread toucheth the Wall or Ceiling, I make a Mark, which Mark or Point will be directed in the reflected Meridian of the World, according to the Situation of that Glaſs. Then again I remove that Thread, (overthwart the Room) on which the ſaid Knot is, either higher or lower than it formerly was, at pleaſure, ſtill having regard that from ſome part of the ſaid Thread within, you may ſee both the reclining Glaſs and the perpendicular Thread without at one Time; and (as before) move the ſaid ſlipping Knot on the ſaid Thread, until by looking in the ſaid reclining Glaſs, you ſee the ſaid Knot and ſome part of the perpendicular Thread without in one right Line, ſo as the one ſhadows or hinders the ſight of the other, (as before) which Knot then muſt not be removed from its Situation; then take that Thread (whoſe End is faſtened in the Glaſs) and bring it to touch that Knot, the End of the ſaid Thread being continued to touch the Wall or Ceiling: ſo is that Point of Touch on the Ceiling another Point found in the reflected Meridian of the World. So is there two Points found in the ſaid reflected Meridian on the Wall or Ceiling; by which, if a Thread (as before) be ſo ſituated, that it may interpoſe between the Eye and the ſaid two Points, many Points thereby in the ſaid reflected Meridian may be made at every Bending or Angle of the Wall or Ceiling, whereby the reflected Meridian deſired may be drawn, by drawing a Line from Point to point obliquely in the Room, which will be the true reflected Meridian of the World, according to the Situation of that Glaſs.

Now this reflected Horizon and Meridian being firſt drawn, they will be of great uſe in drawing the Hour-Lines, together with all the Furniture that poſſibly can be drawn on any Dial.

*To draw the Reflected Hour-Lines to any Reclining Glaſs on any Plane whatſoever, that the Sun will be reflected on: By help of an ordinary Horizontal Dial for that Latitude.*

Firſt, extend ſeveral Threads from the Centre of the Glaſs to the extremity of the reflected Horizon in the Room (which for more Conveniency and Uſe may be the ſeveral Hour-lines, and may alſo ſerve as a Bed to ſituate the Horizontal Dial on the reflected Horizon) having regard to ſituate the Centre of the Dial on the Centre of the Glaſs, and the Meridian of that Dial on the reflected Meridian of the World: Then to find the Point in the reflected reverſed Axis on the Floor of the Room: Take a Thread, one End thereof being faſtened in the Centre of the Glaſs, and move the other End thereof to and fro in the reflected Meridian under the reflected Horizon, until by help of a Quadrant the ſaid Thread is found to be depreſſed under the reflected Horizon, equal to the Latitude of the place, and where the End of the ſaid Thread interſects or meets the reflected Meridian either on the Floor or Wall, that Point is the reflected reverſed Axis, as was required. In which Point faſten one End of a Thread, which Thread will be of great uſe in drawing the reflected Hour-lines on any Wall or Ceiling whatſoever. Now if this Thread, whoſe End is faſtened in a Point on the reflected reverſed Axis, be taken and brought to touch any part of any one of the Threads of the Hour-lines (produced to and faſtened in the reflected Horizon) the ſaid Thread being continued ſo, as the End thereof may touch the Wall or Ceiling, and alſo any part of the ſaid Thread touch the Hour-line or Thread propoſed; that Point on the Wall or Ceiling is in the reflected Hour-line deſired to be drawn: Alſo the other Point in the ſame reflected Hour-line may be found; if the ſaid Thread, whoſe End is faſtened in the reflected Axis, be brought to touch ſome other part of the ſame Hour-thread propoſed; ſo that when (as before) the End of the ſaid Thread toucheth the Wall or Ceiling, ſome part of that Thread may alſo touch the Hour-line deſired, which Point or Touch on the Wall or Ceiling, is alſo another Point in the ſaid reflected Hour-line deſired. By which two Points ſo found (as before) the reflected Hour-line may be drawn by a Thread, projecting from thoſe Points from the Eye, as it was formerly directed in drawing the reflected Hour-lines to an Horizontal Glaſs.

*To draw the Reflected Equinoctial-line, and alſo the Tropicks on any Wall or Ceiling, to any Reclining Reflecting Glaſs.*

1. *To draw the Reflected Equinoctial-line on the Wall or Ceiling.*

Take that Thread, whoſe End is faſtened in the Centre of the reclining Glaſs, and move the other End thereof to and fro in the ſaid reflected Meridian formerly drawn, until (by help of a Quadrant) the ſaid Thread is elevated above the reflected Horizon formerly drawn, equal to the Complement of the Latitude, (which as before will be always perpendicular to the reverſed Axis) and make a Point in the ſaid reflected Meridian, where the End of the ſaid Thread toucheth; then on that Point and the ſaid reflected Meridian on the Ceiling, raiſe a perpendicular Line, which is the reflected Equinoctial-line deſired.

2. *To draw the Reflected Tropicks, or other Parallels of Declination.*

Firſt, (as before) make or take out of ſome Book or Table of the Sun's Altitude for each Hour of the Day, calculated for the Place of Latitude propoſed, when the Sun is in either of the Tropicks, or other parallel of Declination: Then take that Thread, whoſe End is faſtened in the Centre of the Glaſs, move the other End thereof to and fro in the Hour-line propoſed, until by applying one ſide of a Quadrant to the ſaid Thread you find

find the ſaid Thread elevated above the reflected Horizon anſwerable to the Sun's height in that Hour propoſed, when he is in that Tropick or Degree of Declination propoſed. Which Altitude required will be found in the foreſaid Table for that End calculated, which ſaid Thread being of the Elevation above the reflected Horizon, as the ſaid Table directeth: Then mark where the End of the Thread (ſo elevated) toucheth the Wall or Ceiling in that Hour line: So is one Point found in the reflected Parallel of Declination deſired to be drawn. In like manner, find in the ſaid Table in the ſame Parallel or Degree of Declination what Altitude the Sun hath at the next Hour, and elevate the ſaid Thread, whoſe End is faſtened in the Centre of the Glaſs, equal to the Sun's Altitude in that Hour above the ſaid reflected Horizon, by help of the ſaid Quadrant, and where the other End of the ſaid Thread falleth in the Hour-line propoſed, make another Mark or Point. And ſo in like manner make the Points (belonging to that Parallel of Declination) in the remaining Hour-lines, according to the ſeveral Altitudes found in the ſaid Table of Altitudes: Then drawing by hand a Line to paſs through thoſe ſeveral Points ſo found as before, which Line is the reflected Parallel of the Sun's Declination deſired. In like manner may be drawn all or any other Parallel of Declination, which may have reſpect to the Sun's place, or the Length of the Day, as ſhall be deſired.

Or,

*To draw the ſaid reflected Tropicks, or other Parallels of Declination, without any Tables calculated, only by help of a* Trigon *firſt made on Paſt board, or other Material. Note, that all Parallels are leſſer Circles.*

Firſt (as formerly is ſhewed in drawing the Parallels of Declination to a reflecting Horizontal Glaſs) faſten the Trigon on the reflected reverſed Axis, ſo that the Centre of the Trigon may be in the Centre of the Glaſs, then alſo will the Equinoctial on the Trigon be perpendicular to the ſaid reflected reverſed Axis: Then take the Thread fixed in the Centre of the ſaid Glaſs (which is alſo in the Centre of the Trigon) and lay it upon that Parallel of Declination, drawn on the ſaid Trigon, whoſe reflected Parallel is required to be drawn on the Plane or Ceiling: Then move the Trigon, the Thread lying on the ſaid Parallel, until the End of the ſaid Thread touch any Hour-line on the ſaid Wall or Ceiling, in which Point of Touch on that Hour-line make a Mark, ſo will that Point be in the reflected Parallel of Declination deſired. In like manner, move the ſaid Trigon, ſtill keeping the Thread on the ſame Parallel, until the End of that Thread touch another Hour-line on the ſaid Plane or Ceiling, and there alſo make another Mark. And ſo in like manner find a Point in each Hour-line, through which that reflected Parallel muſt paſs; then drawing a Line to paſs through thoſe ſeveral Points on the ſaid Plane or Ceiling, which Line is the reflected Parallel of the Sun's Declination deſired.

In like manner may be drawn any other reflected Parallel of Declination required.

*To draw the Reflected Azimuth-lines to any Reclining Glaſs, or any Plane whatſoever that the Sun-beams will be reflected on. Here note that Azimuths are great Circles.*

Firſt, know that the reflected Vertical-point in the Axis of the reflected Horizon, will always be found in the reflected Meridian. And look how many Degrees the reflected Horizon differs from the direct Horizon, ſo many muſt the reflected Axis of the Horizon differ from the direct Axis of the Horizon: Hence the reflected Vertical-point, whereby the reflected Azimuth-lines are drawn, may be thus found.

Take that Thread whoſe End is fixed in the Centre of the Glaſs, and move the other End thereof to and fro in the reflected Meridian, until by applying one Side of a Quadrant thereto, you find the ſaid Thread depreſſed juſt 90 Degrees, or perpendicular under the reflected Horizon; then make a Mark or Point where the other End of the ſaid Thread toucheth the ſaid reflected Meridian on the Wall, Ground or Floor of the Room, which Point ſo found, is the reflected Vertical-point deſired, in which Point faſten one End of a Thread:

Then on Paſt-board or other Material draw the Points of the Compaſs or other Degrees, placing the Centre thereof in the Centre of the Glaſs, and the Meridian thereof in the reflected Meridian of the World, which ſaid Paſt-board muſt be alſo ſituated in the reflected Horizon juſt as the Horizontal Dial was formerly directed to be ſituated for drawing the reflected Hour-lines: And as the Threads from the Centre faſtened in the reflected Horizon were alſo the Hour-lines on the Horizontal Dial, whereby the reflected Hour-lines were drawn: So now the Threads from the Centre faſtened in the reflected Horizon may be the Horizontal Azimuth-lines, whereby the reflected Azimuth-lines may be drawn: Or if that Thread, which is faſtened in the Centre of the Glaſs be drawn exactly over any Azimuth-line, the End whereof being faſtened by a Nail or other Means in the reflected Horizon on the other Side of the Room, there may ſeveral Points be found in the Wall or Ceiling, through which the reflected Azimuth-line muſt paſs, as followeth:

Take that Thread, one End of which is faſtened in the ſaid Vertical-point, and bring it juſt to touch the Azimuth-thread formerly faſtened, and continue it until the End thereof touch the Wall or Ceiling, (and alſo the Thread it ſelf touch the ſaid Azimuth it ſelf, as before) in which Point of Touch on the Wall or Ceiling make a Mark, thro' which Point that reflected Azimuth-line muſt paſs. Then move the ſaid String faſtened in the ſaid Vertical-point, ſo that it may juſt touch the ſaid Thread again, but in another place: Then as before continue that Thread, until the End thereof touch the Wall or Ceiling again, as before, and there make another Mark, through which the ſaid reflected Azimuth-line muſt alſo paſs: In like manner may more Points be found for your further Guide, in drawing that Azimuth-line. But two Points being found will be ſufficient.

*To draw any Reflected Line by any two Points given over any Plane whatſoever, without projecting by the Eye.*

Faſten two Threads in the place of the Centre of the ſaid reclining Glaſs, drawing the ſaid

Threads ſtraight, faſtening each of the other Ends in the two reflected Azimuth-points formerly found on the Wall or Ceiling. Then ſituate a Thread croſs or thwart the Room, ſo as it may croſs thoſe other Threads from the Centre, near at right Angles, and alſo juſt touch both of them in that Situation. By which ſaid Thread croſs the Room may any Number of Points in the ſaid reflected Azimuth-line to be drawn, be found at pleaſure: For if the End of another Thread be alſo faſtened in the Centre of the ſaid Glaſs, making the other End thereof to touch the Wall or Ceiling, but ſo that it may alſo juſt touch the ſaid Thread, which is faſtened croſs the Room, which Point of Touch on the ſaid Wall or Ceiling is another Point in the ſaid reflected Azimuth-line required to be drawn. In like manner may more Points be found at every Angle or Bending of the Wall or Ceiling for the exacter drawing the reflected Azimuth-line required, which doth find Points, whereby is drawn the ſame reflected Azimuth-line (or other Lines) as was formerly done by a Thread ſo ſituated, that it may interpoſe between the Eye and any two Points aſſigned on the Wall or Ceiling.

In like manner, if the Thread faſtened on the further Side of the Room were removed to another Azimuth-line on the ſaid Paſt-board, and then faſten it again on the further Side of the Room (as before) you may by help of the ſaid Thread, faſtened in the ſaid Vertical-point, find ſeveral Points on the Wall or Ceiling, thro' which that Azimuth-line will paſs: So may you either by this or the former way draw what Azimuth-lines you pleaſe, either in Points of the Mariner's Compaſs or Degrees, as you pleaſe, by drawing it firſt on Paſt-board, as before is directed.

And note generally, that ſuch Relation the point found on the Floor or Ground in the reflected reverſed Axis, hath to the Hour-line drawn on the Horizontal Dial, in drawing the reflected Hour-lines: The ſame hath the reflected Vertical-point found on the Floor or Ground, to the Azimuths drawn on the Paſt-board in the drawing the reflected Azimuth-lines.

*To draw the Reflected Parallels of the Sun's Altitude, or Proportions of Shadows to any Reclining Glaſs on any Plane whatſoever, that the Sun-beams be reflected on. Here note, that Parallels of Altitude are leſſer Circles, therefore are not repreſented by a Right-line.*

Firſt, know generally that what reſpect the Parallels of Declination have to Hour-lines, ſuch have the Parallels of Altitude to the Azimuths.

For if one End of a Thread be faſtened in the Place of the Centre of the reclining Glaſs, and the other End moved to and fro in any reflected Azimuth-line, until the ſaid Thread be elevated any Number of Degrees propoſed above the reflected Horizon (the Elevation of which Thread being found, by applying a Quadrant thereto) and making a Mark or Point where the End of the ſaid Thread toucheth the ſaid reflected Azimuth drawn on the Wall or Ceiling, that Point ſo found is the Point through which that Almicanter or reflected Parallel of the Sun's Altitude muſt paſs.

In like manner, remove the other End of the ſaid Thread faſtened in the Centre of the Glaſs to another reflected Azimuth-line, and (as before) move it higher or lower, until by applying the Edge of a Quadrant to that Thread, you find the ſaid Thread above the reflected Horizon on the ſame Number of Degrees firſt propoſed, and at the End of the ſaid Thread in that reflected Azimuth-line drawn on the Wall or Ceiling, I make another Mark or Point, through which the ſame reflected Almicanter or Parallel of Altitude muſt alſo paſs: And ſo in like manner I find a Point on each reflected Azimuth-line, through which the ſame Parallel of Altitude muſt paſs. Then drawing by hand a Line to paſs through theſe ſeveral Points ſo found, as before, that Line is the reflected Parallel of the Sun's Altitude propoſed. In like manner may be drawn all the other Parallels of Altitude deſired, which will ſhew the Sun's Altitude or the Proportion of any Shadow to its Altitude, at any Appearance of the Sun's Reflexion thereon.

*To draw the Jewiſh or old Unequal Hour-lines to any Reclining Glaſs on any Plane whatſoever that the Sun-beams will be reflected on. Here note, that the Jewiſh Hour-lines are great Circles.*

Firſt, (by the Rules formerly given) draw two reflected Parallels of Declination of 16 deg. 55′, the one being near the Summer, and the other near the Winter-Tropicks: For when the Sun hath that Declination, the Day is 15 Hours long in the Summer, and 9 in the Winter: Then (as is formerly directed) ſituate a Thread juſt between the Eye, and thoſe three Points in the ſaid reflected Dial, as is expreſſed in the inſuing Table, ſo may you thereby draw all or any of thoſe Jewiſh Hour-lines deſired, which will at any Appearance of the Spot by the Reflex of the Glaſs amongſt thoſe Hour-lines, ſhew how many of the Equal Hours is paſt ſince Sun-riſing, as was deſired. Now in this Latitude of 51 deg. 30′. If the Parallels of the Sun's Declination be drawn, both when the Day is 9 and 15 Hours long, that is, when it is 16 deg. 55′, any of thoſe Jewiſh Hour-lines will interſect the common Hour-lines, either upon the Hours, Half-hours, or Quarters. And ſuch a Declination may be found, that it ſhall ſo do in any Latitude deſired.

| Unequ. Hours. | 15 H. M. | Equal H. | 9 H M. | Unequ. Hours. | 15 H. M. | Equal H. | 9 H M. |
|---|---|---|---|---|---|---|---|
| 0 | 4 30 | 6 | 7 30 | | | | |
| 1 | 4 45 | 7 | 8 15 | 7 | 1 15 | 1 | 0 45 |
| 2 | 7 00 | 8 | 9 00 | 8 | 2 30 | 2 | 1 30 |
| 3 | 8 15 | 9 | 9 45 | 9 | 3 45 | 3 | 2 15 |
| 4 | 9 30 | 10 | 10 30 | 10 | 5 00 | 4 | 3 00 |
| 5 | 10 45 | 11 | 11 15 | 11 | 6 15 | 5 | 3 45 |
| 6 | 12 00 | 12 | 12 00 | 12 | 7 30 | 6 | 4 30 |

REFLECTING *Teleſcope*. See *Teleſcope*.

REFLECTION, is a Power the Human Mind hath of perceiving its own Operations, within it ſelf, when it is employed about the *Ideas* it hath before gotten by Senſation; which *Operations*, when we come to reflect and conſider on them, do furniſh our Underſtanding with a great Number of Ideas, which could not be had by bare *Senſation*, of things without us: Such as *Perception Thinking*, *Believing*, *Doubting*, *Raſoning*, *Knowing*, *Willing*, &c. and all the differing Actions of the Mind.

REFLECTION in the Pythagorean or Copernican Syſtem is the Diſtance of the Pole from the Horizon of the Diſk; which is the ſame thing as the Sun's Declination in the Ptolemaick Hypotheſis.

REFLEXIBILITY of the Rays of Light is their Diſpoſition to be turned back into the ſame *Medium*, from any other *Medium* on whoſe Surface they fall; and therefore thoſe Rays are more or leſs reflexible, which are returned back more or leſs eaſily.

As if Light paſs out of Glaſs into Air, and by being enclined more and more to the common Surface of the Glaſs and Air, begins at length to be totally reflected by that Surface; thoſe Sorts of Rays which at like Incidences are reflected moſt copiouſly; or by inclining the Rays begin ſooneſt to be totally reflected, are moſt reflexible. *Newton's Opticks*, p. 2.

There is the ſame conſtant Relation between Colour and Reflexibility: Light of a violet Colour being in like Circumſtances reflected at leaſt Thickneſs of any Plate or Bubble; (ſee Obſ. 13, 14, and 15, compared with 4 or 18th) The red Rays at the greateſt Thickneſſes; and the intermediate Colours at intermediate Thickneſſes: So that the coloretick Properties of the Rays muſt be connate with them, and immutable.

REFORM, to *reform* in a Military Senſe is to reduce a Body of Men either by diſbanding the Whole, or only breaking a Part, and retaining the Reſt, or ſometimes by incorporating them in other Regiments. So that a

REFORMED *Officer* is one whoſe Troop or Company is broke, and he continued in either whole or half Pay, doing Duty in the Regiment.

REFRACTED *Dials* are ſuch as ſhew the true Hour only, by the means of ſome Refracting Tranſparent Fluid: As thus,

If you ſtick up a Pin or Stick, or aſſign any Point in any Concave, Bowl, or Diſh, to ſhew the Hour, and make that the Centre of your Horizontal Dial; (ſee *Reflected Dialling*) aſſigning the Meridian Line on the Edges of the Bowl, point out the reſt of the Hour-line alſo on the Edges of the Bowl, and taking away the Horizontal Dial, elevate a String, or Thread from the End of the ſaid Pin faſtened thereto over the Meridian Line, equal to the Latitude or Elevation of the Pole of the Place: Then with a Candle, or by bringing the Thread to caſt a Shadow on any Hour-point formerly mark'd out on the Edges of the Bowl, that Shade in the Bowl is the true Hour-line; and if the Bowl be full of Water, *&c.* When this is done, it will never ſhew the true Hour by the Shadow of the Top of the Pin, but when filled again with the ſame Liquor.

REFRACTION, Sir *Iſ. Newton* in his Opticks *p.* 56, 57, 58. On this Natural Suppoſition that *Bodies refract Light by acting upon its Rays in Lines perpendicular to their Surfaces*, demonſtrates: *That the Sine of Incidence of every Ray of Light conſidered apart, is to its Sine of Refraction in a given Ratio.* See *Incidence*.

And as he ſhews that the Sun's Light conſiſts of Rays of different Degrees of Refrangibility; ſo *p.* 61. he proves that the Difference of the Refraction of the leaſt Refrangible and moſt Refrangible Rays is about the $27\frac{1}{2}$ Part of the whole Refraction of the mean refrangible Rays; and that in ſome Refractions, the Refraction of the leaſt to that of the moſt refrangible Rays, is very nearly as 27 to 28.

Then in Book 2. Part 3. He demonſtrates that Bodies reflect and refract Light by one and the ſame Power variouſly exerciſed in various Circumſtances, (ſee Reflexion) and then he comes to this Propoſition; That if Light be ſwifter in Bodies than *in vacuo*, in the Proportion of the Sines which meaſure the Refraction of thoſe Bodies, then *the Forces of the Bodies to reflect and refract Light, are very nearly proportional to the Denſities of the ſame Bodies*; excepting that unctuous and ſulphureous Bodies refract more than others of the ſame Denſity. Of this at *p.* 73. he gives a Table, and compares the refracting Power of many Bodies with that of the Air.

And the Refraction of the Air is determined by that of the Atmoſphere obſerved by Aſtronomers, and he ſhews that the whole Refraction of Light in paſſing thro' the Atmoſphere, from the higheſt and rareſt Part of it down to the loweſt and denſeſt, is equal to the Refraction it would ſuffer, in paſſing at like Obliquity out of a *Vacuum* immediately into Air of equal Denſity, with that in the loweſt Part of the Atmoſphere.

In particular he ſhews there, That the Refractions of a *Pſeudo Topaz*, a *Selenitis*, Rock Chryſtal, Iſland Chryſtal, vulgar Glaſs, (*i. e.* Sand melted together) and Glaſs of Antimony; which are terreſtrial ſtony Alcalizate Concretes; and of Air, (which probably is the Reſult of ſuch Subſtances by fermentation) tho' theſe Subſtances be very differing from one another in Denſity, yet have they their refracting Powers almoſt in the ſame *Ratio* to one another as their Denſities are: Excepting that the Refraction of that ſtrange Subſtance, *Iſland Chryſtal*, is a little greater than the Reſt. And particularly *Air*, which is 3400 Times rarer than the *Pſeudo Topaz*, and 4200 Times rarer than Glaſs of Antimony, hath, notwithſtanding its Rarity, the ſame refracting Power in reſpect of its Denſity, which thoſe two very denſe Subſtances have in reſpect of theirs; excepting ſo far as thoſe two differ one from another.

Again, the Refraction of Camphire, Oil Olive, Line ſeed Oil, Spirits of Turpentine, Amber, which are fat ſulphureous Bodies; and a Diamond, (which probably is an Unctuous Subſtance coagulated) have their refractive Powers in proportion to one another as their Denſities; without any conſiderable Variation.

But the refractive Power of theſe *Unctuous* Bodies is 2 or 3 Times greater in reſpect of their Den-

Denſities, than the refractive Powers of the former Subſtances in reſpect of theirs.

*Water* hath a refractive Power in a middle Degree between thoſe two Sorts of Subſtances, and probably is of a middle Nature; for out of it grow all vegetable and animal Subſtances, which conſiſt as well of ſulphureous, fat and inflamable Parts, as of earthly, lean, and alcalizate Ones.

*Salts* and *Vitriols* have refractive Powers in a middle Degree between thoſe of earthy Subſtances and Water; and accordingly are compoſed of thoſe two Sorts of Subſtances; for by Diſtillation and Rectification of their Spirits,

*Spirits of Wine* have a refractive Power in a middle Degree between thoſe of Water and oily Subſtances; and accordingly ſeems to be compoſed of both, united by Fermentation: The Water, by means of ſome Saline Spirits with which it is impregnated, diſſolving the Oil, and volatilizing it by the Action; for Spirit of Wine is inflamable by means of its oily Parts; and being diſtilled often from Salt of Tartar, grows by every Diſtillation more and more aqueous and flegmatick.

So that it ſeems rational to attribute the *Refractive Power of all Bodies chiefly, if not wholly, to the ſulphureous Parts with which they abound.* For it's probable that all Bodies abound more or leſs with Sulphurs. And as Light congregated by a Burning Glaſs, acts moſt upon ſulphurous Bodies, to turn them into the Fire and Flame; ſo, ſince all Action is mutual, Sulphurs ought to act moſt upon Light: And that the Action between Light and Bodies is mutual, appears from hence, that the denſeſt Bodies which refract and reflect Light moſt ſtrongly, grow hotteſt in the Summer Sun, by the Action of the refracted or reflected Light.

At the End of his Latin Edition of the Opticks under Query 21. He ſhews that the Cauſe of *Refraction* (and Reflexion both) is the Attraction of the Parts of the refracting Body, acting at a little diſtance, upon the Rays of Light as they paſs thro' it.

And becauſe the Particles which compoſe the *Iſland Chryſtal* (*ſee Light*) do all act by a *conſimilar Ratio*, on the Rays of Light in order to produce that *Unuſual Refraction*, which is obſerved in that odd Body: Therefore 'tis probable that thoſe Particles in the forming the Parts of that Chryſtal, were not only diſpoſed themſelves in *certain Order*, ſo that their Extremities all looking the ſame way, they did concrete into regular Figures; but alſo that their *Sides*, that is ſuch as were homogeneal as to their attracting Forces, by a kind of *Polar Virtue* or *Polarity*, were all turned the ſame way.

The ſame Excellent Author ſhews Optic. Lat. *p.* 316. That having demonſtrated in his *Principia*; that if Refraction were cauſed by the Attraction of the Rays of Light; the *Sine of the Angle of Incidence* muſt be *to* That *of the refracted Angle always in a given Ratio*; and this being by repeated Experience found to be true in Fact: 'tis then plain that Attraction is the Cauſe of the Rays of Light.

REFRANGIBILITY *of the Rays of Light*, Sir *Iſ. Newton* defines to be their Diſpoſition to be *refracted*, or *turned out* of their way, in paſſing out of one Tranſparent Body or Medium into another; and a greater or leſs Refrangibility of Rays is their Diſpoſition to be turned more or leſs out of their way (in Obſervat. 24 of his Opticks) in like Incidences on the ſame Medium.

He ſhews alſo that there is conſtant Relation betwen Colours and Refrangibility: The moſt refrangible Rays being of a *violet Colour*; the leaſt refrangible *Red*; and thoſe of intermediate Colours, having proportionably intermediate Degrees of Refrangibility.

REGAL *Fiſhes* are Whales and Sturgeons, *An.* 1. *Eliz. c.* 5. to which ſome add Porpuſſes. The King by his Prerogative, hath every Whale caſt aſhore in his Dominions, unleſs granted to Subjects by ſpecial Words: The King himſelf hath the Head and Body; and the Queen the Tail to make Whale bones for her Royal Veſtments.

REGALIA, are the Perſonal Prerogatives of a Prince; and theſe are either *Prerogatives of Juſtice*; ſuch as his Power over *Weights and Meaſures*; of *Coining Money*; of *making Magiſtrates*, *&c.* or *Prerogatives of Favour*: Such as the Power of *making Communities* and *Colleges*, &c.

REGARDERS *of the Foreſt* } were formerly
REGARDATORES *Foreſtæ* }

a Sort of Officers, who were every Year, upon Oath, to make a *Regard*, or to make a View of the Foreſt Limits, and to enquire into all the Damages and Treſpaſſes committed, and to preſent them at the next *Swain Mote* or *Foreſt Court*. *Manwood* refers their Inſtitution to K. *Henry* II. But *Spelman* thinks the Name at leaſt was given ſince; and that then they were the ſame with thoſe Officers, called *Cuſtodes Venationis*. Dr. *Kennet*'s Par. Antiq.

REGIUS *Profeſſor Anno* 12. *Car.* 2. *cap.* 17. K. *Henry* the Eighth founded five Lectures in each of our Univerſities, *viz.* of Divinity, Hebrew, Greek, Law, and Phyſick; the Readers of which Lectures are in the Univerſity Statutes, called *Regii Profeſſores.*

REHABERE *facias ſeiſinam, quando Vicecomes liberavit ſeiſinam de majore parte quam deberet*, Is a Writ judicial mentioned, *Reg. Judic.* fol. 13. 51. and in *fol.* 54. there is another Writ mentioned of this Name and Nature.

REHABILIATION *Anno* 25. H. 8. *cap.* 21. was one of thoſe Exactions mentioned in that Statute to be claimed heretofore by the Pope in *England*; and ſeems to ſignifie a *Bull* or *Breve*, for re-inabling a ſpiritual Perſon to exerciſe his Function, that was formerly diſabled.

RE INFORCED Ring of a Cannon, is that which is next after the *Trunnions*, between them and the *Vent*, and the *Re-inforced* part of a Gun, is from the Baſe Ring to the Re inforced Ring. This part is made thicker in Metal than any other part of the Piece.

RELATION in the Law ſenſe is the ſame as *Fictio Juris*, to make a Nullity of a thing from the beginning (for a certain Intent) which had Eſſence, *Vide Co. Lib.* 3. *fol.* 28. *Butler* and *Baker*'s Caſe; but more plainly thus: *Relation* is where, in conſideration of Law two *Times*, or other things are conſidered ſo, as if they were all one; and by this the thing ſubſequent is ſaid to take its Effect by *Relation*, at the *Time preceeding*. As if *A* deliver a Writing to *B*, to be delivered to *C*, as the Deed of *A*, when C has paid a Summ of Money. Here when the Money is paid, and the Writing delivered; this ſhall be taken as the Deed of *A*, at the Time when it was *firſt* delivered. And ſo Bills of Parliament, to which the Queen aſſents

on

on the *laſt* Day of Parliament ſhall *Relate*, and be of Force from the *firſt* Day of the Seſſion.

RELIEF, *Relevamen*, (in Doomſday *Relevatio*, *Relevium*) was a certain Summ of Money, which the Tenant holding by Knights Service, Grand Sergeanty, or other Tenure, for which Homage or Regal Service is due; or by Soccage, for which no Homage is duely paid to his Lord at his Entrance, *Mag. Cart. c.* 2. and 38. *E.* 1. Stat. 1. *Skene de Verbor.* ſaith *Relief* was given by the Tenant or Vaſſal that was of perfect Age, after the expiring of his Wardſhip, to the Superior Lord, of whom he held his Lands in Knight Service: That is by *Ward* and *Relief*; for by payment thereof he *Relieves*, and as it were *relevat*, raiſeth up again his Lands after they were ſunk into his Superiors Hand, by Reaſon of Wardſhip, *&c.* See alſo 12 *Car.* 2. *c.* 24.

RELIEF, *Relevium*, was a Fine formerly paid to the King by every one that came to the Inheritance of Land held in *Capite*, or *Military Service*, to *Relieve*, or as it were to redeem their Eſtate, and to hold Poſſeſſion of it. At firſt it conſiſted in Horſes and Arms, till by the *Aſſiſe* of Arms in 27 *Henry* 2. every Man's Armour was preſerved for his Heir, and the *Relief* payable in Money, of which the fixt Rates were determined by *Magna Charta*.

RELIEFS were payable alſo not only to the King as Supreme Lord, but to all Barons and Knights by thoſe Tenants who held under them by Military Service. *Relevare* was the word for paying ſuch *Relief*, and for obtaining by that means Poſſeſſion of ſuch Eſtate.

Some Cuſtomary and Servile Tenants paid a *Relief* for renewing of a *Tenure*, on the Death of the laſt Poſſeſſor. *Kennet*'s Paroch. Antiquit.

RENEWING *of Leaſes and Lives*, &c. (See alſo *Reverſions*) Tho' there be Variety of Tables extant for computing Intereſt and Annuities; (in this Vol.) yet till the little Book of Tables for *Renewing and Purchaſing College and Church Leaſes*, was publiſhed at *Cambridge*, (and recommended by the Famous Sir *Iſ. Newton*) there was a Defect in this Affair. But there the Tables are not only eaſie and commodious, and their Conſtruction clear; but the *Ground* and *Reaſons* of *Renewing*, are given, from the Conſtruction and Uſe of a little Table of *Reverſions*; which you will find inſerted here with its Uſe and Application under the word *Reverſion*.

I have therefore given you the following, plain and eaſie *Tables of Renewing*, from the ſaid Book; by the Uſe of which the Renewing of Leaſes or Lives, will become a clear, facile and intelligible Thing.

And altho' *theſe Tables* are only for Leaſes of 21, 20, 40, and 10 Years; yet by the Table of *Reverſions* above mentioned, other Tables of Renewing of Leaſes for any Number of Years under 41, may be made; as by this Example will appear.

Suppoſe in a Leaſe of 31 Years, I would renew 7 Years lapſed; allowing 6 *l. per Cent.* profit. To do this, I take the *Summ* of the Reverſions for 7 Years from 31 upwards (from the Table of Reverſions) accounting 31 as 1; which Summ is 1 *l.* 7 *s.* 7 *d.* 0 *q.* or according to the way of accounting in the following Tables; 1 Year, 2 Quarters, 1 Month, and 5 Decimal parts purchaſe; and that is the *Fine* to be paid for renewing the 7 Years lapſed, and which was ſought.

And this being underſtood it will not be difficult to do the like for any other Number of Years, either in this or any other Leaſe; and according to any other Rate of Intereſt.

As to the Nature of the following Tables, they differ a little from Mr. *Ætcroids*, in the Rate of Intereſt for which they are calculated.

Mr. *Ætcroids* are made at 11 *l.* 3 *s.* 6 *d.* $\frac{6}{7}$ *per Cent.* But this Table for renewing a Leaſe of 21 Years, is calculated at 11 *l.* 11 *s.* 8 *d.* $\frac{1}{4}$ $\frac{3}{210}$, and at 5, 6, 8 and 10 *per Cent.* So the Fine for renewing 7 Years lapſed in a Leaſe of 21 Years, by *Ætcroid*'s Tables is 1 *l.* 1 *s.* 3 *d.* (i. e.) 1 Year, and 3 Weeks purchaſe: But by our Tables it is but *one Years Value*, at 11 *l.* 11 *s.* 8 *d.*, $\frac{1}{4}$, $\frac{3}{80}$ *per Cent.* The Reaſon of which is, becauſe the *Rate of Intereſt is greater*: But when the *Rate of Intereſt is leſſer*, then the *Fine is greater*.

Thus at 10 *l. per Cent.* The Fine for renewing 7 Years lapſed, is 1 Years, 1 Quarters, and 1 Weeks Value: But at 8 *l. per Cent.* the Fine for renewing 7 Years lapſed, is above 1 Year and 3 Quarters Value; and at 6 *per Cent.* the Fine is 2 Years and almoſt an half Value.

So in the Table for renewing a Leaſe of 20 Years, at 12 *l.* 6 *s. per Cent.* The Fine for renewing 7 Years lapſed, is but one Years Value in theſe Tables; whereas in his, it is 1 *l.* 3 *s.* 8 *d.* That is one Year and above two Months Value. But at 5, 6, 8 and 10 *l. per Cent.* the *Fine is greater*, becauſe the *Rate of Intereſt is leſs*, as was ſaid above.

And that this is *Right*, will appear, if you conſider that the *Tables for Renewing of Leaſes*, conſiſt of the *Summs of the Tables of Reverſion*, or *Decreaſe of Money*.

For 'tis apparent that the *greater* the Rate of Intereſt is, the *greater* is the *Decreaſe* of Money in the Reverſion: And conſequently the *leſſer* are the *Summs* of thoſe Reverſions; which are the *Fines* for *Renewing*: An Example will make this very plain.

If you look into the Table of Reverſions, you will find: That 1 *l.* or 20 *s.* in 40 Years, *decreaſes* to 2 Pence Half penny at 12 *l. per Cent.* compound Intereſt; and at 10 *l. per Cent.* it decreaſes to 5 Pence Farthing in 40 Years: Now the Summ of theſe Reverſions for 7 Years, accounting 40 as 1; 39 as 2, *&c.* is but 2 *s.* 1 *d.* 2 *q.* But at 10 *per Cent.* the Summ for 7 Years is 4 *s.* 2 *d.* 3 *q.* which Summs are the *Fines* for renewing 7 Years lapſed in a Leaſe of 40 Years, at the Rates of 12, and 10 *per Cent.*

From whence 'tis clear and plain, that the *leſſer* the Rate of Intereſt is, the *greater* muſt be the *Fine* for renewing: And the *greater* that Rate is, the *leſſer* muſt be the *Fine*: And conſequently the Difference between theſe Tables and *Ætcroids* ariſes only from the different Rate of Intereſt, for which they were calculated.

The following Tables for renewing and purchaſing of Leaſes, do ſhew the Value in *Years*, *Quarters*, *Months*, and *Decimal Parts* of a Month, accounting 3 Months to a Quarter, and that a *Month* is divided into Ten parts. And tho' this way of Diviſion be not quite ſo exact, as if it were expreſt in Decimals of *Pounds*, *Shillings*, *Pence*, &c. Yet 'tis more familiar and commodious, and the Difference is very inconſiderable, for it will never be

be above a Decimal of a Month over or under the true Value, which in these Considerations is not to be regarded. And therefore when a Fine is required of any Person, either for renewing or purchasing of a Lease, the Tables will shew exactly enough what *Rate* of Interest is allowed: And so if any one would *give* or *take* a Fine according to any Rate of Interest proposed, they may do it near enough by the Tables.

At 1 *l. per An.* Rent, the Divisions by these Tables will be 5 *s. per* Quarter, 1 *s.* 8 *d. per* Month, and a Decimal of a Month 2 *d.* And because there are 4 Weeks in a Month it will be 5 *d. per* Week; five Decimals of a Month therefore make 10 *d.* which are equal to 2 Weeks, and 3 Decimals of a Month are but 1 Penny above a Week; so that 'tis easie to turn the Decimal parts of a Month into Weeks.

And these Kind of Numbers will be easily added or substracted as in these 2 Examples.

| | *Y.* | *Q.* | *M.* | *d. p* |
|---|---|---|---|---|
| Suppose I were to add | 3 | 2 | 1 | 6 |
| these 2 Fines, | 2 | 3 | 1 | 7 |
| Summ | 6 | 2 | 0 | 3 |

## ADDITION.

I say 7 and 6 makes 13 Decimals, 10 of which making a Month, I write 3 and carry 1; 1 I carried and 2 Months makes 3 Months; wherefore I write a Cypher, and carry 1 Quarter, *&c.*

And this being understood, Substraction will also be easie, as in this Instance.

| | *Y.* | *Q.* | *M.* | *d. p.* |
|---|---|---|---|---|
| If from | 3 | 2 | 1 | 6 |
| You take | 2 | 3 | 1 | 7 |
| Remains— | 0 | 2 | 2 | 9 |

The first Table which offers it self for Renewing of Leases, is for the Term of 21 Years, it shews the Values in Years, Quarters, Months, and Decimal-parts of a Month, as all the Rest do: the First part of this Table is calculated at 11 *l.* 11 *s.* 8 *d.* $\frac{1}{4}$, $\frac{3}{10}$, *per Cent. per An.* Compound Interest, so that the Fine for Renewing 7 Years Lapsed, or the present Worth of 7 Years in Reversion, not to begin till 14 are expired, is exactly one Years Value; which Fine, and consequently Rate of Interest, Bishops, Deans and Chapters, Heads and Fellows of most Colleges in both Universities, do observe in Letting and Renewing of their Leases; but at other Rates of Interest, the Fine for Renewing 7 Years lapsed, the Table shews as followeth, *viz.*

The Fine for Renewing 7 Years Lapsed

| | *Y.Q.M.D.pts.* | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|
| at 5 *p. c.* | is 1 3 2 0 | Which by the | 29 | 3 | 4 |
| 6 *p. c.* | is 2 1 2 6 | Table of Red. | 24 | 13 | 4 |
| 8 *p. c.* | is 1 3 0 3 | at 10 *l.* yearly | 17 | 15 | 0 |
| 10 *p. c.* | is 1 1 0 3 | Rent is | 12 | 15 | 0 |

The Years *in esse* may be valued as a Lease of so many Years, as in this Lease of 21 Years, if 7 Years are run out, then there are 14 *in esse*, whose Value are as a Lease of 14 Years, and may be found by the Table for Purchasing; or if you substract the Value of the Years in Reversion from the Value of the whole Lease, the Remainer is the Value of the Years *in esse.*

To find the Value of some of the Years in Reversion, as suppose 3 of the 7, I do thus, because 3 wants 4 of 7, I take the Value of 4 Years in Reversion, from the Value of 7 in Reversion, the Remainer is the Value of 3 Years required.

*Example.*

| | *X.* | *Q.* | *M.* | *D* | *p.* |
|---|---|---|---|---|---|
| The Value of 7 Years in Reversion, at 11 *l.* 11 *s.* 8 *d. per Cent.* is | 1 | 0 | 0 | 0 | |
| The Value of 4 Years in Reversion at the same Rate is | 0 | 1 | 2 | 7 | |
| Which substract | 0 | 2 | 0 | 3 | |

Which Remainder being given for a Fine, will make up the Lease to 17 Years, that is, 3 added to 14

A Table

## A Table for the Renewing of any Number of Years lapſed in a Leaſe for 21 Years.

| 10 per Cent. | | | | 8 per Cent. | | | | 6 per Cent. | | | | 5 per Cent. | | | | l. s. d. | l. s. d. ¼ p. c. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Decimal Parts. | 6 | 4 | 3 | 5 | Decimal Parts. | 4 | 0 | 7 | 7 | Decimal Parts. | 5 | 2 | 2 | 4 | Decimal Parts. | 3 | 8 | 5 | 5 | Decimal Parts | 4 | 5 | 0 | 7 | 6 |
| Months. | 1 | 0 | 2 | 1 | Months. | 2 | 2 | 1 | 1 | Months. | 0 | 1 | 2 | 0 | Months. | 1 | 2 | 1 | 0 | Months. | 1 | 2 | 1 | 2 | 1 |
| Quarters. | 0 | 0 | 0 | 0 | Quarters. | 0 | 1 | 2 | 3 | Quarters. | 1 | 2 | 3 | 1 | Quarters. | 1 | 2 | 0 | 2 | Quarters. | 0 | 0 | 1 | 1 | 2 |
| Years. | 0 | 1 | 1 | 2 | Years. | 0 | 0 | 0 | 1 | Years. | 0 | 0 | 0 | 1 | Years. | 0 | 0 | 1 | 1 | Years. | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 2 | 1 | 0 | 1 | 2 | 3 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 1 | 2 | 2 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |
| 2 | 0 | 4 | 2 | 0 | 2 | 1 | 1 | 2 | 2 | 0 | 2 | 4 | 0 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 2 | 2 |
| 3 | 0 | 6 | 3 | 0 | 3 | 0 | 0 | 3 | 3 | 0 | 3 | 6 | 0 | 3 | 1 | 0 | 2 | 3 | 2 | 3 | 0 | 0 | 3 | 3 | 3 |
| 4 | 0 | 8 | 4 | 0 | 3 | 2 | 0 | 3 | 4 | 0 | 4 | 8 | 0 | 4 | 0 | 9 | 3 | 0 | 3 | 4 | 0 | 1 | 0 | 0 | 4 |
| 5 | 1 | 0 | 5 | 0 | 4 | 1 | 0 | 4 | 5 | 0 | 5 | 9 | 0 | 5 | 0 | 8 | 3 | 1 | 3 | 5 | 0 | 1 | 1 | 1 | 5 |
| 6 | 1 | 2 | 6 | 0 | 4 | 3 | 0 | 4 | 6 | 0 | 6 | 1 | 0 | 6 | 0 | 7 | 3 | 2 | 3 | 6 | 0 | 1 | 2 | 2 | 6 |
| 7 | 1 | 4 | 7 | 0 | 5 | 0 | 0 | 5 | 7 | 0 | 7 | 2 | 0 | 7 | 0 | 6 | 3 | 3 | 3 | 7 | 0 | 1 | 3 | 3 | 7 |
| 8 | 1 | 6 | 8 | 0 | 5 | 2 | 0 | 5 | 8 | 0 | 8 | 3 | 0 | 8 | 0 | 5 | 4 | 0 | 4 | 8 | 0 | 2 | 0 | 0 | 8 |
| 9 | 1 | 8 | 9 | 0 | 6 | 1 | 0 | 6 | 9 | 0 | 9 | 4 | 0 | 9 | 0 | 4 | 4 | 1 | 4 | 9 | 0 | 2 | 1 | 1 | 9 |
| 10 | 2 | 0 | 10 | 0 | 6 | 3 | 0 | 7 | 10 | 0 | 10 | 5 | 0 | 10 | 0 | 3 | 4 | 2 | 4 | 10 | 0 | 2 | 2 | 2 | 10 |
| 11 | 2 | 2 | 11 | 0 | 7 | 0 | 0 | 8 | 11 | 0 | 11 | 6 | 0 | 11 | 0 | 2 | 4 | 3 | 4 | 11 | 0 | 2 | 3 | 3 | 11 |
| 12 | 2 | 4 | 12 | 0 | 7 | 2 | 0 | 8 | 12 | 0 | 12 | 7 | 0 | 12 | 0 | 1 | 5 | 0 | 5 | 12 | 0 | 3 | 0 | 0 | 12 |
| 13 | 2 | 6 | 13 | 0 | 8 | 1 | 0 | 9 | 13 | 1 | 0 | 8 | 1 | 0 | 0 | 0 | 5 | 1 | 5 | 13 | 0 | 3 | 1 | 1 | 13 |
| 14 | 2 | 8 | 14 | 0 | 8 | 3 | 0 | 10 | 14 | 1 | 1 | 9 | 1 | 1 | 0 | 0 | 5 | 2 | 6 | 14 | 0 | 3 | 2 | 2 | 14 |
| 15 | 3 | 0 | 15 | 0 | 9 | 0 | 0 | 11 | 15 | 1 | 2 | 10 | 1 | 2 | 0 | 0 | 5 | 3 | 6 | 15 | 0 | 3 | 3 | 3 | 15 |
| 16 | 3 | 2 | 16 | 0 | 9 | 2 | 0 | 11 | 16 | 1 | 3 | 11 | 1 | 3 | 0 | 0 | 6 | 0 | 7 | 16 | 0 | 4 | 0 | 0 | 16 |
| 17 | 3 | 4 | 17 | 0 | 10 | 1 | 0 | 12 | 17 | 1 | 4 | 12 | 1 | 4 | 0 | 0 | 6 | 1 | 7 | 17 | 0 | 4 | 1 | 1 | 17 |
| 18 | 3 | 6 | 18 | 0 | 10 | 3 | 0 | 13 | 18 | 1 | 5 | 13 | 1 | 5 | 0 | 0 | 6 | 2 | 8 | 18 | 0 | 4 | 2 | 2 | 18 |
| 19 | 3 | 8 | 19 | 0 | 11 | 0 | 0 | 14 | 19 | 1 | 6 | 14 | 1 | 6 | 0 | 0 | 7 | 3 | 8 | 19 | 0 | 4 | 3 | 3 | 19 |
| 20 | 4 | 0 | 20 | 0 | 11 | 2 | 0 | 14 | 20 | 1 | 7 | 15 | 1 | 7 | 0 | 0 | 7 | 3 | 9 | 20 | 0 | 5 | 0 | 0 | 20 |
| Total Value. | | | | | Total Value. | | | | | Total Value. | | | | | Total Value. | | | | | Years Lapſed. | | | | |
| 8 | 2 | 1 | 7 | | 10 | 0 | 0 | 2 | | 11 | 3 | 0 | 1 | | 12 | 3 | 0 | 8 | | 1 | 2 | 3 | 4 | 5 | 6 |
| 7 | 3 | 0 | 3 | | 10 | 0 | 0 | 2 | | 11 | 3 | 0 | 1 | | 12 | 3 | 0 | 8 | | 7 | 8 | 9 | 10 | 11 | 12 |

The next Table is for the Term of 20 Years, the Firſt part thereof is calculated according to the Rate of about 12 *l.* 6 *s. per Cent. per Ann.* ſo that 1 Years value is the Worth of 7 Years lapſed, or in Reverſion; which Fine, and conſequently Rate of Intereſt, by ſome is obſerved in a Leaſe for 20 Years; but at other Rates of Intereſt: The Fine for Renewing 7 Years lapſed in this Leaſe of 20 Years, you will find by the Table as followeth, *viz.*

The Fine for Renewing 7 Years lapſed.

| | *Y. Q. M. D. pts.* | | | | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|
| at 5 *p. c.* is | 3 | 0 | 0 | 8 | Which by the Table of Red. at 10 *l.* yearly Rent is | 30 | 13 | 4 |
| 6 *p. c.* is | 2 | 2 | 1 | 4 | | 26 | 3 | 4 |
| 8 *p. c.* is | 1 | 3 | 1 | 9 | | 19 | 1 | 8 |
| 10 *p. c.* is | 1 | 1 | 1 | 8 | | 14 | 0 | 0 |

The Years *in eſſe* may be valued as a Leaſe of ſo many Years, or their Value may be found, by ſubtracting the Value of the Years lapſed, from the Value of the whole Leaſe, as was directed before in the Leaſe of 21 Years.

The Value of ſome of the Years in Reverſion may alſo be found in this Leaſe, as is directed before in the former Leaſe; however to make all plain, I ſhall give one Example: As ſuppoſe, I am to find the Value of 4 of the 7 Years in Reverſion in this Leaſe; then according to the Rule given in the Leaſe of 21 Years, I do thus; becauſe 4 wants 3 of 7, I take the Value of 3 Years in Reverſion, from the Value of 7 in Reverſion, the Remainder is the Value of the 4 Years required.

*Example.*

| | *Y.* | *Q.* | *M.* | *D. p.* |
|---|---|---|---|---|
| The Value of 7 Years in Reverſion at 6 *l. per Cent.* | 2 | 2 | 1 | 4 |
| The Value of 3 Years at the ſame Rate is | 0 | 3 | 2 | 9 |
| Which ſubtract | | | | |
| Remains | 1 | 2 | 1 | 5 |

This Remainder being given for a Fine will make up this Leaſe to 17 Years, that is 4 added to 13.

A Table

## A Table for the Renewing of any Number of Years lapſed in a Leaſe for 20 Years.

| 12 l. 6 s. p c. | | | | | 5 per Cent. | | | | 6 per Cent. | | | | 8 per Cent. | | | | 10 per Cent. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Years Lapſed. | Years. | Quarters. | Months. | Decimal Parts | Years. | Quarters. | Months. | Decimal Parts. | Years. | Quarters. | Months. | Decimal Parts. | Years. | Quarters. | Months. | Decimal Parts. | Years. | Quarters. | Months. | Decimal Parts. |
| 1 | 0 | 0 | 0 | 2506 | 0 | 0 | 1 | 5325 | 0 | 0 | 1 | 7941 | 0 | 0 | 0 | 6336 | 0 | 0 | 0 | 8792 |
| 2 | 0 | 1 | 1 | 5065 | 0 | 1 | 0 | 8828 | 0 | 1 | 0 | 1400 | 0 | 0 | 1 | 8930 | 0 | 0 | 1 | 7831 |
| 3 | 0 | 2 | 2 | 7625 | 0 | 1 | 1 | 1288 | 0 | 1 | 1 | 2059 | 0 | 1 | 0 | 1121 | 0 | 0 | 2 | 6870 |
| 4 | 1 | 0 | 0 | 0185 | 0 | 2 | 0 | 1748 | 0 | 2 | 0 | 2718 | 0 | 1 | 1 | 3312 | 0 | 1 | 0 | 5909 |
| 5 | 1 | 0 | 1 | 2745 | 0 | 2 | 1 | 2208 | 0 | 2 | 1 | 3377 | 0 | 2 | 0 | 0502 | 0 | 1 | 1 | 4948 |
| 6 | 1 | 1 | 2 | 5305 | 0 | 3 | 0 | 2668 | 0 | 3 | 0 | 4036 | 0 | 2 | 1 | 1693 | 0 | 2 | 0 | 3987 |
| 7 | 1 | 2 | 2 | 7865 | 0 | 3 | 1 | 3128 | 0 | 3 | 1 | 4695 | 0 | 2 | 2 | 2884 | 0 | 2 | 1 | 3026 |
| 8 | 2 | 0 | 0 | 0425 | 0 | 4 | 0 | 3588 | 0 | 4 | 0 | 5354 | 0 | 3 | 0 | 4074 | 0 | 3 | 0 | 2065 |
| 9 | 2 | 1 | 1 | 2985 | 0 | 4 | 1 | 4048 | 0 | 4 | 1 | 6013 | 0 | 3 | 1 | 5265 | 0 | 3 | 1 | 1104 |
| 10 | 2 | 2 | 2 | 5545 | 0 | 5 | 0 | 4508 | 0 | 5 | 0 | 6672 | 0 | 4 | 0 | 6456 | 0 | 4 | 0 | 0143 |
| 11 | 3 | 0 | 0 | 8105 | 0 | 5 | 1 | 4968 | 0 | 5 | 1 | 7331 | 0 | 4 | 1 | 7647 | 0 | 4 | 1 | 9182 |
| 12 | 3 | 1 | 1 | 0665 | 0 | 6 | 0 | 5428 | 0 | 6 | 0 | 7990 | 0 | 5 | 0 | 8838 | 0 | 5 | 0 | 8221 |
| 13 | 3 | 2 | 2 | 3225 | 0 | 6 | 1 | 5888 | 0 | 6 | 1 | 8649 | 0 | 5 | 1 | 0029 | 0 | 5 | 1 | 7260 |
| 14 | 4 | 0 | 0 | 5785 | 0 | 7 | 0 | 6348 | 0 | 7 | 0 | 9308 | 0 | 6 | 0 | 1220 | 0 | 6 | 0 | 6299 |
| 15 | 4 | 1 | 1 | 8345 | 0 | 7 | 1 | 6808 | 0 | 7 | 1 | 9967 | 0 | 6 | 1 | 2411 | 0 | 6 | 1 | 5338 |
| 16 | 4 | 2 | 2 | 0905 | 0 | 8 | 0 | 7268 | 0 | 8 | 0 | 0626 | 0 | 7 | 0 | 3602 | 0 | 7 | 0 | 4377 |
| 17 | 5 | 0 | 0 | 3465 | 0 | 8 | 1 | 7728 | 0 | 8 | 1 | 1285 | 0 | 7 | 1 | 4793 | 0 | 7 | 1 | 3416 |
| 18 | 5 | 1 | 1 | 6025 | 0 | 9 | 0 | 8188 | 0 | 9 | 0 | 1944 | 0 | 8 | 0 | 5984 | 0 | 8 | 0 | 2455 |
| 19 | 5 | 2 | 2 | 8585 | 0 | 9 | 1 | 8648 | 0 | 9 | 1 | 2603 | 0 | 8 | 1 | 7175 | 0 | 8 | 1 | 1494 |
| | Total Value. | | | | Total Value. | | | | Total Value. | | | | Total Value. | | | | Total Value. | | | |
| | 7 | 1 | 0 | 8 | 12 | 1 | 2 | 5 | 11 | 1 | 2 | 6 | 9 | 3 | 0 | 8 | 8 | 2 | 0 | 1 |

The third Table for renewing of Leaſes, is for the Term of 40 Years; it is calculated according to five ſeveral Rates of Intereſt, and in its manner of uſing differs not from the other, nevertheleſs an Example will be convenient, which therefore I ſhall give; as ſuppoſe there be 14 Years lapſed or run out in a Leaſe for 40 Years, What muſt I give to make up this Leaſe again, according to thoſe ſeveral Rates of Intereſt ſignified by the Table? That is, What muſt I give for 14 Years in Reverſion, after 26 *in eſſe*? Or, What's the preſent Worth of 14 Years, beginning 26 Years hence? For anſwer I find by the Table that the Fine for Renewing 14 Years lapſed.

| | Y. Q. M. D. pts. | | | | | l. | s. | d. |
|---|---|---|---|---|---|---|---|---|
| at | 5 p. c. is | 2 | 3 | 0 | 4 | 27 | 16 | 8 |
| | 6 p. c. is | 2 | 0 | 0 | 2 | 20 | 03 | 4 |
| | 8 p. c. is | 1 | 0 | 1 | 3 | 11 | 01 | 8 |
| | 10 p. c. is | 0 | 2 | 1 | 4 | 6 | 03 | 4 |
| | 12 p. c. is | 0 | 1 | 1 | 1 | 3 | 08 | 4 |

Which by the Table of Red. at 10 *l.* yearly Rent is

The Years *in eſſe*, as was ſaid before, are valued as a Leaſe of ſo many Years, as in a Leaſe for 40 Years, if 14 Years are run out, then there are 26 *in eſſe*, whoſe Value are as a Leaſe of 26 Years, and may be found by the Table for Purchaſing, &c.

The Value of ſome of the Years in Reverſion, may be found in this Leaſe, by the ſame Rules that they were found by in the foregoing Leaſes; as if it were required to find the Value of 6 of the 14 Years in Reverſion in this Leaſe of 40 Years, then becauſe 6 wants 8 of 14, I take the Value of 8 Years in Reverſion from the Value of 14 in Reverſion, and the Remainder is the Value of the 6 Years required, which will make the Leaſe up to 32 Years.

A Table

## A Table for the Renewing of any Number of Years lapſed in a Leaſe for 20 Years.

| Years Lapſed. | 5 per Cent. | | | | 6 per Cent. | | | | 8 per Cent. | | | | 10 per Cent. | | | | 12 per Cent. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Decimal Parts. | | | | Decimal Parts. | | | | Decimal Parts. | | | | Decimal Parts. | | | | Decimal Parts. | | | |
| | Months. | | | | Months. | | | | Months. | | | | Months. | | | | Months. | | | |
| | Quarters. | | | | Quarters. | | | | Quarters. | | | | Quarters. | | | | Quarters. | | | |
| | Years. | | | | Years. | | | | Years. | | | | Years. | | | | Years. | | | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| 4 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 |
| 5 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 6 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| 7 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 |
| 8 | 0 | 0 | 1 | 3 | 0 | 0 | 1 | 3 | 0 | 0 | 1 | 3 | 0 | 0 | 1 | 3 | 0 | 0 | 1 | 3 |
| 9 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 |
| 10 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | 1 |
| 11 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 2 |
| 12 | 0 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 0 | 0 | 2 | 3 | 0 | 0 | 2 | 3 |
| 13 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 0 | 0 |
| 14 | 0 | 0 | 3 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 1 |
| 15 | 0 | 0 | 3 | 2 | 0 | 0 | 3 | 2 | 0 | 0 | 3 | 2 | 0 | 0 | 3 | 2 | 0 | 1 | 0 | 2 |
| 16 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 3 | 0 | 1 | 0 | 3 |
| 17 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 18 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 19 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 1 | 1 | 2 |
| 20 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 0 | 1 | 1 | 3 |
| 21 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 | 0 |
| 22 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 2 | 0 | 1 |
| 23 | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 1 | 1 | 2 | 0 | 2 | 0 | 2 |
| 24 | 0 | 1 | 1 | 3 | 0 | 1 | 1 | 3 | 0 | 1 | 1 | 3 | 0 | 1 | 1 | 3 | 0 | 2 | 0 | 3 |
| 25 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 0 |
| 26 | 0 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 0 | 1 | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 1 |
| 27 | 0 | 1 | 2 | 2 | 0 | 1 | 2 | 2 | 0 | 1 | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 1 | 2 |
| 28 | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 | 0 | 2 | 0 | 3 | 0 | 2 | 1 | 3 |
| 29 | 0 | 1 | 3 | 0 | 0 | 1 | 3 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 3 | 0 | 0 |
| 30 | 0 | 1 | 3 | 1 | 0 | 1 | 3 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 1 | 0 | 3 | 0 | 1 |
| 31 | 0 | 1 | 3 | 2 | 0 | 1 | 3 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 3 | 0 | 2 |
| 32 | 0 | 1 | 3 | 3 | 0 | 1 | 3 | 3 | 0 | 2 | 0 | 3 | 0 | 2 | 1 | 3 | 0 | 3 | 0 | 3 |
| 33 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 1 | 0 |
| 34 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 1 | 1 |
| 35 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 3 | 0 | 2 | 0 | 3 | 1 | 2 |
| 36 | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 3 | 0 | 2 | 1 | 3 | 0 | 3 | 0 | 3 | 0 | 3 | 1 | 3 |
| 37 | 0 | 2 | 1 | 0 | 0 | 2 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 4 | 2 | 0 |
| 38 | 0 | 2 | 1 | 1 | 0 | 2 | 1 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 1 | 1 | 0 | 4 | 2 | 1 |
| 39 | 0 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 0 | 3 | 0 | 2 | 0 | 3 | 1 | 2 | 0 | 4 | 2 | 2 |
| | Total Value. | | | | Total Value. | | | | T tal Value. | | | | Total Value. | | | | Total Value. | | | |
| | 17 | 0 | 1 | 7 | 15 | 0 | 0 | 3 | 11 | 3 | 2 | 0 | 9 | 3 | 0 | 2 | 8 | 0 | 2 | 8 |

## A Table for the Renewing of any Number of Years lapſed in a Leaſe for 20 Years.

| Years Lapſed. | 17 l. 18 s. per Cent. | | | | 5 per Cent. | | | | 6 per Cent. | | | | 8 per Cent. | | | | 10 per Cent. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Decimal Parts. | Months. | Quarters. | Years. | Decimal Parts. | Months. | Quarters. | Years. | Decimal Parts. | Months. | Quarters. | Years. | Decimal Parts. | Months. | Quarters. | Years. | Decimal Parts. | Months. | Quarters. | Years. |
| 1 | 3 | 9 | 2 | 0 | 4 | 7 | 2 | 0 | 7 | 8 | 2 | 0 | 5 | 6 | 2 | 0 | 6 | 7 | 2 | 0 |
| 2 | 6 | 6 | 1 | 0 | 9 | 2 | 1 | 0 | 3 | 4 | 1 | 0 | 1 | 1 | 1 | 0 | 3 | 4 | 1 | 0 |
| 3 | 9 | 3 | 3 | 0 | 3 | 0 | 3 | 0 | 8 | 1 | 3 | 0 | 6 | 7 | 3 | 0 | 9 | 1 | 3 | 0 |
| 4 | 0 | 0 | 2 | 1 | 7 | 7 | 0 | 1 | 4 | 7 | 0 | 1 | 2 | 2 | 0 | 1 | 6 | 8 | 0 | 1 |
| 5 | 2 | 9 | 1 | 1 | 2 | 5 | 1 | 1 | 9 | 4 | 1 | 1 | 7 | 8 | 1 | 1 | 2 | 5 | 1 | 1 |
| 6 | 5 | 6 | 0 | 1 | 5 | 2 | 2 | 1 | 5 | 0 | 2 | 1 | 3 | 3 | 2 | 1 | 9 | 2 | 2 | 1 |
| 7 | 8 | 3 | 3 | 1 | 8 | 0 | 3 | 1 | 0 | 7 | 3 | 1 | 8 | 9 | 3 | 1 | 5 | 9 | 3 | 1 |
| 8 | 1 | 0 | 2 | 2 | 0 | 5 | 0 | 2 | 6 | 3 | 0 | 2 | 4 | 4 | 0 | 2 | 2 | 6 | 0 | 2 |
| 9 | 3 | 9 | 1 | 2 | 3 | 3 | 1 | 2 | 1 | 9 | 1 | 2 | 0 | 0 | 1 | 2 | 8 | 3 | 1 | 2 |
| 10 | 6 | 6 | 0 | 2 | 6 | 0 | 2 | 2 | 7 | 6 | 2 | 2 | 5 | 6 | 2 | 2 | 5 | 0 | 2 | 2 |
| 11 | 9 | 3 | 3 | 2 | 8 | 8 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 1 | 7 | 3 | 2 |
| 12 | 0 | 0 | 2 | 3 | 1 | 5 | 0 | 3 | 8 | 9 | 0 | 3 | 6 | 8 | 0 | 3 | 8 | 4 | 0 | 3 |
| 13 | 2 | 9 | 1 | 3 | 4 | 3 | 1 | 3 | 3 | 5 | 1 | 3 | 2 | 3 | 1 | 3 | 4 | 1 | 1 | 3 |
| 14 | 5 | 6 | 0 | 3 | 7 | 0 | 2 | 3 | 9 | 2 | 2 | 3 | 7 | 9 | 2 | 3 | 1 | 8 | 2 | 3 |
| 15 | 8 | 3 | 3 | 3 | 9 | 8 | 3 | 3 | 4 | 8 | 3 | 3 | 3 | 4 | 3 | 3 | 7 | 5 | 3 | 3 |
| 16 | 1 | 0 | 2 | 4 | 2 | 5 | 0 | 4 | 0 | 5 | 0 | 4 | 8 | 0 | 0 | 4 | 4 | 2 | 0 | 4 |
| 17 | 3 | 9 | 1 | 4 | 5 | 3 | 1 | 4 | 5 | 1 | 1 | 4 | 4 | 5 | 1 | 4 | 0 | 9 | 1 | 4 |
| 18 | 6 | 6 | 0 | 4 | 8 | 0 | 2 | 4 | 1 | 8 | 2 | 4 | 9 | 1 | 2 | 4 | 5 | 6 | 2 | 4 |
| 19 | 9 | 3 | 3 | 4 | 0 | 8 | 3 | 4 | 6 | 4 | 3 | 4 | 9 | 6 | 3 | 4 | 1 | 3 | 3 | 4 |
| 20 | 0 | 0 | 2 | 5 | 3 | 5 | 0 | 5 | 7 | 1 | 0 | 5 | 0 | 2 | 0 | 5 | 6 | 0 | 0 | 5 |

This being the laſt Table for Renewing of Leaſes, is for the Term of 10 Years: The Firſt part thereof is calculated according to the Rate of about 17 *l.* 18 *s. per Cent.* ſo that the Fine for renewing 4 Years lapſed is one Years Value, but at other Rates of Intereſt, the Fine for renewing 4 Years lapſed, is by the Table as followeth, *viz.* the Fine for renewing 4 Years lapſed

| | *Y.* | *Q.* | *M.* | *D.p.* | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|
| at 5 *p. c.* is | 2 | 2 | 1 | 7 | Which by the Table of Reduction at 10 *l. per Ann.* | 26 | 68 | 4 |
| at 6 *p. c.* is | 2 | 1 | 2 | 3 | | 24 | 68 | 4 |
| at 8 *p. c.* is | 2 | 0 | 1 | 0 | | 20 | 16 | 8 |
| at 10 *p. c.* is | 1 | 3 | 0 | 4 | | 17 | 16 | 8 |

The Years *in eſſe* are valued as before directed in the other Leaſes; as if there be 4 Years run out in this Leaſe of 10 Years, then there are 6 Years *in eſſe*, whoſe Value are as a Leaſe of 6 Years, *&c.*

The next Table is for the Reduction of the Values given in Years, Quarters, Months, and Decimal Parts of a Month, into Pounds, Shillings, and Pence, the Uſe of it is very plain and eaſie, as by Example will appear.

*Example.*

Suppoſe the Fine for renewing any Number of Years lapſed, in any Leaſe to be 6 *y.* 2 *q.* 2 *m.* 4 *d.p.* and the yearly Rent 55 *l.* What is this Fine in Pounds, Shillings, and Pence? Then by the Table I find

| | | *l.* | *s.* | *d.* |
|---|---|---|---|---|
| againſt 50 *l.* | under 2 Quarters | 25 | 00 | 0 |
| | under 2 Months | 8 | 06 | 8 |
| | under 4 Dec. parts | 1 | 13 | 4 |
| againſt 5 *l.* | under 2 Quarters | 2 | 10 | 0 |
| | under 2 Months | 0 | 16 | 8 |
| | under 4 Dec. parts | 0 | 03 | 4 |
| | Summ of all is | 38 | 10 | 0 |
| Then for the 6 years Value I ſay, 6 times 55 *l.* is 330 *l.* which added to 38 *l.* 10 *s.* 0 *d.* the Summ is | | 330 | 00 | 0 |
| | | 368 | 00 | 0 |

Which is the Value reduced into Pounds, Shillings, and Pence required.

Suppoſe again the Fine for renewing any Number of Years lapſed in any Leaſe, to be 2 *y.* 3 *q.* 2 *m* 9 *d. p.* and yearly Rent 156 *l.* then what is this Fine in Money? For Anſwer I ſay, twice 156 is 312 *l.* which is the 2 years Value, then by the Table I find

| | | | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|
| againſt 100 *l.* | under 3 | Quarters | 75 | 00 | 0 |
| | under 2 | Months | 16 | 13 | 4 |
| | under 5 | Dec. parts | 4 | 03 | 4 |
| | under 4 | Dec. parts | 3 | 06 | 8 |
| againſt 50 *l.* | under 3 | Quarters | 37 | 10 | 0 |
| | under 2 | Months | 8 | 06 | 4 |
| | under 5 | Dec. parts | 2 | 01 | 8 |
| | under 4 | Dec. parts | 1 | 13 | 4 |
| againſt 6 *l.* | under 3 | Quarters | 4 | 10 | 0 |
| | under 2 | Months | 1 | 00 | 0 |
| | under 5 | Dec. parts | 0 | 05 | 0 |
| | under 4 | Dec. parts | 0 | 04 | 0 |
| | Summ is | | 154 | 13 | 8 |
| The 2 years Value add, *viz.* | | | 312 | 00 | 0 |
| | The Summ is | | 466 | 13 | 8 |

Which is the Fine reduced into Money required. In like manner is any other Fine reduced, at any other yearly Rent from 1 *l.* to 600 *l.* a Year, or if it be more, it is but adding, after the ſame manner as is done in the Examples, as ſuppoſe the Rent to be 700 *l. per Ann.* then I muſt find the Values for 600 *l.* and for 100 *l.* and add them together, *&c.*

A Table

A Table for the Reduction of the Values given in Years, Quarters, Months, and Decimal Parts of a Month, into Pounds, Shillings, and Pence.

| Yearly Rent. | 3 Quarters. | 2 Quarter. | 1 Quarter | 2 Months. | 1 Month. | 1 Dec. part. | 2 Dec. part. | 3 Dec. part. | 4 Dec. part. | 5 Dec. part. |
|---|---|---|---|---|---|---|---|---|---|---|
| | l. s. d. | l. s. d. | . s. d | l. s. d. | l. s. d | l. s. d. | l. s. d | l. s. d. | l. s. d. | l. s. d. |
| 1 | 0 15 0 | 0 10 0 | 0 0 0 | 0 3 4 | 0 1 8 | 0 0 2 | 0 0 4 | 0 0 6 | 0 0 8 | 0 0 10 |
| 2 | 1 10 0 | 1 0 0 | 0 15 0 | 0 6 8 | 0 3 4 | 0 0 4 | 0 0 8 | 0 1 0 | 0 1 4 | 0 1 8 |
| 3 | 2 5 0 | 1 10 0 | 0 15 0 | 0 10 0 | 0 5 0 | 0 0 6 | 0 1 0 | 0 1 6 | 0 2 0 | 0 2 6 |
| 4 | 3 0 0 | 2 0 0 | 1 0 0 | 0 13 4 | 0 6 8 | 0 0 8 | 0 1 4 | 0 2 0 | 0 2 8 | 0 3 4 |
| 5 | 3 15 0 | 2 10 0 | 1 5 0 | 0 16 8 | 0 8 4 | 0 0 10 | 0 1 8 | 0 2 6 | 0 3 4 | 0 4 2 |
| 6 | 4 10 0 | 3 0 0 | 1 10 0 | 1 0 0 | 0 10 0 | 0 1 0 | 0 2 0 | 0 3 0 | 0 4 0 | 0 5 0 |
| 7 | 5 5 0 | 3 10 0 | 1 15 0 | 1 3 4 | 0 11 8 | 0 1 2 | 0 2 4 | 0 3 6 | 0 4 8 | 0 5 10 |
| 8 | 6 0 0 | 4 0 0 | 2 0 0 | 1 6 8 | 0 13 4 | 0 1 4 | 0 2 8 | 0 4 0 | 0 5 4 | 0 6 8 |
| 9 | 6 15 0 | 4 10 0 | 2 5 0 | 1 10 0 | 0 15 0 | 0 1 6 | 0 3 0 | 0 4 6 | 0 6 0 | 0 7 6 |
| 10 | 7 10 0 | 5 0 0 | 2 10 0 | 1 13 4 | 0 16 8 | 0 1 8 | 0 3 4 | 0 5 0 | 0 6 8 | 0 8 4 |
| 20 | 15 0 0 | 10 0 0 | 5 0 0 | 3 6 8 | 1 13 4 | 0 3 4 | 0 6 8 | 0 10 0 | 0 13 4 | 0 16 8 |
| 30 | 22 10 0 | 15 0 0 | 7 10 0 | 5 0 0 | 2 10 0 | 0 5 0 | 0 10 0 | 0 15 0 | 1 0 0 | 1 5 0 |
| 40 | 30 0 0 | 20 0 0 | 10 0 0 | 6 13 4 | 3 6 8 | 0 6 8 | 0 13 4 | 1 0 0 | 1 6 8 | 1 13 4 |
| 50 | 37 10 0 | 25 0 0 | 12 10 0 | 8 6 8 | 4 3 4 | 0 8 4 | 0 16 8 | 1 5 0 | 1 13 4 | 2 1 8 |
| 60 | 45 0 0 | 30 0 0 | 15 0 0 | 10 0 0 | 5 0 0 | 0 10 0 | 1 0 0 | 1 10 0 | 2 0 0 | 2 10 0 |
| 70 | 52 10 0 | 35 0 0 | 17 10 0 | 11 13 4 | 5 16 8 | 0 11 8 | 1 3 4 | 1 15 0 | 2 6 8 | 2 18 4 |
| 80 | 60 0 0 | 40 0 0 | 20 0 0 | 13 6 8 | 6 13 4 | 0 13 4 | 1 6 8 | 2 0 0 | 2 13 4 | 3 6 8 |
| 90 | 67 10 0 | 45 0 0 | 22 10 0 | 15 0 0 | 7 10 0 | 0 15 0 | 1 10 0 | 2 5 0 | 3 0 0 | 3 15 0 |
| 100 | 75 0 0 | 50 0 0 | 25 0 0 | 16 13 4 | 8 6 8 | 0 16 8 | 1 13 4 | 2 10 0 | 3 6 8 | 4 3 4 |
| 200 | 150 0 0 | 100 0 0 | 50 0 0 | 33 6 8 | 16 13 4 | 1 13 4 | 3 6 8 | 5 0 0 | 6 13 4 | 8 6 8 |
| 300 | 225 0 0 | 150 0 0 | 75 0 0 | 50 0 0 | 25 0 0 | 2 10 0 | 5 0 0 | 7 10 0 | 10 0 0 | 12 10 0 |
| 400 | 300 0 0 | 200 0 0 | 100 0 4 | 66 13 4 | 33 6 8 | 3 6 8 | 6 13 4 | 10 0 0 | 13 6 8 | 16 13 4 |
| 500 | 375 0 0 | 250 0 0 | 125 0 0 | 83 6 8 | 41 13 4 | 4 3 4 | 8 6 8 | 12 10 0 | 16 13 4 | 20 16 8 |
| 600 | 450 0 0 | 300 0 0 | 150 0 0 | 100 0 0 | 50 0 0 | 5 0 0 | 10 0 0 | 15 0 0 | 20 0 0 | 25 0 0 |

The way of purchasing by Lives was commonly to reckon one Life as a Lease of 7 Years, two Lives as a Lease of 14 Years, and three Lives as a Lease of 21 Years: But this way seeming Unequal, there is another way which is more agreeable to Reason, and it is this, *viz.* for every Life to decrease one Year, as if one Life be reckoned as a Lease for 10 Years, then two will be as a Lease of 19, and three as a Lease of 27 Years, *&c.* so that at 7 *l. per Cent.* one Life is reckoned worth a little above 7 Years Purchase, two Lives 10 Years, 1 Quarter, and 1 Month's Purchase, *&c.* as the Table for purchasing of Lives sheweth.

So if you reckon one Life as a Lease of 9 Years, then two will be as a Lease of 17, three as a Lease of 24, *&c.* as is evident by the Table; and one Life will be worth above 6 Years and 2 Quarters Purchase, 2 Lives 9 Years and 3 Quarters Purchase, 3 Lives 11 Years, 1 Quarter, 2 Months, and 6 Decimal parts Purchase, *&c.*

So if one single Life be reckoned as a Lease of 12 Years, then two will be as a Lease of 23, three as a Lease of 33 Years, *&c.* so that at 6 *per Cent.* one Life is worth above 8 Years and a Quarters Purchase, two Lives above 12 Years and a Quarters Purchase, *&c.* as the Table shews.

Now suppose any of those Persons which have their Lives upon an Estate should die, to take in others to make up the Number again, is done by the Table of Reversions at the Beginning of the Book: Example, suppose there be three Lives upon an Estate, which at 7 Years Purchase for the first Life, are valued at almost 12 Years Purchase, and as a Lease of 27 Years, at 7 *l. per Cent.* and if one of those Persons should die, what must be given to make up the Number again? Then I say, one Life which is dead was as a Lease of 10 Years, and therefore to take in a New Life, I may reckon 10 Years of the 27 lapsed, and so take as it were a Fine for renewing 10 Years lapsed in a Lease of 27 Years: now to find this Fine, I take the Summ of the Reversions for 10 Years in the Table under 7 *l. per Cent.* counting 27 as 1, 26 as 2, and 25 as 3, *&c.* And so I find the Summ to be 2 *l.* 4 *s.* 5 *d.* 2 *q.* that is two Years, and almost one Quarters Purchase, which I may take for renewing or taking in a New Life; so if two Lives be dead I may reckon 19 Years lapsed in a Lease of 27 Years, and find the Summ of the Reversions for 19 Years, for a Fine for taking in two Lives: But if there be 4 Lives upon the Estate, then at 7 *l. per Cent.* and at 10 Years for one Life, they will be reckoned as a Lease of 34 Years, and so I must begin at 34 to summ the Reversions, or at 30 if one Life be reckoned as a Lease of 9 Years, and then if one Life be dead, I must reckon 9 Years lapsed in a Lease of 30 Years, if two Lives are dead I must reckon 17 Years lapsed in the same Lease, and if three are dead I must reckon 24 lapsed: So at 6 *l. per Cent.*

## A Table for the Purchasing of Lives.

| Number of Lives. | Number of Years. | What they are worth at 7 *l.* per Cent | | | |
|---|---|---|---|---|---|
| | | Years. | Quarters. | Months. | Dec. parts |
| 1 | 10 | 7 | 0 | 0 | 3 |
| 2 | 19 | 10 | 1 | 1 | 0 |
| 3 | 27 | 11 | 3 | 2 | 1 |
| 4 | 34 | 12 | 3 | 1 | 0 |
| 5 | 40 | 13 | 2 | 0 | 1 |
| 6 | 45 | 13 | 2 | 1 | 0 |
| 7 | 49 | 13 | 3 | 0 | 2 |
| 8 | 52 | 13 | 3 | 1 | 3 |
| 9 | 54 | 13 | 3 | 1 | 6 |

| Number of Lives. | Number of Years. | What they are worth at 7 *l.* per Cent. | | | |
|---|---|---|---|---|---|
| | | Years. | Quarters. | Months | Dec. parts |
| 1 | 9 | 6 | 2 | 0 | 2 |
| 2 | 17 | 9 | 3 | 0 | 2 |
| 3 | 24 | 11 | 3 | 1 | 1 |
| 4 | 30 | 12 | 1 | 1 | 0 |
| 5 | 35 | 12 | 3 | 2 | 2 |
| 6 | 39 | 13 | 1 | 0 | 1 |
| 7 | 42 | 13 | 1 | 2 | 4 |
| 8 | 44 | 13 | 2 | 0 | 6 |
| 9 | 45 | 13 | 2 | 1 | 2 |

| Number of Lives. | Number of Years. | What they are worth at 6 *l.* per Cent. | | | |
|---|---|---|---|---|---|
| | | Years. | Quarters. | Months. | Dec. parts |
| 1 | 12 | 8 | 1 | 1 | 6 |
| 2 | 23 | 12 | 1 | 0 | 6 |
| 3 | 33 | 14 | 1 | 2 | 6 |
| 4 | 42 | 15 | 1 | 0 | 7 |
| 5 | 50 | 15 | 2 | 2 | 7 |
| 6 | 57 | 16 | 0 | 0 | 8 |
| 7 | 63 | 16 | 0 | 2 | 8 |
| 8 | 68 | 16 | 1 | 1 | 2 |
| 9 | 72 | 16 | 1 | 2 | 0 |

reckoning one Life as a Leaſe of 12 Years, three Lives are as a Leaſe of 33 Years, and ſo if one of theſe Lives be dead, I may reckon 12 Years lapſed in a Leaſe of 33 Years, if two Lives are dead, I may reckon 23 Years lapſed in the ſame Leaſe, and begin at 33 to ſumm the Reverſions, under 6 *l. per Cent.* becauſe the Lives are valued according to the ſame Rate of Intereſt. This being underſtood, it will not be difficult to do the like for any other Number of Lives, and at other Rates of Intereſt, and Number of Years for one Life; for you may by the Table for purchaſing of Leaſes, *&c.* make Tables for purchaſing of Lives according to what Rate of Intereſt you think is moſt convenient; as ſuppoſe you reckon one Life as a Leaſe of 10 Years, and you would have 5 *l. per Cent.* profit, then that will be worth 7 Years and almoſt 3 Quarters Purchaſe, but at 8 *l. per Cent.* it is worth but 6 Years and almoſt 3 Quarters Purchaſe, *&c.*

The Table for purchaſing is calculated for ſeveral Rates of Intereſt, that ſo the Purchaſer may uſe that which is moſt convenient for him, as in purchaſing of Free-hold Land, 5 *l. per Cent.* may be enough, but for Copy hold or Leaſes of Land 6 *l. per Cent.* for Leaſes of Land and good Houſes 8 *l. per Cent.* and for Leaſes of ordinary Houſes 10 *l.* or 12 *l. per Cent.*

The Uſe of the Table is very plain and eaſie, as by Example will appear, *viz.*

*Example.*

What is a Leaſe or Annuity of 20 Years worth at 5, 6, 8, 10, or 12 *per Cent. per Annum?*

| A Leaſe for 20 Years at | p. c. is worth | *Y. Q. M. D. p.* | | | | | Which at 20 *l. per Ann.* Rent is | *l.* | *s.* | *d.* |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | 12 | 1 | 2 | 5 | | | 249 | 3 | 4 |
| 6 | | 11 | 1 | 2 | 6 | | | 229 | 6 | 8 |
| 8 | | 9 | 3 | 0 | 8 | | | 196 | 6 | 8 |
| 10 | | 8 | 2 | 0 | 1 | | | 170 | 3 | 4 |
| 12 | | 7 | 1 | 2 | 6 | | | 149 | 6 | 8 |

To increaſe the Number of Years in a Leaſe do thus: Suppoſe a Landlord would make a Leaſe of Land up to 40 Years, wherein his Tenant hath 20 Years to come, what is it worth? Then I ſay,

| | *Y.* | *Q.* | *M.* | *D.* | *p.* |
|---|---|---|---|---|---|
| A Leaſe for 4 Years at 6 *per Cent.* is worth | 15 | 0 | 0 | 3 | |
| 20 Years at the ſame Rate are worth | 11 | 1 | 2 | 6 | |
| Which ſubtract | | | | | |
| The Remainder is | 3 | 2 | 0 | 7 | |

Which is the Fine to be given to make the Leaſe up to 40 Years.

To buy a Leaſe which is not to begin until your old Leaſe is out; as thus, ſuppoſe a Man's Leaſe is out within 4 Years, and he deſires to have a New Leaſe of 21 Years, to begin when his 4 Years are out, what is this Leaſe worth in ready Money?

For Anſwer, I add 4 Years which is the Time he hath in his old Leaſe, and 21 together, the Summ is 25, then I find the Worth of theſe 25 Years, and ſubtract from it the Value of the 4 Years, the Remainder is the Value of the ſaid Leaſe in ready Money.

*Example.*

| | *Y.* | *Q.* | *M.* | *D.* | *p.* |
|---|---|---|---|---|---|
| A Leaſe for 25 Years at 6 *l. per Cent.* is worth | 12 | 3 | 0 | 3 | |
| The 4 Years at the ſame Rate are worth | 3 | 1 | 2 | 6 | |
| Which ſubtract | | | | | |
| The Remainder is the Value of the Leaſe in ready Money required, *viz.* | 9 | 1 | 0 | 7 | |

A Table ſhewing how many Years, Quarters, Months, and Decimal Parts of a Months Purchaſe, any Annuity or Leaſe of any Land or Houſe is worth, according to ſeveral Rates of Intereſt, *viz.* according to 5, 6, 8, 10 and 12 *per Cent.*

| Number of Years to be purchaſed. | 5 *per Cent.* Years. | Quarters. | Months. | Decimal Parts. | 6 *per Cent.* Years. | Quarters. | Months. | Decimal Parts. | 8 *per Cent.* Years. | Quarters. | Months. | Decimal Parts. | 10 *per Cent.* Years. | Quarters. | Months. | Decimal Parts. | 12 *per Cent.* Years. | Quarters. | Months. | Decimal Parts. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 2 | 3345 | 0 | 1 | 2 | 3478 | 0 | 1 | 2 | 3712 | 0 | 1 | 2 | 3945 | 0 | 1 | 2 | 4178 |
| 2 | 0 | 2 | 3 | 6690 | 0 | 2 | 3 | 6956 | 0 | 2 | 3 | 7224 | 0 | 2 | 3 | 7491 | 0 | 2 | 3 | 7758 |
| 3 | 1 | 0 | 0 | 0035 | 1 | 0 | 0 | 0434 | 1 | 0 | 0 | 0835 | 1 | 0 | 0 | 1235 | 1 | 0 | 0 | 1635 |
| 4 | 1 | 1 | 0 | 3380 | 1 | 1 | 0 | 3912 | 1 | 1 | 0 | 4447 | 1 | 1 | 0 | 4980 | 1 | 1 | 0 | 5513 |
| 5 | 1 | 2 | 0 | 6725 | 1 | 2 | 0 | 7390 | 1 | 2 | 0 | 8059 | 1 | 2 | 0 | 8726 | 1 | 2 | 0 | 9391 |
| 6 | 1 | 3 | 0 | 0070 | 1 | 3 | 0 | 0868 | 1 | 3 | 0 | 1671 | 1 | 3 | 0 | 2471 | 1 | 3 | 0 | 3269 |
| 7 | 2 | 0 | 0 | 3415 | 2 | 0 | 0 | 4346 | 2 | 0 | 0 | 5283 | 2 | 0 | 0 | 6216 | 2 | 0 | 0 | 7147 |
| 8 | 2 | 1 | 0 | 6760 | 2 | 1 | 0 | 7824 | 2 | 1 | 0 | 8895 | 2 | 1 | 0 | 9961 | 3 | 0 | 0 | 1025 |
| 9 | 2 | 2 | 0 | 0105 | 2 | 2 | 0 | 1302 | 2 | 2 | 0 | 2507 | 2 | 2 | 0 | 3706 | 2 | 2 | 0 | 4903 |
| 10 | 2 | 3 | 0 | 3450 | 2 | 3 | 0 | 4780 | 2 | 3 | 0 | 6119 | 2 | 3 | 0 | 7451 | 2 | 3 | 0 | 8781 |
| 11 | 3 | 0 | 0 | 6795 | 3 | 0 | 0 | 0258 | 3 | 0 | 0 | 1731 | 3 | 0 | 0 | 3196 | 3 | 0 | 0 | 4659 |
| 12 | 3 | 1 | 0 | 0140 | 3 | 1 | 0 | 3736 | 3 | 1 | 0 | 5343 | 3 | 1 | 0 | 6941 | 3 | 1 | 0 | 8537 |
| 13 | 3 | 2 | 0 | 3485 | 3 | 2 | 0 | 7214 | 3 | 2 | 0 | 8955 | 3 | 2 | 0 | 0686 | 4 | 0 | 0 | 2415 |
| 14 | 3 | 3 | 0 | 6830 | 3 | 3 | 0 | 0692 | 3 | 3 | 0 | 2567 | 3 | 3 | 0 | 4431 | 4 | 1 | 0 | 6293 |
| 15 | 4 | 0 | 0 | 0175 | 4 | 0 | 0 | 4170 | 4 | 0 | 0 | 6179 | 4 | 0 | 0 | 8176 | 4 | 2 | 0 | 0171 |
| 16 | 4 | 1 | 0 | 3520 | 4 | 1 | 0 | 7648 | 4 | 1 | 0 | 9791 | 4 | 1 | 0 | 1921 | 4 | 3 | 0 | 4049 |
| 17 | 4 | 2 | 0 | 6865 | 4 | 2 | 0 | 1126 | 4 | 2 | 0 | 3403 | 4 | 2 | 0 | 5666 | 4 | 3 | 0 | 7927 |
| 18 | 4 | 3 | 0 | 0210 | 4 | 3 | 0 | 4604 | 4 | 3 | 0 | 7015 | 4 | 3 | 0 | 9411 | 5 | 0 | 0 | 1805 |
| 19 | 5 | 0 | 0 | 3555 | 5 | 0 | 0 | 8082 | 5 | 0 | 0 | 0627 | 5 | 0 | 0 | 3156 | 5 | 1 | 0 | 5683 |
| 20 | 5 | 1 | 0 | 6900 | 5 | 1 | 0 | 1560 | 5 | 1 | 0 | 4239 | 5 | 1 | 0 | 6901 | 5 | 2 | 0 | 9561 |
| 21 | 5 | 2 | 0 | 0245 | 5 | 2 | 0 | 5038 | 5 | 2 | 0 | 7851 | 5 | 2 | 0 | 0646 | 6 | 0 | 0 | 3439 |
| 22 | 5 | 3 | 0 | 3590 | 5 | 3 | 0 | 8516 | 5 | 3 | 0 | 1463 | 5 | 3 | 0 | 4391 | 6 | 1 | 0 | 7317 |
| 23 | 6 | 0 | 0 | 6935 | 6 | 0 | 0 | 1994 | 6 | 0 | 0 | 5075 | 6 | 0 | 0 | 8136 | 6 | 3 | 0 | 1195 |
| 24 | 6 | 1 | 0 | 0280 | 6 | 1 | 0 | 5472 | 6 | 1 | 0 | 8687 | 6 | 1 | 0 | 1881 | 7 | 0 | 0 | 5073 |
| 25 | 6 | 2 | 0 | 3625 | 6 | 2 | 0 | 8950 | 6 | 2 | 0 | 2299 | 6 | 2 | 0 | 5626 | 7 | 1 | 0 | 8951 |
| 26 | 6 | 3 | 0 | 6970 | 6 | 3 | 0 | 2428 | 6 | 3 | 0 | 5911 | 6 | 3 | 0 | 9371 | 7 | 3 | 0 | 2829 |
| 27 | 7 | 0 | 0 | 0315 | 7 | 0 | 0 | 5906 | 7 | 0 | 0 | 9523 | 7 | 0 | 0 | 3116 | 8 | 0 | 0 | 6707 |
| 28 | 7 | 1 | 0 | 3660 | 7 | 1 | 0 | 9384 | 7 | 1 | 0 | 3135 | 7 | 1 | 0 | 6861 | 8 | 1 | 0 | 0585 |
| 29 | 7 | 2 | 0 | 7005 | 7 | 2 | 0 | 2862 | 7 | 2 | 0 | 6747 | 7 | 2 | 0 | 0606 | 8 | 2 | 0 | 4463 |
| 30 | 7 | 3 | 0 | 0350 | 7 | 3 | 0 | 6340 | 7 | 3 | 0 | 0359 | 7 | 3 | 0 | 4351 | 8 | 3 | 0 | 8341 |
| 31 | 8 | 0 | 0 | 3695 | 8 | 0 | 0 | 9818 | 8 | 0 | 0 | 3971 | 8 | 0 | 0 | 8096 | 9 | 0 | 0 | 2219 |
| 40 | 8 | 3 | 0 | 6740 | 8 | 3 | 0 | 3296 | 8 | 3 | 0 | 8583 | 9 | 0 | 0 | 3871 | 9 | 3 | 0 | 8097 |
| 50 | 9 | 3 | 0 | 6585 | 9 | 3 | 0 | 3174 | 9 | 3 | 0 | 8163 | 10 | 0 | 0 | 3151 | 11 | 0 | 0 | 8139 |
| 60 | 10 | 3 | 0 | 6430 | 10 | 3 | 0 | 3052 | 10 | 3 | 0 | 7743 | 11 | 0 | 0 | 2431 | 12 | 2 | 0 | 8181 |
| 70 | 11 | 3 | 0 | 6275 | 11 | 3 | 0 | 2930 | 11 | 3 | 0 | 7323 | 12 | 0 | 0 | 1711 | 14 | 1 | 0 | 8223 |
| 80 | 12 | 3 | 0 | 6120 | 12 | 3 | 0 | 2808 | 12 | 3 | 0 | 6903 | 13 | 0 | 0 | 0991 | 16 | 0 | 0 | 8265 |
| 90 | 13 | 3 | 0 | 5965 | 13 | 3 | 0 | 2686 | 13 | 3 | 0 | 6483 | 14 | 0 | 0 | 0271 | 17 | 3 | 0 | 8307 |
| | Fee Simple. | | | | Fee Simple. | | | | Fee Simple. | | | | Fee Simple. | | | | Fee Simple. | | | |
| | 20 | 0 | 0 | 0 | 16 | 2 | 2 | 0 | 12 | 2 | 0 | 0 | 10 | 0 | 0 | 0 | 8 | 1 | 1 | 0 |

How

*How to buy the Reverſion of any Leaſe or Annuity.*

Although this may be done by the Table of Reverſions at the Beginning of the Book, yet I think it will not be amiſs, if I ſhew how it may be done by the Tables of Purchaſing alſo.

Suppoſe you are to buy the Reverſion of a Leaſe after 6 Years, that is, if it be 6 Years before you commence, what is the preſent Worth of a Leaſe ſuppoſe of 30 Years at 6 *per Centum*? Then for Anſwer look the Value of the whole Leaſe, which

| | *Y.* | *Q.* | *M.* | *D.* | *p.* |
|---|---|---|---|---|---|
| will be found to be | 13 | 3 | 0 | 1 | |
| Then find the Value of the 6 Years which will be | 4 | 3 | 2 | 0 | |
| Which ſubtract | | | | | |
| The Remainder in the Value of the Reverſion required, *viz.* | 8 | 3 | 1 | 1 | |

The Value of the Years lapſed or in Reverſion of any Leaſe, may alſo be found by the Table for purchaſing; for the Value of the Years *in eſſe*, ſubtracted from the Value of the whole Leaſe, the remainder is the Value of the Years in Reverſion, as is ſhewed in the Preface; therefore, ſuppoſe in a Leaſe of 31 Years there be 12 Years lapſed, what muſt be given to renew this Leaſe again at 6 *per Centum*? Then I find the Value of

| | *Y.* | *Q.* | *M.* | *D.* | *p.* |
|---|---|---|---|---|---|
| the whole Leaſe to be | 13 | 3 | 2 | 2 | |
| And becauſe there are 12 Years lapſed, there are 18 Years *in eſſe* whoſe Value is | 10 | 3 | 0 | 9 | |
| Which ſubtract | | | | | |
| The Remainder is the Value of the Years in Reverſion required, *viz.* | 3 | 0 | 1 | 3 | |

| Years. | The increaſe of 1 *l.* yearly at 6 *per Cent.* | | | | The Value of 1 *l.* Annuity to be paid at the end thereof at 6 *l. per Cent.* | | | | What Annuity 1 *l.* ready Money will purchaſe at 6 *l. per Cent.* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *l.* | *s.* | *d.* | *q.* | *l.* | *s.* | *d.* | *q* | *l.* | *s.* | *d.* | *q.* |
| 1 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 0 |
| 2 | 1 | 2 | 5 | 2 | 2 | 1 | 2 | 0 | 0 | 10 | 6 | 0 |
| 3 | 1 | 3 | 9 | 3 | 3 | 3 | 8 | 0 | 0 | 7 | 6 | 0 |
| 4 | 1 | 5 | 3 | 0 | 4 | 7 | 5 | 3 | 0 | 5 | 9 | 0 |
| 5 | 1 | 6 | 9 | 0 | 5 | 12 | 8 | 3 | 0 | 4 | 9 | 0 |
| 6 | 1 | 8 | 4 | 1 | 6 | 19 | 6 | 1 | 0 | 4 | 2 | 0 |
| 7 | 1 | 10 | 0 | 3 | 8 | 7 | 10 | 1 | 0 | 3 | 7 | 0 |
| 8 | 1 | 11 | 10 | 2 | 9 | 17 | 11 | 1 | 0 | 3 | 2 | 0 |
| 9 | 1 | 13 | 9 | 1 | 11 | 9 | 9 | 3 | 0 | 2 | 11 | 0 |
| 10 | 1 | 15 | 9 | 3 | 13 | 3 | 7 | 0 | 0 | 2 | 8 | 0 |
| 11 | 1 | 17 | 11 | 2 | 14 | 19 | 5 | 0 | 0 | 2 | 6 | 1 |
| 12 | 2 | 0 | 3 | 0 | 16 | 17 | 4 | 2 | 0 | 2 | 4 | 2 |
| 13 | 2 | 2 | 7 | 3 | 18 | 17 | 7 | 2 | 0 | 2 | 3 | 0 |
| 14 | 2 | 5 | 2 | 2 | 21 | 0 | 3 | 2 | 0 | 2 | 1 | 3 |
| 15 | 2 | 7 | 11 | 0 | 23 | 5 | 6 | 0 | 0 | 2 | 0 | 2 |
| 16 | 2 | 10 | 9 | 2 | 25 | 1 | 5 | 0 | 0 | 1 | 11 | 2 |
| 17 | 2 | 13 | 10 | 0 | 28 | 4 | 3 | 0 | 0 | 1 | 10 | 3 |
| 18 | 2 | 17 | 1 | 0 | 30 | 18 | 1 | 0 | 0 | 1 | 10 | 0 |
| 19 | 3 | 0 | 6 | 0 | 33 | 15 | 2 | 0 | 0 | 1 | 9 | 1 |
| 20 | 3 | 4 | 2 | 0 | 36 | 15 | 8 | 0 | 0 | 1 | 8 | 3 |
| 21 | 3 | 7 | 11 | 3 | 39 | 19 | 10 | 0 | 0 | 1 | 8 | 3 |
| 22 | 3 | 12 | 0 | 3 | 43 | 7 | 10 | 0 | 0 | 1 | 7 | 3 |
| 23 | 3 | 16 | 4 | 2 | 46 | 19 | 10 | 0 | 0 | 1 | 7 | 1 |
| 24 | 4 | 0 | 11 | 2 | 50 | 16 | 3 | 2 | 0 | 1 | 7 | 0 |
| 25 | 4 | 5 | 10 | 0 | 54 | 17 | 3 | 1 | 0 | 1 | 6 | 2 |
| 26 | 4 | 10 | 11 | 3 | 59 | 3 | 1 | 0 | 0 | 1 | 6 | 1 |
| 27 | 4 | 16 | 5 | 1 | 63 | 14 | 1 | 0 | 0 | 1 | 6 | 0 |
| 28 | 5 | 2 | 2 | 3 | 68 | 10 | 6 | 2 | 0 | 1 | 5 | 3 |
| 29 | 5 | 8 | 4 | 0 | 73 | 12 | 9 | 1 | 0 | 1 | 5 | 2 |
| 30 | 5 | 14 | 10 | 0 | 79 | 1 | 2 | 0 | 0 | 1 | 5 | 1 |

The Uſe of theſe Tables aforegoing is eaſie, as by Example will appear.

The firſt is this, ſuppoſe 30 *l.* be put out for 20 Years, what will it amount unto in that time at *6 per Cent.* Compound Intereſt?

Then I look againſt 20 Years, and find under the Increaſe of 1 *l.* &c. 3 *l.* 4 *s.* 2 *d.* which ſhews that 1 *l.* in 20 Years time will increaſe to 3 *l.* 4 *s.* 2 *d.* which I multiply by 30 thus,

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 30 times 3 *l.* is | 90 | 0 | 0 |
| 30 times 4 *s.* is | 6 | 0 | 0 |
| 30 times 2 *d.* is | 0 | 5 | 0 |
| Summ | 96 | 5 | 0 |

That is, 30 *l.* in 20 Years time at *6 per Cent.* Compound Intereſt, will amount to 96 *l.* 5 *s.* 0 *d.*

The Uſe of the Second is thus, What will an Annuity of 30 *l.* forborn 20 Years amount to in that time? Then for Anſwer I look againſt 20 Years, and under the Value of 1 *l.* Annuity, &c. I find 36 *l.* 15 *s.* 8 *d.* which 36 *l.* 15 *s.* 8 *d.* is the Value of 1 *l.* Annuity forborn 20 Years, then I multiply 36 *l.* 15 *s.* 8 *d.* by 30 *l.* thus,

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 30 times 36 *l.* is | 1080 | 00 | 0 |
| 30 times 15 *s.* is | 22 | 10 | 0 |
| 30 times 8 *d.* is | 1 | 00 | 0 |
| Summ | 1103 | 10 | 0 |

That is, 36 *l.* Annuity forborn 20 Years will at the End of that Term amount to 1103 *l.* 10 *s.* 0 *d.*

The Uſe of the third Table is thus, ſuppoſe a Gentleman hath 300 *l.* by him, with which he's willing to purchaſe an Annuity for 20 Years. What Annuity will that purchaſe at *6 per Centum?* For Anſwer, I look againſt 20 Years, and find under *What Annuity* 1 *l. ready Money*, &c. 1 *s.* 8 *d.* 3 *q.* which ſhews that 1 *l.* ready Money will purchaſe an Annuity of 1 *s.* 8 *d* 3 *q.* for 20 Years, which I multiply by 300 *l.* thus,

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 300 Shillings are | 15 | 00 | 0 |
| 300 times 8 *d.* is | 10 | 00 | 0 |
| 300 times 3 *q.* is | 00 | 18 | 9 |
| Summ | 25 | 18 | 9 |

That is, 300 *l.* ready Money will purchaſe an Annuity of 25 *l.* 18 *s.* 9 *d.* for 20 Years at *6 per Cent.*

RENTS *of Aſſiſe* were the certain and determined Rents of Ancient Tenants, and were paid in a ſet Quantity of Money or Proviſions: They were ſo called, becauſe they were *aſſiſed*, and made certain; and ſo diſtinguiſhed from *Redditus Mobiles*, or ſuch variable Rents as did riſe and fall, like the Corn-rent now reſerved to Colleges.

RENTS *Reſolute*, are accounted among the Fee Farm-Rents, to be ſold by the Statutes of 22 *Car.* 2. c. 6. And are ſuch Rents or Tenths as were anciently payable to the Crown from the Lands of Abbies, and Religious Houſes: And after their Diſſolution, tho' the Lands were demiſed to others, yet the Rents were ſtill *Reſerved*, and made payable to the Crown.

REPELLING *Force*: That there is ſuch a thing in Nature, ſee *Attraction* towards the End.

REPLEVISH, Signifies in our Law the letting any one to *Main Priſe*, upon Surety, 3 *E.* 1. 11.

REPOSE, is a Term in Painting, ſignifying the Place where the *Maſſes*, or great Lights and Shadows are aſſembled: And this being well underſtood hinders the Confuſion of Objects; ſuffering not the View to be contracted altogether, but to proceed gradually and ſucceſſively without Diſturbance.

REPOSITION of the Foreſt, was an Act whereby certain Foreſt Lands being made *Purlion* upon *View*; were on a *Second View* laid to the Foreſt again. *Manwood, ph.* 1. p. 178.

REP. *Silver.* The Ancient Servile Tenants were bound to reap their Lord's Corn: But to be acquitted from this Duty, they ſometimes paid an Acknowledgment or Compoſition in Money, which Money was called by this Name of Rep-Silver.

REPULSE or *Reaction.* It is one of the Laws of Nature, (Sir *Iſ. Newton's* third) that *Repulſe* or *Reaction* is always equal to Impulſe or Action. That is, the Action of two Bodies one upon another, is always equal, but with a contrary Direction: in other words, the ſame Force with which one Body ſtrikes upon another, is returned back by that other on it, and the Forces are impreſſed with Directions directly contrary. Thus if one Body preſs or draw another, 'tis juſt as much preſt or drawn by it: If a Man preſs a Stone with his Hand, the Stone equally preſſes his Hand; if a Horſe draw forward any Weight by a Rope, the Weight equally draws back the Horſe: for the Rope being equally ſtretch'd both ways, acts upon both equally: So 'tis in all Blows and Strokes, the thing ſtruck (ſuppoſe with a Hammer) ſtrikes the Hammer with equal Force. The Iron draws the Load ſtone as much as the Load ſtone draws it; as will appear by Experiment, if you make them both flote in Water. Thus alſo in the Deſcent of heavy Bodies the Stone attracts the Earth, as much as the Earth the Stone; or the Earth *gravitates* as much towards the Stone, as it doth towards the Earth. For the Motions produced by both theſe Gravitations are equal in *both*: Only the Stone being very inconſiderable in reſpect of the Bulk of the Earth, the Velocity of the Earth towards the Stone muſt be ſo too, and conſequently inſenſible, in compariſon of the Motion of the Stone towards it. And ſo it is Univerſally, in all the Actions of Bodies: For if one Body act on another, and change its Motion any manner of way, that other Body will make the ſame Change in the Motion of this Body, but with a contrary Direction: So that by theſe Actions there are made equal Changes, not of the *Velocities* but of the Motion: For the Changes made on the Velocities in contrary Directi-

Directions, are in a *Reciprocal Proportion to the Bodies.*

REQUESTS, See Court of Requests in Vol. 1.

RESCRIPT in the Civil Law, is a Letter of the Emperour in answer to particular Persons who enquire the Law of him: But if it be sent to a Corporation or any Publick Body of Men who have consulted him, then they call it a *Pragmatick Sanction.*

RESEISER, is taking (or resuming) of Lands again into the Hands of the King, whereof a general *Livery*, or *Ouster le Maine*, was formerly miss sued, contrary to the Order and Form of Law: *Stanif. Prerog.* 26. see *Resumption.*

RESISTENCE of a *Fluid Medium*, The incomparable Sir *Is. Newton* at the End of the Lat. Edit. of his Opticks, *Qu.* 20. saith that the Resistence of Fluid Mediums arises partly from the *Attrition* of the Parts of the Medium; and partly from the *Vis Inertiæ Materiæ*, or Inactivity of Matter. And supposing a Body to be perfectly spherical, the Resistence arising from the Former of these two, or from the *Attrition* of the Parts of the Medium, is as the Rectangle under the Diameter, and the Velocity with which the Body moves. But the Resistence arising from the *Vis Inertiæ*, is as the Square of that Product. And by this difference may the two Kinds of Resistence in all Mediums be distinguished: And since the Kinds are thus distinct, it will appear that the Resistence of Bodies which are of a proper Magnitude and Velocity, whether they move in Air, Water, Quick-silver, or in any other Fluid, will almost all arise from the *Vis Inertiæ* of the Parts of the Fluid.

For that Part of the Resistence of any Medium which arises from Friction, Attrition, or Tenacity of the Particles of the Fluid, may be diminished, by supposing the matter to be divided into smaller Particles, and those also to be rendred more smooth and slippery. But that Part which arises from the *Vis Inertiæ* answers in Proportion to the Density of the Matter, and can neither be diminished by dividing the Matter into smaller Particles, nor by any other Means, than by the Diminution of the Density it self.

Whence it is, that *Density* of Fluid Mediums becomes very nearly *proportionable* to the *Resistence*. For those Liquors which differ insensibly as to Density, as Water, Spirit of Wine, Oil of Turpentine, warm Oil of Olives, and such like, have very little difference also as to the Force of Resistence. Water being 13 or 18 Times lighter, and consequently rarer than Quick-silver, hath its Resistence less than that of Mercury in the same Proportion, as he tried by the Experiment of Pendulums swimming in those two Fluids. The common Air such as we usually breath in, is about 8 or 9 hundred Times lighter, and rarer than Water, and he found the Resistence in Air to be less in that *Ratio*, by the same Kind of Trials. And in a thinner and rarer Air, the Resistence must still be less; till at last in the Thoughts of all, it will grow insensible. A Feather in the exhausted Receiver descends with equal Celerity as a Stone or a Piece of Lead, tho' in the open Air it find a very great Resistence to its Descent: And by all the Experiments he could make he found the Resistence of all Fluid Mediums to depend only on their Density and a little on their Tenacity: But there must needs be another Sort of Resistence, if the Pores of all Fluids were filled with another, yet more *Subtle Matter* or *Fluid*. Now if the Resistence in the *Exhausted Receiver* of the Air-Pump, should be only a 100 Times less than in the common Air, it would be a Million of Times less than that of Quick-silver: But it is certainly much less than that, and much less yet in the Celestial Spaces or Regions at 2 or 300 Miles in height above our Earth. For the Honourable Mr. *Boyle* hath shewn that Air may be rarified in Glass-Vessels to above 10000 Times its natural State, and the Celestial Regions must be much more empty of Air, than any Space which we can here evacuate by an Air-Pump: Because since our Air is here compressed by the weight of the Incumbent Atmosphere, and its Density proportionable to that compressing Power; it will follow by Calculation, that the Air, at 7 Miles above the Earth's Surface will be 4 Times as rare, as here; at the Distance of 14 Miles 16 Times as rare; and so on in the same *Ratio:* So that at the Distance of 210 Miles from the Earth, the Air will be 1000000000000000000 or 10 Millions of Millions of Millions of Times thinner or rarer than 'tis here.

We find that Heat conduces much towards the Fluidity of many Bodies, by diminishing their Tenacity; for it renders many Bodies (as all Metals and some Minerals) Fluid, which are not naturally so; and it increases the Fluidity of Tenacious Liquors, such as Oil, Balsams, Honey, and by that Means diminishes the Power of their Resistence. And yet it doth not much diminish the Resistence of Water; which it must certainly do if any considerable Degree of the Resistence of that Fluid arose from the *Attrition* or Tenacity of its Particles. And therefore we may fairly conclude that the Resistence of Water arises chiefly from the *Vis Inertiæ* of its Matter. And consequently, if the Celestial Regions or Spaces, were equally *dense* with Water, they could not have a much less Resistence than it: If they were as *dense* as Quick silver, they would have a Resistence near as great as that: And if they were perfectly and completely dense, or full of Matter without any Pores or Vacuities at all interspersed, they would have a much greater Resistence than Quick-silver. *A Globe perfectly solid, in such a Medium, would lose above half of its Motion, before it could move 3 of its own Diameters in length.* And a Globe not perfectly solid, such as are those of the Planets, would be stopt much sooner. Wherefore there is a Necessity of supposing that the Regions where the Planets and Comets move should *be devoid of all matter:* Except perhaps some very thin and fine Vapours and Exhalations, or *Effluvia* which may arise from the Atmosphere of the Earth of the Planets and Comets. That *Fictitious Subtile Matter* therefore with which some have filled the Heavens, is by no means useful for the Solution of the *Phænomena* of Nature; since the Motions of the Planets and Comets may be much better explained without by the Laws of Gravity; and *Gravity* it self hath never yet been well accounted for by that *Subtile Matter*. In Reality, that *Subtle Matter* can only serve to obstruct and disturb the Motions of the Heavenly Bodies, and if there were any such thing would destroy and overthrow the Course and Order of Nature. And if you suppose it interspersed also within the hidden Pores and *Meatus* of Bodies, it will do nothing

thing there but ſtop and obſtruct the *Vibrating Motions* of the Particles of Matter, in which their *Heat* and all their Energy and Active Power conſiſts. And as it is of no uſe but to do Miſchief, ſo there are no good Reaſons at all to induce us to believe the Exiſtence of any ſuch thing as a *Materia Subtilis* in their Senſe.

RESISTANCE *of the Air* to the Motion of *Projects*. In Phil. Tranſ. N. 186. There is the Meaſure of this given very largely and accurately by Dr. *Wallis:* He lays down at firſt this *Lemma. That the Reſiſtance of Bodies is proportional to their Celerity*; and then branches out into all the particular Varieties that can well be imagined, and at laſt computing different Mediums one with another, he concludes their different Reſiſtances to be as their Specifick Gravities, obſtructed from the Viſcidity of the Particles of ſome Fluids: And alſo that the Specifically Heavier Project once in motion (being equally ſwift with another that is lighter, *&c.*) will move through the ſame Medium more ſtrongly in proportion to its greater Intenſive or Specifick Gravity.

In the *Acta Eruditorum Lipſiæ* for *July* 1684, Mr. *G. G. Leibnitz* propoſes ſome New Demonſtrations about the Reſiſtances of *Solid Bodies*; which are very Geometrical and Curious.

And in the *Leipſick* Acts for *January* 1689. He reduces his Thoughts on this Subject into a Diſſertation. Entitled, A Diſcourſe concerning the Reſiſtance of *Mediums*, and the Motion of *Projects* in reſiſting Mediums.

As to the *Geometrical Conſiderations* of the Reſiſtance of Bodies of different Figures in one and the ſame Medium: Mr. *James Bernouli* in the *Acta Lipſiæ* for *May* 1693. gives theſe Rules.

1. If an *Iſoceles* Triangle be moved in the Fluid according to the Direction of a Line which is Normal to its Baſe; Firſt with the Vertex foremoſt, and then with its Baſe; the Reſiſtances will be of the Leggs, and as the Square of the Baſe, and as the Summ of the Leggs.

2. The Reſiſtance of a Square moved according to the Direction of its Side, and of its Diagonal, is as the Diagonal to the Side.

3. The Reſiſtance of a Circular Segment (leſs than a Semi-circle) carried in a Direction perpendicular to its Baſis, when it goes with the Baſe foremoſt, and when with its Vertex foremoſt (the ſame Direction and Celerity continuing, which is all along ſuppoſed) is as the Square of the Diameter, to the ſame leſs $\frac{1}{3}$ of the Square of the Baſe of the Segment.

*Cor.* Hence the Reſiſtances of a Semi-circle when its Baſe, and when its Vertex goes foremoſt, are to one another in a Seſquialteral *Ratio.*

4. A Parabola moving in the Direction of its Axis, with its Baſis, and then its Vertex foremoſt, hath its Reſiſtances, as the Tangent to an Arch of a Circle whoſe Diameter is equal to the Parameter, and the Tangent equal to half the Baſis of the Parabola.

5. The Reſiſtances of an Hyperbola, or a Semi-Ellipſis; when the Baſe and when the Vertex goes foremoſt, may be thus computed: Let it be, as the Summ (or Difference) of the Tranſverſe Axis, and *Latus Rectum*; is to the Tranſverſe Axis :: So is the Square of the *Latus Rectum*, to the Square of the Diameter of a certain Circle, in which Circle apply a Tangent equal to half the Baſis of the Hyperbola or Ellipſis. Then ſay again, as the Summ and Difference of the Axis and Parameter, is to the Parameter; ſo is the aforeſaid Tangent to another Right-line. And further, as the Summ (or Difference) of the Axis and Parameter, is to the Axis :: So is the circular Ark correſponding to the aforeſaid Tangent, to another Arch. This done, the Reſiſtances will be as the Tangent to the Summ (or Difference) of the Right-line thus found, and that Ark laſt mentioned.

6. In General, the Reſiſtances of any Figure whatſoever going now with its Baſe foremoſt, and then with its Vertex, are as the Figures of the Baſis to the Summ of all the Cubes of the *Elementa* of the Baſis divided by the Squares of the *Elementa* of the Curve-line.

All which Rules he thinks may be of Uſe in the Fabrick or Conſtruction of Ships, and in perfecting the Art of Navigation univerſally. As alſo for determining the Figures of the Bobs of Pendulums for Clocks.

RESPECTU *Compŭti Vice-Comitis habendo:* Is a Writ for the Reſpiting a Sheriff's Accounts, on juſt Occaſion delivered to the Treaſurer and the Barons of the Exchequer. *Regiſt. fol.* 139 & 179.

RESPIRATION. How ſuch Globules of the Blood as by uniting together in the Veins, from others too large for any Secretion, and are therefore neceſſarily afterwards broken on the Lungs by the Force of Reſpiration, Dr. *Keil* ſhews in his *Animal Secretion*, p. 24, *&c.* And to eſtimate the Force by which the Air is thruſt out of the Lungs in Exſpiration he took a thin Hog's Bladder which he could eaſily blow up with the Breath of one Exſpiration; and having moiſtened it, that it might neither reſiſt the Air in blowing up, nor the Weights which were laid upon it: He fix'd a ſmall Tube, whoſe Diameter was $\frac{1}{10}$ part of an Inch, to the Neck of the Bladder; and then filling the Bladder with Air, he put a Weight of 2 *lb.* 4 *z.* on the Top of it: And repeating the Experiment ſeveral Times he found that this Weight ſqueezed all the Air out of the Bladder, through the ſmall Tube in the Space of 25 Vibrations of a Pendulum, ſwinging Seconds, and by a Calculation which he there gives, he found the Force by which the Air is forced out of the Lungs at every Exſpiration to be equal to 100 *lb.* Weight: And therefore, *Action and Reaction being Equal*, the Preſſure of the Air upon the Lungs every Exſpiration muſt be equal to the Preſſure of 100 *lb.* Weight. That is, ſuppoſing the Gravity of the Air to be always the ſame, and the Diameter of the *Trachæa* the ſame alſo in every Exſpiration. But ſince we find by the Barometer, that there is 3 Inches difference between the greateſt and the leaſt Gravity of the Air, which is the Tenth-part of its greateſt Gravity; there muſt be likewiſe the Difference of 10 *lb.* Weight in its Preſſure upon the Lungs at one Time more than at another. He thinks no one can doubt but that this Preſſure of the Air on the Lungs in breathing, is ſufficient to break the Globules of the Blood, and to diſſolve all the Coheſions they might con-

contract in their Circulation through the Veins and Arteries. And when the Blood is thus dissolved and thrown out by the Heart into the *Aorta*; tis evident that the Re-union of the Particles requires more or less Time, according to their several Attractive Powers, even though they all moved with the same *Velocity*, and in the same *Direction*.

But neither doth this happen, for a Fluid moves through a Cylinder or Conical Vessel (such as the Arteries are) with a greater Velocity at the Axis, than at the Sides. And again, the Blood is thrust into the *Aorta*, by the whole Force of the Heart: And Fluids when they are pressed, press *undequaque*; by which means the Arteries are dilated, and the Blood moves not only forwards, but likewise presses perpendicular on the Sides of the Arteries: And as the Sides of the Arteries (being Elastick) return, they press the Blood from them every way, which must produce an Intestine Motion, and so hinder the Attraction of the Particles; and by this frequent and strong Cohesion of the Particles of the Blood against the Sides of the great Arteries, the Cohesions of the Particles, if any of them happen to unite, will be immediately dissolved. Again, this Intestine Motion must greatly increase on the Account that many of the Particles of the Blood are Elastick: For by this Resistance of the Sides of the Vessels, they must necessarily hit one against another, and being Elastick, reflect from one another, and so increase the Intestine Motion of the Blood.

On this Intestine Motion of the Blood its *Heat* depends; which therefore is every where proportional to the *Impetus* of the Particles against the Sides of the Vessels; supposing the Elasticity of the Particles every-where the same. But the *Impetus* of the Particles against the Sides of the Vessels decreases, as the Summ of the Cavities of the Vessels increases: And consequently where the Summ of the Cavities of the Vessels is greatest, there the Intestine Motion of the Blood is least, and the Attractive Power of the Particles (*cæteris paribus*) is greatest.

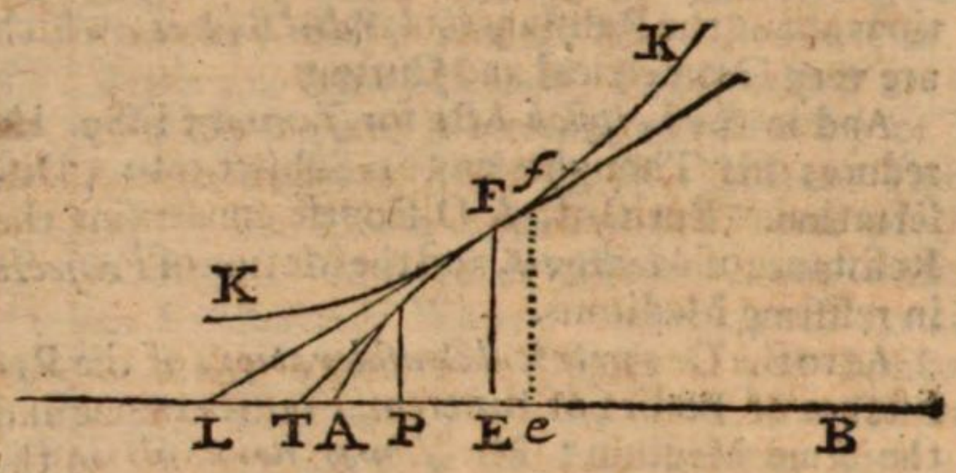
RESTITUTIO *in Integrum*, is a Writ of Restitution to put a Person into Re-possession of such Lands and Tenements, as whereof he had been wrongfullly disseized.

RETENTION, is a Faculty of the Human Mind, whereby in Order to a farther Progress in Knowledge it keeps or retains those *Simple Ideas*, which it before received by *Sensation or Reflection*; and this is done two ways. First by keeping the *Idea*, which is brought into the Mind, for some Time actually in *view*, which is called *Contemplation*: And Secondly, by *Reviving* again in our Minds those *Ideas*, which after imprinting have disappeared, or have been as it were laid out of sight: And this we do, when we conceive Heat or Light, Yellow, or Sweet, the Object in which those Qualities are, being removed: And this is called *Memory*; which is as it were the common Store-house of all our *Ideas*. And our *Ideas* being nothing but *Actual Perceptions* in the Mind, which cease to be any thing, when there is no Perception of them; This *Laying up* of our *Ideas* in the Repository of the Memory, signifies no more than this: That the Mind hath a Power in many Cases, to revive Perceptions which it once had, with this Additional Perception annexed to them, *That it hath had them before*. And in this sense it is, that our *Ideas* are said to be in our Memory; when indeed they are actually no where: But only there is an Ability in the Mind, when it will to revive them again; and as it were paint them a-new on it self.

RETRAXIT; in the Law, (so called from being the Effectual Word in the Entry,) is where the Plaintiff or Defendant comes into Court, and declares he hath *with-drawn* his Suit, and will proceed no further; and this is a Bar of all other Actions of a like or inferior Nature. The Difference between a *Retraxit* and a *Non-suit*, is that the former supposes the Plaintiff or Defendant to be actually present in Coutt; whereas a *Non-suit* is upon a Demand made, when he should appear, and he makes default. A *Retraxit* also is a *Bar*, but not a *Non-suit*; for then he may commence a New Action of the like Nature.

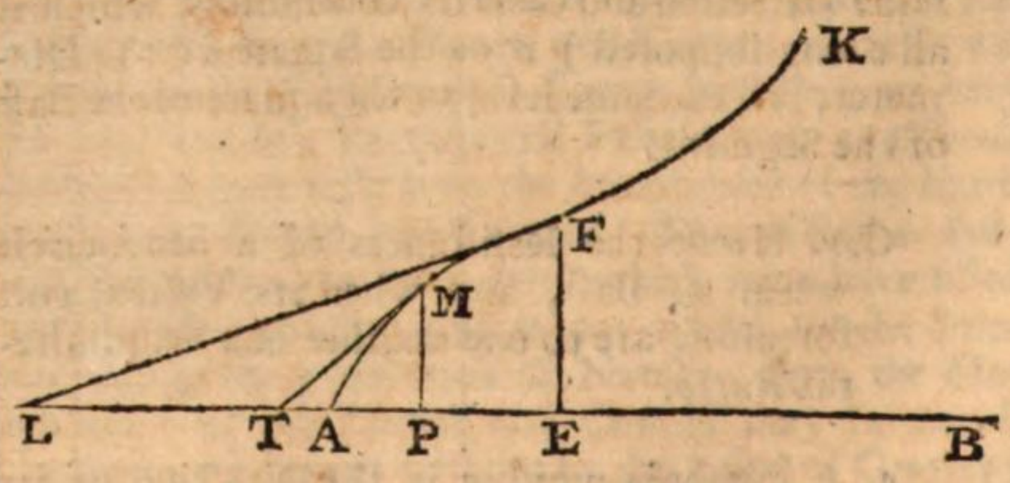
RETROGRADATION of a Planet. See an Account of the Reason of this Phænomenon, under the word *Direct*. in Vol. II.

RETROGRESSION *of Curves*: The same with what is otherwise called contrary Flexion; and is thus: when a Curve-line AFK is partly



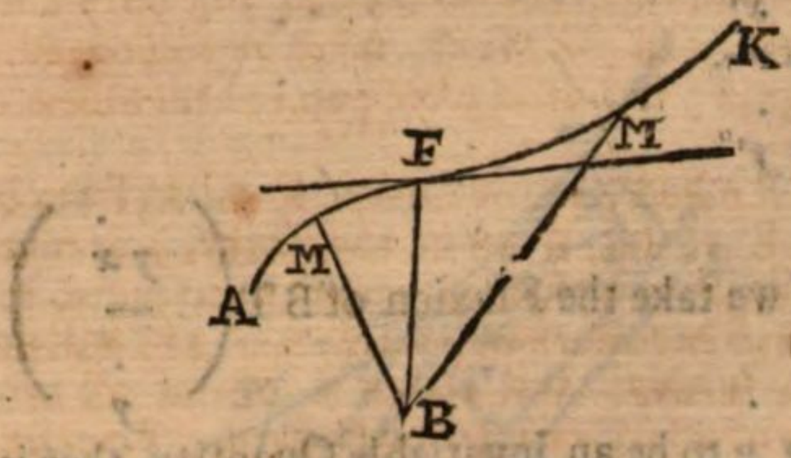

Concave and partly Convex, in respect of the Right-line A B, or in respect of the determinate Point B; the Point F which separates the Concave part of the Curve from the Convex, or which is the end of the one, and the beginning of the other, is called the *Point of contrary Flexion*, when the Curve is continu'd from F towards the same side as before. But when the Curve is continu'd backwards towards A, then F is call'd the *Point of Retrogression*.

179. If we suppose the Ordinate P M to move from A towards B, and consider the various Af-




fections of the Fluxions thereof, as it moves along, it will be an easie matter to determine the Point of contrary Flexion or Retrogression.

In the first place, let A B be the Diamater of the Curve-line AMK; and let the Ordinate PM, EF be parallel between themselves; and draw the Tangents MT, FL; then tis evident, that in Curves having a point of contrary Flexion, the Inter-




Intercepted Diameter encreaſes continually, and the Portion of the Diameter AT Intercepted between the Tangent MT, and A the beginning of the Abſciſſa increaſes alſo, till the point P arrive at E, and afterwards decreaſes again; and hence 'tis plain, that the Portion of the Sub-tangent AT becomes a *Maximum*, when the points P and M fall in E and F.

180. But when the Curve AMF is continu'd backwards from F towards A, then the Sub-tangent AT increaſes continually; but the intercepted Diameter increaſes only, until the point T arrive in L, or until the Ordinate PM co-incides with EF; and afterwards it decreaſes again.

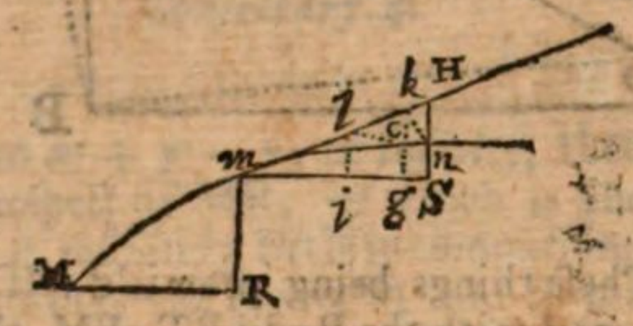
*Hence to find a general Form which ſhall ſerve to Inveſtigate the Points of contrary Flexion and Retrogreſſion.*

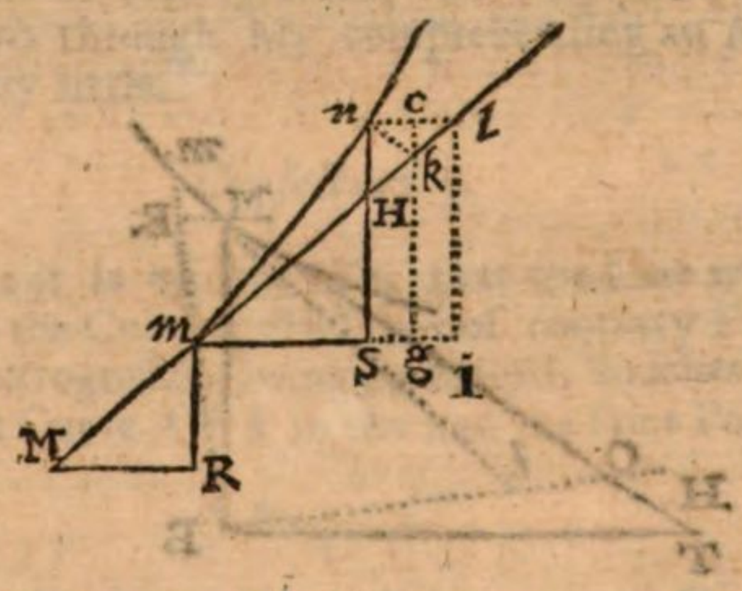
Suppoſe AE $=x$, EF $=y$; then is AL $=\frac{\dot{y}\dot{x}}{\dot{y}} - x$, and the Fluxion thereof $\frac{\dot{y}^2\dot{x} - \dot{y}\ddot{y}\dot{x}}{\dot{y}^2} - \dot{x}$ muſt be $=$ o, and by Tranſpoſition, and Diviſion (by $\dot{x}$, ſuppoſing $\dot{x}$ an Invariable Quantity) $\frac{\dot{y}^2\dot{x} - \dot{y}\ddot{y}\dot{x} - \dot{y}^2\dot{x}}{\dot{y}^2} =$ o, and $\frac{-\dot{y}\ddot{y}\dot{x}}{\dot{y}^2} =$ o, or *Infinity*; and multiplying by $\dot{y}^2$ and dividing by $-\ddot{y}$, we have $\dot{y} =$ o, or *Infinity*: which for the future will ſerve for a General Form to find the points (F) of contrary Flexion and Retrogreſſion; for the Nature of the Curve AFK being given, if we find the Value of $\dot{y}$ in $\dot{x}$, and again find the Fluxion of that Value (ſuppoſing $\dot{x}$, to be Invariable) we ſhall have the Value of $\dot{y}$ in $\dot{x}^2$, which being put equal to nothing or Infinity, will ſerve in either of theſe Suppoſitions, to find ſuch a Value of AE, that the Ordinate EF ſhall interſect the Curve AFK in F the point of contrary Flexion or Retrogreſſion.

181. The point A the beginning of $x$ may be ſo ſituated, that AL ſhall be $= x - \frac{\dot{y}\dot{x}}{\dot{y}}$ inſtead of $\frac{\dot{y}\dot{x}}{\dot{y}} - x$, and AE or AE may be a *minimum* inſtead of being a *maximum*, but becauſe the conſequence is ſtill the ſame, and that this can create no difficulty, it ſhall be ſufficient to obſerve,

That AL can never be $= x + \frac{\dot{y}\dot{x}}{\dot{y}}$; for when the point T falls on the other ſide of P in reſpect of the beginning of $x$, then the Value of $\frac{\dot{y}\dot{x}}{\dot{y}}$ will be Negative, and conſequently, the Value of $\frac{\dot{y}\dot{x}}{\dot{y}}$ will be Poſitive, and therefore in ſuch a Caſe AE + EL is $= x - \frac{\dot{y}\dot{x}}{\dot{y}}$.

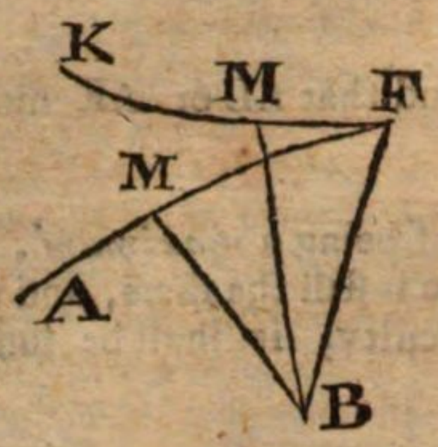
182. The point of contrary Flexion or Retrogreſſion may be found otherwiſe, in this manner:



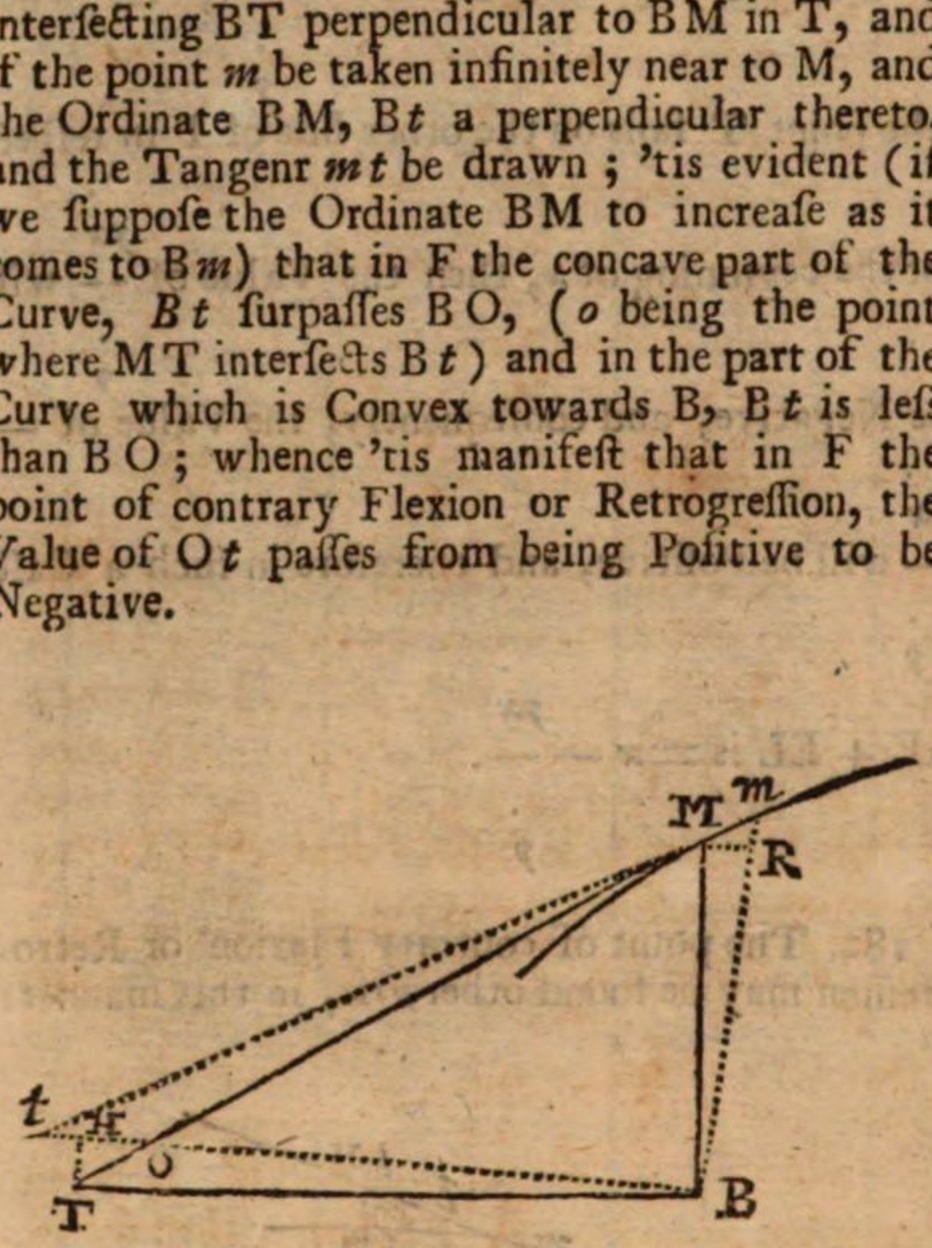




It is evident that if $\dot{x}$ be ſuppoſed invariable, and that the Ordinate $y$ be a flowing Quantity, then S $n$ is leſs than SH or R $m$, when the Curve is Concave towards the Axis: and S $n$ is greater than SH or R $m$, when the Curve is Convex towards the Axis. Whence it follows, that the Value of H $n$ or $\ddot{y}$ from being Poſitive becomes Negative in F, the point of Inflexion or Retrogreſſion; that is $\ddot{y}$ is $=$ o, or *Infinity*.

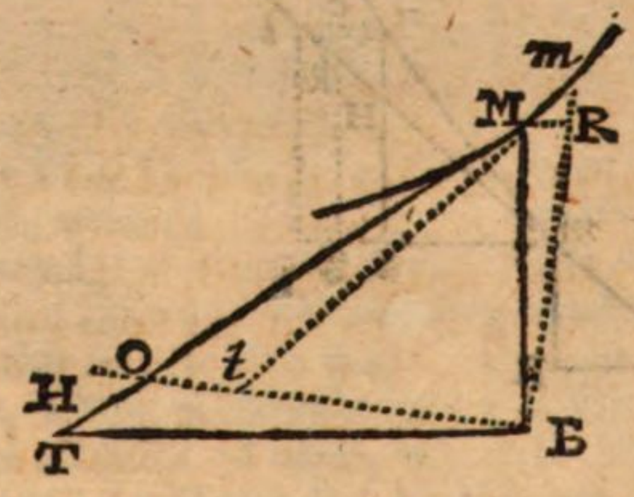
183. And if the Curve AFK reſpect a ſingle point B, then draw the Ordinates BM, BF, BM, all concurring in the given point B. Then if you draw any Ordinate as BM, and the Tangent MT




interſecting BT perpendicular to BM in T, and if the point *m* be taken infinitely near to M, and the Ordinate BM, B*t* a perpendicular thereto, and the Tangenr *m t* be drawn ; 'tis evident (if we ſuppoſe the Ordinate BM to increaſe as it comes to B*m*) that in F the concave part of the Curve, *B t* ſurpaſſes BO, (*o* being the point where MT interſects B*t*) and in the part of the Curve which is Convex towards B, B*t* is leſs than BO ; whence 'tis manifeſt that in F the point of contrary Flexion or Retrogreſſion, the Value of O*t* paſſes from being Poſitive to be Negative.




184. Theſe things being premis'd : If on the Center B, and with the Radii BT, BM, the little Arches TH, MR be deſcrib'd ; then the Triangles




MR*m*, MBT and THO are ſimilar, and the little Sectors BMR, BTH are alſo ſimilar ; whence

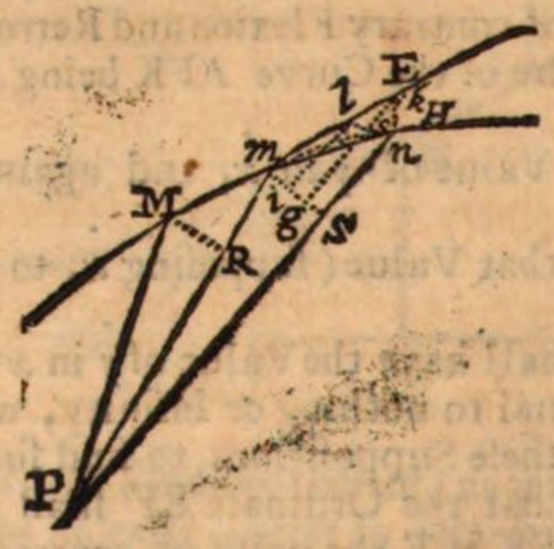
(ſuppoſing EM $= y$, MR $= \dot{x}$, RM $= \dot{y}$,) *m* R ($\dot{y}$) : RM ($\dot{x}$) : : BM ($y$) : BT $= \frac{y\dot{x}}{\dot{y}}$

: : MR ($\dot{x}$) : TH $= \frac{\dot{x}^2}{\dot{y}}$ : : TH $\left(\frac{\dot{x}}{\dot{y}}\right)$ : HO $= \frac{\dot{x}^3}{\dot{y}^2}$.

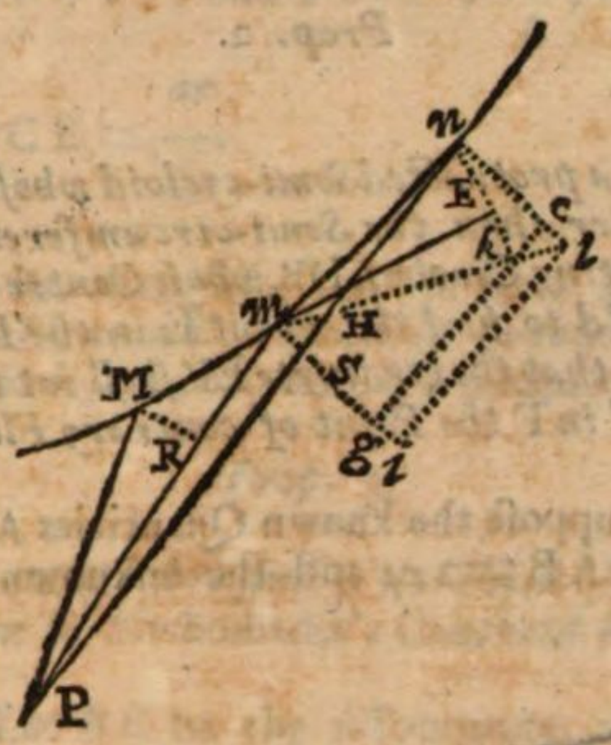
And if we take the Fluxion of BT $\left(\frac{y\dot{x}}{\dot{y}}\right)$ ſuppoſing $x$ to be an Invariable Quantity, then is

Bt — BT $=$ Ht $= \frac{\dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}$ and OH $+$ Ht $= \frac{\dot{x}^3 + \dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}$. Now becauſe in the point of contrary Flexion or Retrogreſſion, O*t* is either $=$ o, or *Infinity*, therefore in the ſaid point $\frac{\dot{x}^3 + \dot{y}^2\dot{x} - y\dot{x}\ddot{y}}{\dot{y}^2}$ is $=$ o, or *Infinity*, and multiplying by $\dot{y}^2$, and dividing by $\dot{x}$, we have $\dot{x}^2 + \dot{y}^2 - y\ddot{y} =$ o, or *Infinity* ; whence if the Nature of the Curve A F K be given, then the Value of $\dot{y}$ may be found in $\dot{x}$, and the Value of $\ddot{y}$ in $\dot{x}^2$ ; and if the ſaid Values be ſubſtituted in the general Form, there will remain one unknown Quantity ($\dot{x}$) and the Equation thus cleared, will ſerve to find ſuch a Value of BF, that ſetting one foot of your Compaſſes in B, and with the other, at the diſtance BF, deſcribing a Circle, it will cut the Curve in F, the Point of contrary Flexion or Retrogreſſion ; which was required to be done.

185. And to determine the ſaid points another way, it muſt be obſerv'd, that in the Concave Part, the Angle P *m* E, is greater than the Angle P *m n*, and contrarily, in the Convex Part, the




Angle P *m* E is leſs than P *m n*, and conſequently that the Angle P *m* E — P *m n* $=$ E *m n*, or the Arch E *n*, from being Poſitive becomes Negative in F the point of contrary Flexion or Retrogreſſion. And taking $\dot{x}$ for an invariable Quantity,




tity, the right angled Triangles H *m* S, H *n k* are similar; therefore $H m\ (=\dot{z}) : m\,S\ (\dot{x}) :: \ddot{xy} : H\,n\ (-\ddot{y}) : n\,k = \frac{\dot{x}\ddot{y}}{\dot{z}}$; and here it must be observed, that H *n* is Negative, because while B *m* (*y*) Increases, *m* R ($\dot{y}$) Decreases. Now because the Sectors P *m* S, *m* E *k* are similar, it is $B\,m\,(y) : m\,S\,(\dot{x}) :: m\,E\,(\dot{z}) : E\,k = \frac{\dot{x}\dot{z}}{y}$; and therefore $E\,k + k\,n$ is $= \frac{\dot{x}\dot{z}^2 - y\dot{x}\dot{y}}{\dot{y}\dot{z}}$ and multiplying by $y\dot{z}$, and dividing by $\dot{x}$, we shall have $\dot{z}^2 - y\ddot{y}$, or (substituting $\dot{x}^2 + \dot{y}^2$ for $\dot{z}^2$) because of the right angled Triangle *m* S *n*, $\dot{x}^2 + \dot{y}^2 - y\ddot{y}$, which passes from being Positive to be Negative, in the point of contrary Flexion or Retrogression.

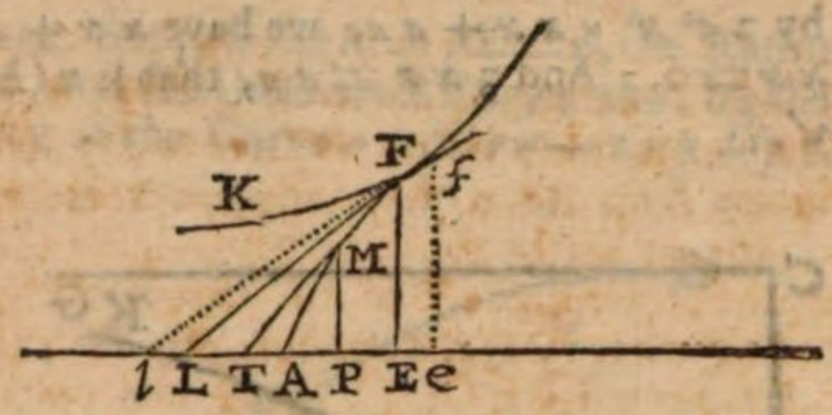
And if we suppose *y* to be Infinite, then the Terms $\dot{x}^2$, and $\dot{y}^2$ vanish, and are equal to nothing in respect of $y\ddot{y}$, and consequently the form $\dot{x}^2 + \dot{y}^2 - y\ddot{y} = 0$, or *Infinity*, will become $-y\ddot{y} = 0$, or *Infinity*, that is to say, dividing by $-y$, $\ddot{y} = 0$, or *Infinity*; which is the form of the first case; and this ought to be so, because the Ordinates BM, BF, BM are then parallel to one another.

*Consectary* 1.

186. When $\ddot{y} = 0$, then 'tis evident that the Fluxion of AL is nothing in respect of *x* the Fluxion of AE; and that the two Tangents F L, *f* L being infinitely near each other, ought to make but one streight Line *f* F L.

*Consectary* 2.

And when $\ddot{y} =$ Infinity, then the Fluxion of A L ought to be infinitely great in comparison of that of A E, or which is the same thing, the Fluxion of A E (or $\dot{x}$) is infinitely little in respect of that of A L; and consequently we may draw




two Tangents FL, F*l*, to the same point F, comprehending the infinitely little Angle L F *f*.

*Consectary* 3.

In like manner, when $\dot{x}^2 + \dot{y}^2 - y\ddot{y} = 0$, 'tis evident that, *o t* ought to be equal to nothing in respect of M R; and consequently, that the two Tangents M T, *m t*, infinitely near each other, must Co-incide, when the point M is the same with the point of contrary Flexion or Retrogression.

*Consectary* 4.

And when $\dot{x}^2 + \dot{y}^2 - y\ddot{y} =$ *Infinity*, then *o t* is infinite in respect of MR, or which is the same thing, M R is infinitely little in comparison of *o t*, and consequently the Points M and *m* must Co-incide; that is when the Point M is the Point of Inflexion or Retrogression, we may draw two Tangents through M, comprehending an Angle infinitely little.

*Consectary* 5.

Hence it is evident also, that the Line which touches the Curve in the Point of contrary Flexion or Retrogression, being prolonged, touches and cuts the Curve A F K in one and the same Point.

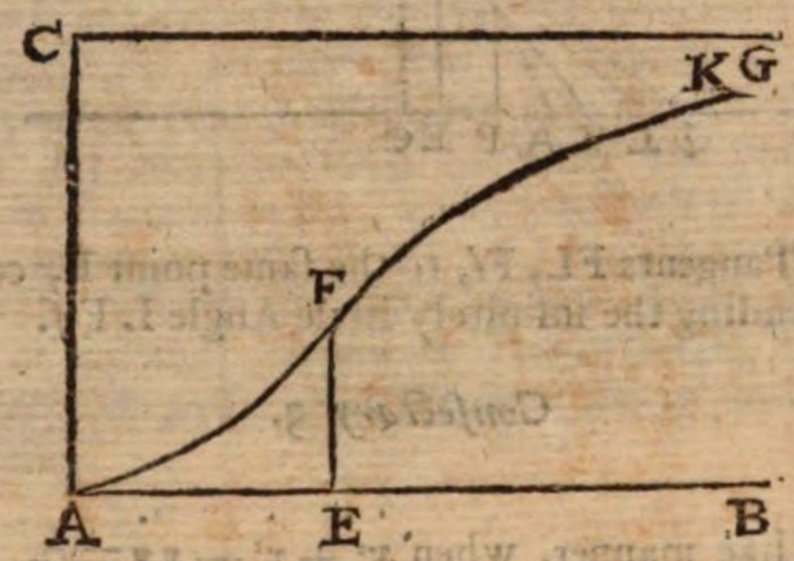
*Prop.* I.

*If the Curve-line* A F K *be given, and its Diameter* A B; *and if the Relation of the Abscissa* A E (*x*) *to the Ordinate* E F (*y*) *be express'd by this Equation* $a\,x\,x = x\,x\,y + a\,a\,y$; *'tis requir'd to find the Value of* A E, *so that the corresponding Ordinate* E F *shall intersect the Curve* A F K *in the Point of contrary Flexion* F.

187. The Equation Curve is $y = \frac{\dot{x}\,x}{x\,x + a\,a}$ and $\dot{y} = \frac{2\,a^3\,x\,\dot{x}}{\overline{x\,x + a\,a}^{\frac{3}{2}}}$; and taking the Fluxion of this

Quan-

Quantity, and ſuppoſing $\dot{x}$ invariable, and putting the ſaid Second Fluxion equal to nothing; we have $2a^3x^2 \times \dot{x}\dot{x}\dot{x} + aa^2 - 8a^3x^2\dot{x}^2 \times \dot{x}\dot{x}\dot{x} + aa$ $\times xx + aa^4$ $= 0$, and multiplying by $xx + aa^4$, and dividing by $2a^3x^2 \times \dot{x}\dot{x}\dot{x} + a\dot{a}$, we have $\dot{x}\dot{x} + a\dot{a} - 4\dot{x}\dot{x} = 0$. And $3\dot{x}\dot{x} = a\dot{a}$, that is $x$ (AE) $= a\sqrt{\frac{1}{3}}$.




If we ſubſtitute $\frac{1}{3}aa$ in place of $xx$ in the Equation of the Curve $y = \frac{axx}{xx + aa}$, then $y = \frac{\frac{1}{2}a^3}{\frac{4}{3}aa} = \frac{1}{4}a = EF$; ſo that we may determine the Point of Inflexion F, without ſuppoſing the Curve AFK to be deſcrib'd.

If AC be drawn parallel to the Ordinate EF, and equal to the given Line $a$, and if CG be drawn parallel to AB, it will be an Aſſymptote to the Curve AFK. For if we ſuppoſe $x$ to be infinite, then the Equation of the Curve $y = \frac{axx}{xx + aa}$ will become $y = \frac{axx}{xx} = a$, ſo that the Ordinate of the Curve EF cannot be $= a = AC$, before the Abſciſſa AE be infinite.

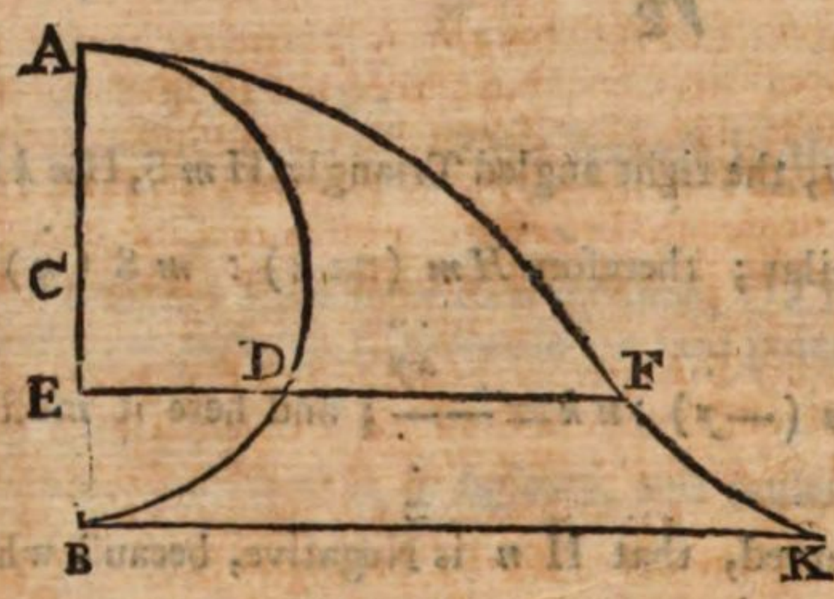
*Corollary.*

188. If the Equation of the Curve be $y - a = \overline{x - a}^{\frac{3}{5}}$ then $\dot{y} = \frac{3}{5}\dot{\overline{x - a}}^{-\frac{2}{5}} \times \dot{x}$, and $\ddot{y} = \frac{6}{25}\dot{\overline{x - a}}^{-\frac{7}{5}} \times \dot{x}^2 = \frac{-6x^2}{25\sqrt[5]{x - a^7}} = 0$. Then $-6x^2$ is $= 0$; which becauſe it makes nothing for the Reſolution of the Queſtion, therefore I put $\frac{-6x^2}{25\sqrt[5]{x - a^7}} = Infinity$; whence the Denominator $25\sqrt[5]{x - a^7}$ is $= 0$, and conſequently, the unknown Quantity $x$ (AE) is $= a$.

*Prop.* 2.

*If* AFK *be a protracted Semi-cycloid whoſe Baſe* BK *is longer than the Semi-circumference of the generating Circle* ADB, *whoſe Centre is* C; *'tis requir'd to find the Point* E *in the Diameter* AB, *ſo that the Ordinate* EF *ſhall cut the Semi-cycloid in* F *the Point of contrary Flexion.*

189. Suppoſe the known Quantities ADB $= a$, BK $= b$, AB $= 2r$, and the unknown Quantities AE $= x$, ED $= z$, the Arch AD $= u$; and EF $= y$; then by the Property of the Cycloid $y = z + \frac{bu}{a}$, and conſequently $\dot{y} = \dot{z} + \frac{b\dot{u}}{a}$; but by the Property of the Circle $z = \sqrt{2rx - xx}$ and conſequently, $\dot{z} = \frac{1}{2} \times \overline{2rx - xx}^{-\frac{1}{2}} \times 2r\dot{x} - 2x\dot{x} = \frac{r\dot{x} - x\dot{x}}{\sqrt{2rx - xx}}$ and $\dot{u} = \frac{r\dot{x}}{\sqrt{2rx - xx}}$, therefore ſubſtituting for $\dot{z}$ and $\dot{y}$ their reſpective Values, we have $\dot{y} = \frac{ar\dot{x} - ax\dot{x}}{a\sqrt{2rx - xx}} + \frac{br\dot{x}}{a\sqrt{2rx - x\ddot{x}}} = \frac{ar\dot{x} - ax\dot{x} + br\dot{x}}{a\sqrt{2rx - xx}}$ and the Fluxion thereof (ſupppoſing $x$ invariable) is, $\ddot{y} = \frac{br - ar - br^2 \times \dot{x}^2}{a\sqrt{2rx - xx}\sqrt{2rx - xx}} = 0$, whence $br\dot{x} - ar\dot{x} - br^2 \times \dot{x}^2$ is $= 0$, and dividing by $\dot{x}^2 \times r$, we have $bx - ar - br = 0$, and by Tranſpoſition $bx =$



$b\,x = a\,r + b\,r$, and $x = r + \frac{ar}{b}$, and consequently $CE = \frac{ar}{b}$.

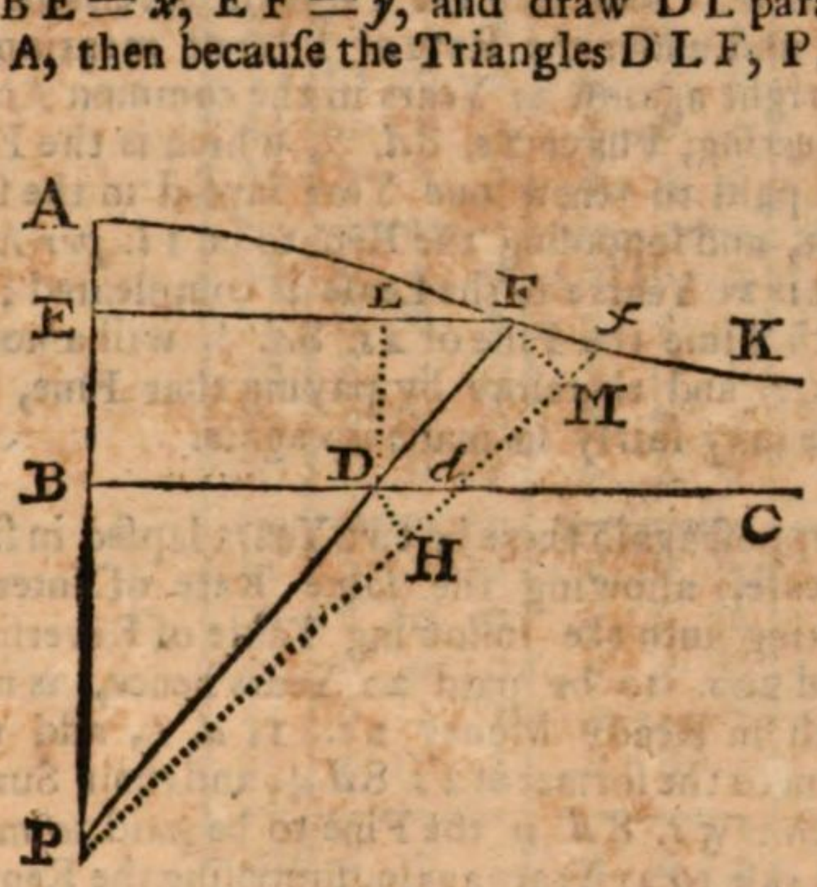
*Hence 'tis manifeſt, that to have a Point of contrary Flexion* F, *b muſt be greater than a; for if b, be leſs than a, then* CE *would exceed* CB.

*Prop.* 3.

*Let it be requir'd to find* F *the Point of contrary Flexion in* Nichomedes's *Conchoid* A F K.

190. Let B C be the Aſſymptote, and P the Pole of the Conchoid; then the Property of the Conchoid is, that if you draw ſtraight Lines from the Pole P to the Curve A F K, as P F, P A, then the Segments between the Aſſymptote and the Curve *v. g.* A B, D F are always equal to a given Line *a*,

Draw P A perpendicular, and F E parallel to B C, and ſuppoſe the known Quantities $AB = FD = a$; $BP = b$; and the unknown Quantities $BE = x$, $EF = y$, and draw D L parallel to B A, then becauſe the Triangles D L F, P E F,




are ſimilar; it is $DL(x) : LF(\sqrt{aa - xx}) :: PE(b + x) : FE = y = \frac{b + x\sqrt{aa - xx}}{x}$

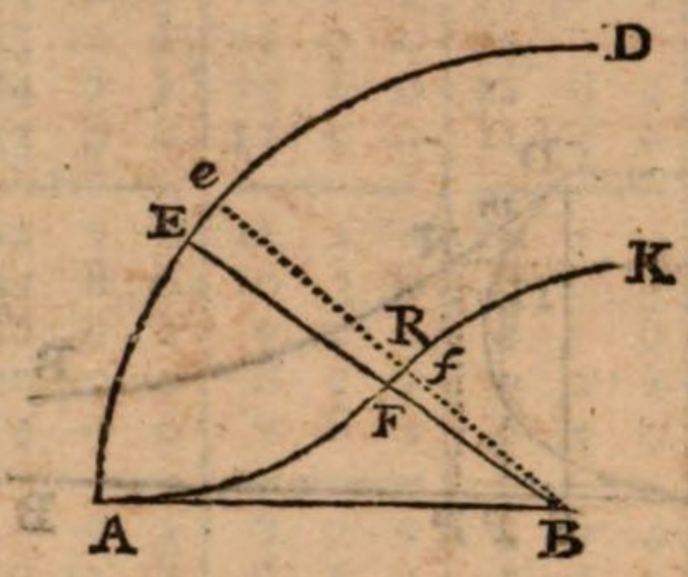
and conſequently $\dot{y} = \frac{x^3\dot{x} + aab\dot{x}}{xx\sqrt{aa - xx}}$. And $\ddot{y} = \frac{2a^4b - aax^3 - 3aabxx\dot{x}^2}{aax^3 - x^5 \times \sqrt{aa - xx}} = 0$, whence by Reduction there will ariſe $x^3 + 3bxx - 2aab = 0$, and one of the Values of the Root $x$ will be $= PF$, which was requir'd.

If $a$ be $= b$, the preceeding Equation will be changed into this other, $x^3 + 3axx - 2a^3 = 0$, which being divided by $x + a$ the Quotient is $xx + 2ax - 2a^2 = 0$, and conſequently $x$ is $= -a + \sqrt{3aa}$.

*Prop.* 4.

*Let* A E D *be an Arch of a Circle, and* B *its Center, and let the Property of the Curve-line* A F K *be ſuch, that drawing any Ray* B F E *at pleaſure, the Square of* F E *be equal to the Rectangle comprehended under the Arch* A E *and a given Right-line a. 'Tis requir'd to find the Point* (F) *of contrary Flexion.*

191. Suppoſe the Arch $AE = z$, the Radius $BA = r$, and the Ordinate $BF = y$; then by the Property of the Curve $az = rr - 2ry + yy$, and




conſequently $\dot{z} = \frac{2y\dot{y} - 2r\dot{y}}{a} = Ee$; and becauſe the Sectors B E *e*, B F R are ſimilar, it is,

$BE(r) : BF(y) :: Ee\left(\frac{2y\dot{y} - 2r\dot{y}}{a}\right) :$

$FR = \dot{x} = \frac{2yy\dot{y} - 2ryy}{ar}$ and the Fluxion thereof (ſuppoſing $x$ invariable) is $4y\dot{y}^2 - 2a\dot{y}^2 + 2yy\ddot{y} - 2ay\ddot{y} = 0$. And conſequently $y\ddot{y} = \frac{a\dot{y}^2 - 2y\dot{y}^2}{y - a}$. Now if we ſubſtitute theſe Values of $\dot{x}^2$ and $y\ddot{y}$ in the general Theorem $y\ddot{y} = \dot{x}^2 + \dot{y}^2$, there will ariſe this Equation $\frac{r\dot{y}^2 - 2y\dot{y}^2}{y - a} = \frac{4y^4\dot{y}^2 - 8ry^3\dot{y}^2 + 4rryy\dot{y}^2 + rraa\dot{y}^2}{aarr}$ which by Reduction, is $4y^5 - 12ry^4 + 12rry^3 - 4r^3yy + 3rraay - 2r^3aa = 0$. And one of the Values of the Root $y$ will be $= BF$ requir'd.

*Scholium* 1.

*That the Curve* A F K, *which we may call a* Parabolical Spiral, *has a Point of contrary Flexion, may eaſily appear.*

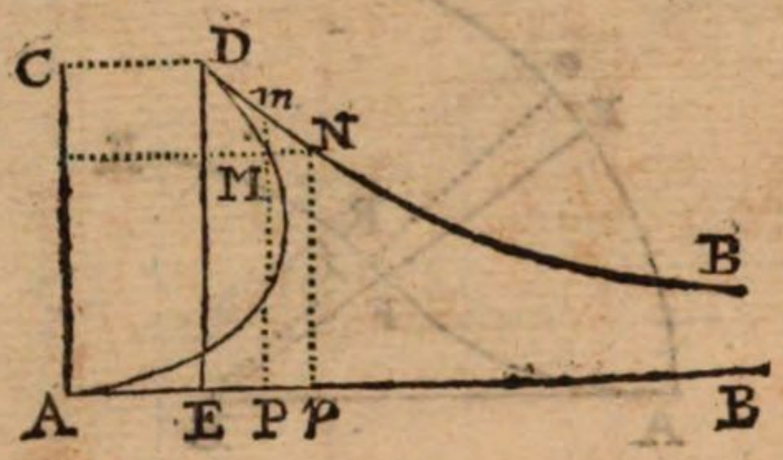
For the Circumference A E D not differing ſenſibly near A, from the Tangent in A, its plain from

from the Nature of the Parabola, that the Curve muſt be concave towards that Tangent, and that afterwards the Curvature of the Circumference about its Centre becoming more and more ſenſible, the ſaid Curve muſt be concave towards the ſaid Centre B.

*Scholium 2.*

*The Points of Retrogreſſion of Curves may be found by help of firſt Fluxions in this manner,*

192. If the Curve AMDB be ſuch that the Ordinates PM *m* interſect the ſame in two Points M and *m*, then that Curve muſt have a Point of Retrogreſſion, *viz.* the Point D; and to determine the ſame it muſt be obſerv'd that if (the Abſciſſa) *x* be ſuppoſed invariable, then the Fluxion of the Ordinate (when it is greateſt) which paſſes thro' the Point of Retrogreſſion D, is equal to nothing; whence we may find the Value of A E the Abſciſſa correſponding to the ſame.




RETURNS *of a Trench* in Fortification, are the Turnings and Windings which runs from the Lines of the Trench, and are, as near as can be, parallel to the Place attacked, to avoid being enfiladed.

REVE alias *Gereve*, ſignifies with us the Bailiff of a Franchiſe or Mannor, eſpecially in the Weſtern Parts of *England*: Hence *Sire-Reve* or *Sheriff*.

REVEILLE. For the Drum to *beat the Reveille* in any Army, is to give notice that 'tis Day-break, and that the Soldiers ſhould riſe, and the Centries forbear *challenging*.

REVERSIONS, or *Eſtates in Reverſion*. In the little Book of Tables for Renewing and Purchaſing College and Church-Leaſes, Printed at *Cambridge* 1700, and recommended by Sir *Iſ. Newton*.

There is alſo ſhew'd the Conſtruction and Uſe of the following Table of *Reverſions*, which is calculated for ſeveral Rates of Intereſt. The Table ſhews the *Decreaſe* of 1 *l.* yearly, according to the ſaid ſeveral Rates; or which is the ſame thing, it ſhews you what one Pound due at the End of any Number of Years to come (not exceeding 40, which is the longeſt Term ſuch Lands can be leaſed for) is now worth in Ready Money at 5, 6, 7, 8, 10, and 12 *per Cent. per Ann.*

And firſt, *What is* 1 *l. due a Year hence, worth in Ready Money now*?

The Rule is this: Let 100 *l.* with the Intereſt of a Year added to it, be the firſt Term in the Rule of Three; 100 *l.* the Second, and 1 *l.* the Third. (For as 100 *l.* with its Intereſt going on to the End of the Year, is to a bare 100 *l.* then due:: So muſt 1 *l.* with its growing Intereſt, be to the Decreaſe of 1 *l.* at the Years End. (Then at 6 *l.* and 10 *l. per Cent.* the Work will ſtand thus.

As 106. 100 :: 1. .94339 or 18*s.* 10*d.* ¼.
110. 100 :: 1. .90909 or 18*s.* 2*d.*

From whence it appears that 1 *l.* in a Years Time at 6 *l. per Cent.* decreaſes to 18 *s.* 10 *d.* ¼ and at 10 *l. per Cent.* to 18 *s.* 2 *d.* So that 18 *s.* 10 *d.* ¼ Ready Money is worth 20 *s.* to be paid a Year hence at 6 *l. per Cent.* and 18 *s.* 2 *d.* Ready Money is worth 20 *s.* to be paid a Year hence at 10 *l. per Cent.* And reckoning thus by a continual Geometrical Proportion decreaſing, it comes to paſs that 20 *s.* to be paid 21 Years, hence, is worth but 5 *s.* 10 *d.* ½ Ready Money. That is, 5 *s.* 10 *d.* ½ paid now, will in 21 Years at 6 *l. per Cent. per Ann.* compl. Intereſt increaſe to juſt 20 *s.* But at 10 *l. per Cent.* 20 *s.* in 21 Years decreaſes to 2 *s.* 8 *d.* ½. So that at the Rate of Intereſt 2 *s.* 8 *d.* ½ to be paid now, will amount to 20 *s.* in 21 Years Time.

In order therefore to renew a Leaſe of 21 Years that hath but one Year lapſed, at the Rate of 10 *l. per Cent.* I look into the Table of Reverſions below, and under the Rate of Intereſt mentioned, and right againſt 21 Years in the common Angle of meeting, I have 2 *s.* 8 *d.* ½, which is the Fine to be paid to renew one Year lapſed in the ſaid Leaſe, and ſuppoſing the Rent to be 1 *l. per* Ann. for it is 21 Years e're the Leaſe is compleated; in which Time the Fine of 2 *s.* 8 *d.* ½. will amount to 20 *s.* and therefore by paying that Fine, the Leaſe may fairly be made up again.

Suppoſe again there be two Years lapſed in ſuch a Leaſe, allowing the ſame Rate of Intereſt. Looking into the following Table of Reverſions I find 20 *s.* to be paid 20 Years hence, is now worth in Ready Money 2 *s.* 11 *d.* ½, add this Summ to the former of 2 *s.* 8 *d.* ½, and their Summ which is 5 *s.* 8 *d.* is the Fine to be paid to make the Leaſe to 21 Years again, ſuppoſing the Rent to be 1 *l.*

Suppoſe an Eſtate in Fee-Simple, whoſe real Value is 100 *l.* But that it is *Mortgaged*, or *Leaſed* out for 20 Years: What is the Reverſion of it worth now, at 6 *l. per Cent.* Intereſt?

By the Table of Reverſions I find 1 *l.* to be paid 20 Years hence, is worth but 6 *s.* 2 *d.* ¼, and multiplying that by 100, I find,

| | *l.* | *s.* | *d.* |
|---|---|---|---|
| 100 times 6 *s.* is | 30 | 00 | 0 |
| 100 times 2 *d.* or 200 *d.* makes | | 16 | 0 |
| And 100 times ¼, or 300 *q.* makes | | 6 | 3 |
| Summ | 31 | 2 | 11 |

Wherefore 31 *l.* 2 *s.* 11 *d.* is the true preſent Value of 100 *l.* to be paid 20 Years hence.

How to value the Reverſion of any Leaſe or Annuity: See in the *Renewing of Leaſes.*

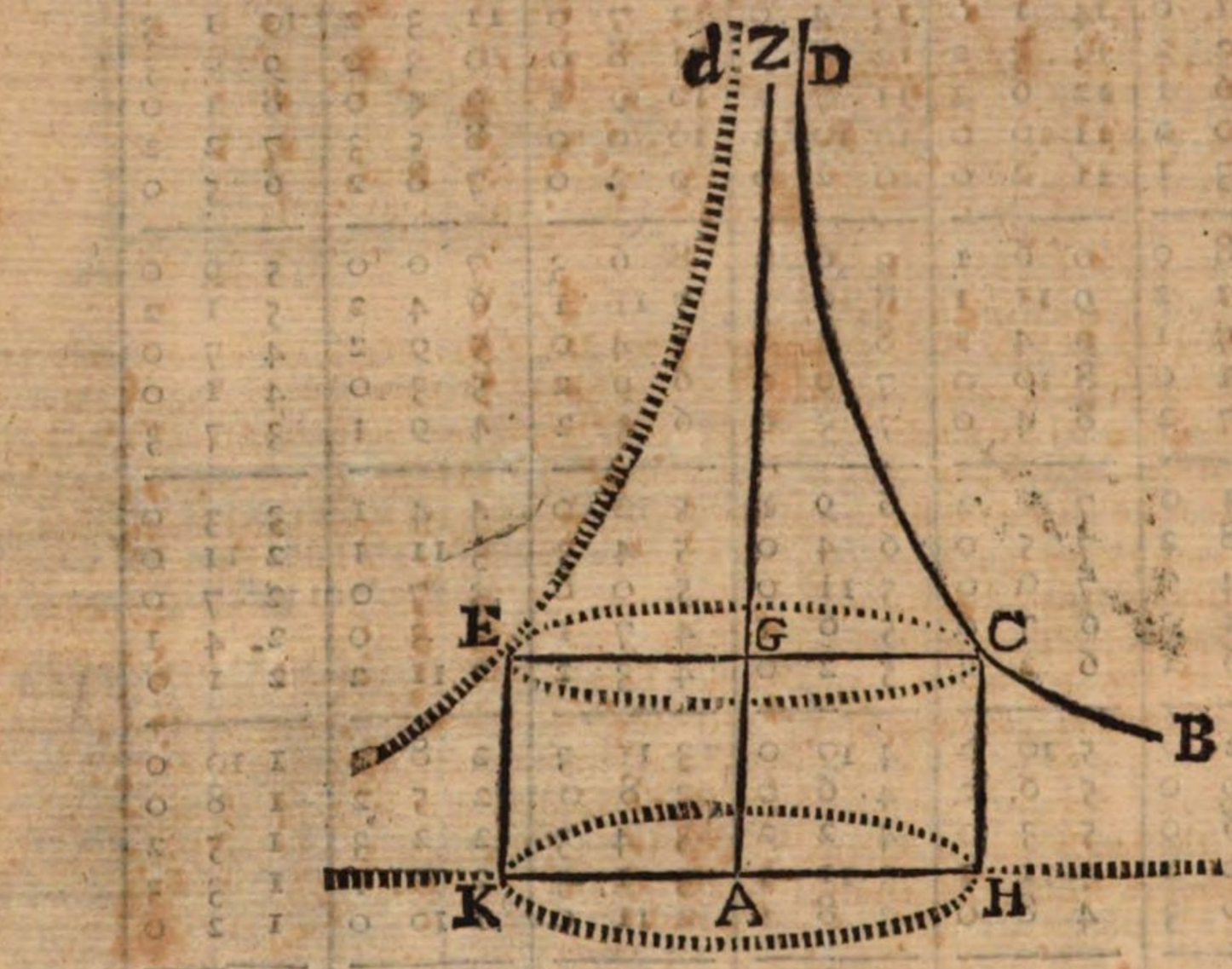
A Table of Reverſions ſhewing what 1 *l.* due any Number of Years hence, under 41 is worth in ready Money at 5. 6, 7, 8, 10, and 12 *l. per Cent.*

| Years. | 5 *per cent.* | | | 6 *per cent.* | | | 7 *per cent.* | | | 8 *per cent.* | | | 10 *p. cent.* | | | 12 *p. cent.* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s. | d. | q. | s. | d. | q. | s. | d. | q. | s. | d. | q. | s. | d. | q. | s. | d. | q. |
| 1 | 19 | 0 | 2 | 18 | 10 | 1 | 18 | 8 | 0 | 18 | 6 | 0 | 18 | 2 | 0 | 17 | 10 | 1 |
| 2 | 18 | 1 | 2 | 17 | 9 | 1 | 17 | 5 | 2 | 17 | 1 | 3 | 16 | 6 | 1 | 15 | 11 | 1 |
| 3 | 17 | 3 | 1 | 16 | 9 | 2 | 16 | 3 | 3 | 15 | 10 | 1 | 15 | 0 | 0 | 14 | 3 | 0 |
| 4 | 16 | 5 | 1 | 15 | 10 | 0 | 15 | 3 | 0 | 14 | 8 | 1 | 13 | 8 | 0 | 12 | 8 | 2 |
| 5 | 15 | 8 | 0 | 14 | 11 | 1 | 14 | 3 | 1 | 13 | 7 | 1 | 12 | 5 | 0 | 11 | 4 | 0 |
| 6 | 14 | 11 | 0 | 14 | 1 | 0 | 13 | 4 | 0 | 12 | 7 | 0 | 11 | 3 | 2 | 10 | 1 | 3 |
| 7 | 14 | 2 | 2 | 13 | 3 | 2 | 12 | 5 | 1 | 11 | 8 | 0 | 10 | 3 | 0 | 9 | 0 | 3 |
| 8 | 13 | 6 | 1 | 12 | 6 | 2 | 11 | 7 | 2 | 10 | 9 | 2 | 9 | 4 | 0 | 8 | 1 | 0 |
| 9 | 12 | 10 | 2 | 11 | 10 | 0 | 10 | 10 | 2 | 10 | 0 | 0 | 8 | 5 | 3 | 7 | 2 | 2 |
| 10 | 12 | 3 | 1 | 11 | 2 | 0 | 10 | 2 | 0 | 9 | 3 | 0 | 7 | 8 | 2 | 6 | 5 | 0 |
| 11 | 11 | 8 | 0 | 10 | 6 | 1 | 9 | 6 | 0 | 8 | 6 | 3 | 7 | 0 | 0 | 5 | 9 | 0 |
| 12 | 11 | 1 | 2 | 9 | 11 | 1 | 8 | 10 | 2 | 7 | 11 | 1 | 6 | 4 | 2 | 5 | 1 | 2 |
| 13 | 10 | 7 | 1 | 9 | 4 | 2 | 8 | 3 | 2 | 7 | 4 | 0 | 5 | 9 | 2 | 4 | 7 | 0 |
| 14 | 10 | 1 | 0 | 8 | 10 | 0 | 7 | 9 | 0 | 6 | 9 | 2 | 5 | 3 | 0 | 4 | 1 | 0 |
| 15 | 9 | 7 | 2 | 8 | 4 | 0 | 7 | 3 | 0 | 6 | 3 | 2 | 4 | 9 | 1 | 3 | 7 | 3 |
| 16 | 9 | 2 | 0 | 7 | 10 | 2 | 6 | 9 | 1 | 5 | 10 | 0 | 4 | 4 | 1 | 3 | 3 | 0 |
| 17 | 8 | 8 | 2 | 7 | 5 | 0 | 6 | 4 | 0 | 5 | 4 | 3 | 3 | 11 | 1 | 2 | 11 | 0 |
| 18 | 8 | 4 | 0 | 7 | 0 | 0 | 5 | 11 | 0 | 5 | 0 | 0 | 3 | 7 | 0 | 2 | 7 | 0 |
| 19 | 7 | 11 | 0 | 6 | 7 | 0 | 5 | 6 | 1 | 4 | 7 | 1 | 3 | 3 | 0 | 2 | 4 | 1 |
| 20 | 7 | 6 | 1 | 6 | 2 | 3 | 5 | 2 | 0 | 4 | 3 | 2 | 2 | 11 | 2 | 2 | 1 | 0 |
| 21 | 7 | 2 | 0 | 5 | 10 | 2 | 4 | 10 | 0 | 3 | 11 | 3 | 2 | 8 | 2 | 1 | 10 | 0 |
| 22 | 6 | 10 | 0 | 5 | 6 | 2 | 4 | 6 | 0 | 3 | 8 | 0 | 2 | 5 | 2 | 1 | 8 | 0 |
| 23 | 6 | 6 | 0 | 5 | 3 | 0 | 4 | 2 | 2 | 3 | 4 | 3 | 2 | 2 | 3 | 1 | 5 | 2 |
| 24 | 6 | 2 | 1 | 4 | 11 | 1 | 3 | 11 | 1 | 3 | 1 | 3 | 2 | 0 | 1 | 1 | 3 | 3 |
| 25 | 5 | 10 | 3 | 4 | 8 | 0 | 3 | 8 | 1 | 2 | 11 | 0 | 1 | 10 | 0 | 1 | 2 | 0 |
| 26 | 5 | 7 | 1 | 4 | 4 | 3 | 3 | 5 | 1 | 2 | 8 | 1 | 1 | 8 | 0 | 1 | 0 | 2 |
| 27 | 5 | 4 | 1 | 4 | 1 | 3 | 3 | 2 | 2 | 2 | 6 | 0 | 1 | 6 | 1 | | 11 | 0 |
| 28 | 5 | 1 | 0 | 3 | 10 | 3 | 3 | 0 | 0 | 2 | 3 | 3 | 1 | 4 | 2 | | 10 | 0 |
| 29 | 4 | 10 | 1 | 3 | 8 | 1 | 2 | 9 | 2 | 2 | 1 | 3 | 1 | 3 | 0 | | 9 | 0 |
| 30 | 4 | 7 | 2 | 3 | 6 | 1 | 2 | 7 | 2 | 1 | 11 | 3 | 1 | 1 | 3 | | 8 | 0 |
| 31 | 4 | 5 | 1 | 3 | 3 | 1 | 2 | 5 | 1 | 1 | 10 | 0 | 1 | 1 | 0 | | 7 | 0 |
| 32 | 4 | 2 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 1 | 8 | 1 | | 11 | 1 | | 6 | 1 |
| 33 | 4 | 0 | 0 | 2 | 10 | 1 | 2 | 1 | 2 | 1 | 6 | 3 | | 10 | 1 | | 5 | 2 |
| 34 | 3 | 9 | 2 | 2 | 8 | 3 | 2 | 0 | 0 | 1 | 5 | 1 | | 9 | 1 | | 5 | 1 |
| 35 | 3 | 7 | 2 | 2 | 6 | 2 | 1 | 10 | 2 | 1 | 4 | 0 | | 8 | 2 | | 4 | 2 |
| 36 | 3 | 5 | 1 | 2 | 5 | 1 | 1 | 9 | 0 | 1 | 3 | 0 | | 7 | 3 | | 4 | 0 |
| 37 | 3 | 3 | 1 | 2 | 3 | 2 | 1 | 7 | 2 | 1 | 2 | 0 | | 7 | 0 | | 3 | 1 |
| 38 | 3 | 1 | 2 | 2 | 2 | 0 | 1 | 6 | 2 | 1 | 1 | 0 | | 6 | 1 | | 3 | 0 |
| 39 | 2 | 11 | 3 | 2 | 0 | 0 | 1 | 5 | 0 | 1 | 0 | 0 | | 5 | 3 | | 3 | 0 |
| 40 | 2 | 10 | 0 | 1 | 11 | 0 | 1 | 4 | 0 | 0 | 11 | 0 | | 5 | 1 | | 2 | 2 |

REVERSION *of Series* in Algebra, is a Method to find a Number from its Logarithm, being given; or the Sine from its Ark: The Ordinate of an Ellepſis, from an Area given to be cut off from any Point in the Axis.

REVOLUTION: In Geometry the Motion of any Figure quite round a fixt Line (which is called therefore its Axis) is called the *Revolution* of that Figure; and the Figure ſo moving is ſaid to *Revolve*. Thus a Right-angled Triangle revolving round one of its Legs, as an Axis, generates by that Revolution a Cone. And to inſtance in a Caſe very wonderful; the Body called by *Torricellius Hyperbolicum Acutum*, tho'its ſelf (as he demonſtrates) be *Finite*; is yet formed by the *Revolution* of an *Infinite* Area: As in the Figure annexed.

Let A be the Centre of the Apollonian common Hyperbola D C B. A Z one of the Aſſymptotes, G C an Ordinate equal to the *Abſciſſa* G A. Compleat the Square G H. And ſuppoſing Z to be at an Infinite Diſtance, imagine the Space D C H A Z to *Revolve* about the Aſſymptote Z A, generating thereby the Body D C H A K E *d*, called the *Hyperbolicum Acutum: I ſay the Conick Body d*E G C D *is Finite and exactly Equal to the Cylinder* E K H C: *But yet the Aſſymptotick Space* G C D, *which its Revolution generates, is Infinite.*




For let a Unit, or 1. repreſent the Ordinate G C or G A. Then will the *Fluent* of the Space Z G C be $\frac{x^0}{0} = \frac{1}{0} =$ Infinite: And the *Fluent* of the Body *d*E G C is $\frac{x^*}{xx} = xyy =$ to the Cylinder E H.

RHANDIR in the Diviſion of the Country of *Wales* before the Conqueſt; what they called a *Cantref* contained an hundred Towns, under which were ſo many *Commots*: Each Commot had 12 *Mannors* or *Circuits*, and two *Townſhips*: There were 4 *Townſhips* to every *Mannor*; and every *Townſhip* comprehended 4 *Gavels*: And every *Gavel* had 4 *Rhandirs*, and in every *Rhandir* were 4 Tenements. *Taylor's Hiſt. of Gavel Kind*, p. 69.

RIAL, A Piece of Gold current, for ten Shillings: In 1 *H.* 6. by Indenture of the Mint, a Pound-weight of Gold of the old Standard, was coined into 45 Rials going for 10 Shillings a piece, or a proportionable Number of half Rials going at five Shilling apiece: Or,

RIALS *Farthings*? which went at 2 *s.* 6 *d.* In 1 *H.* 8. The Golden Rial was ordered to go at 11 *s.* 3 *d.* In 2 *Eliz.* Golden Rials were coined at 15 *s.* a piece, when a Pound-weight of old Standard Gold was to be coined into 48 Rials. In 3 *Jac.* 1. The *Roſe Rials* of Gold were coined at 30 *s.* a piece, and the *Spurr-Rials* at 15 Shillings.

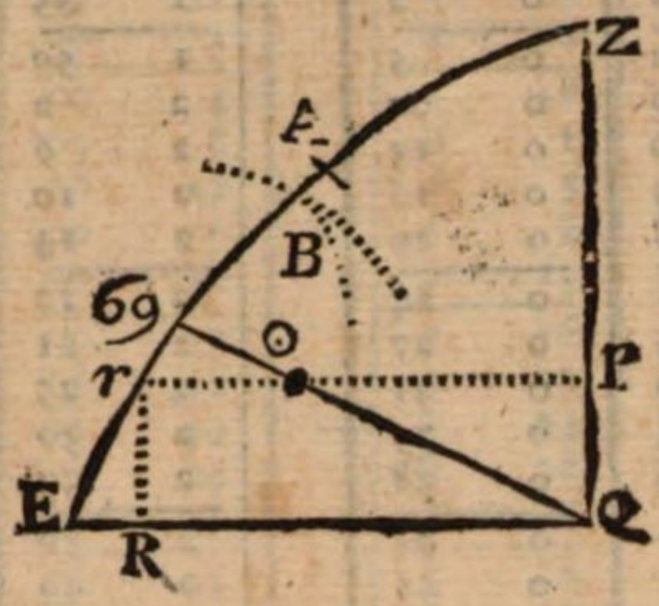
RIBBING *Nails* are ſuch as are uſed to faſten the Ribbing, or to keep the Ribs of a Ship in their Place.

RIDING *Clerk*, one of the ſix Clerks in Chancery, who in his Turn, for one Year, keeps the Controllment-Books of all Grants that paſs the Great Seal that Year. *Cowel.*

RIGHT

RIGHT *Aſcenſion of the Sun.* To find this by the Projection of Part of the Analemma readily; having given either his *Place*, or Declination.

In the Quadrant E Q Z, draw *r p* repreſenting the Parallel of the Sun's Declination; which (having taken E ☋; from the Chords = 23° 30′, and ſo draw *n* EQ) will find ⊙ for the Sun's place; or having the Point of ⊙ firſt, if through it you draw the Parallel *r p*, you will have E *r*, the Sun's preſent Declination. This done, ⊙ *p* will be the Sine of the Sun's right Aſcenſion to the Radius *r p*




Wherefore (by the Sector) ſay as *r p*, to ⊙ *p* :: EQ to a 4th Term; which will be the true Sine of the Sun's right Aſcenſion: But you may find it in the Diagram thus. Set *r p* from Q to R, on which Point R as a Centre, and with ⊙ *p* as a Radius, ſweep an Ark as B: Then a Ruler laid from Q, juſt to touch the Convexity of that Ark B, will find the Point A in the Limb. Then will E A, meaſured on the Chords be the Degrees of right Aſcenſion of the Sun, from the next Equinoctial Point.

Here follow Tables of the Sun's Right Aſcenſion, Declination, and Place in the Ecliptick, which I had from Mr. *James Hodgſon*, the Worthy Maſter of the Queen's Mathematical School in *Chriſt's-Hoſpital*; Together with Tables of the Right Aſcenſion, Declination, Longitude and Latitude of above Fifty of the principal fixed Stars: Moſt of the Firſt and Second, and ſome few of the Third Magnitude. All which Tables are fitted for the Enſuing Year 1710, and will ſerve without any ſenſible Errour for about Twenty Years to come. Their Uſe is ſo eaſie that it needs no Deſcription; and their Benefit and Advantage is ſo Univerſally and ſo previouſly neceſſary in all Aſtronomical Calculations, that they muſt have a Place in a Collection of this Nature.

# A *Table* of the *Sun's* Right Aſcenſion in Hours and Minutes for the Year, 1709.

| Days | *January.* h. | m. | *February.* h. | m. | *March.* h. | m. | *April.* h. | m. | *May.* h. | m. | *June.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 36 | 21 | 44 | 23 | 29 | 1 | 22 | 3 | 16 | 5 | 21 | 1 |
| 2 | 19 | 40 | 21 | 48 | 23 | 33 | 1 | 25 | 3 | 20 | 5 | 25 | 2 |
| 3 | 19 | 44 | 21 | 52 | 23 | 36 | 1 | 29 | 3 | 24 | 5 | 29 | 3 |
| 4 | 19 | 49 | 21 | 56 | 23 | 40 | 1 | 33 | 3 | 27 | 5 | 33 | 4 |
| 5 | 19 | 53 | 22 | 00 | 23 | 44 | 1 | 37 | 3 | 31 | 5 | 37 | 5 |
| 6 | 19 | 57 | 22 | 4 | 23 | 48 | 1 | 40 | 3 | 35 | 5 | 42 | 6 |
| 7 | 20 | 1 | 22 | 7 | 23 | 51 | 1 | 44 | 3 | 39 | 5 | 46 | 7 |
| 8 | 20 | 5 | 22 | 11 | 23 | 54 | 1 | 48 | 3 | 43 | 5 | 50 | 8 |
| 9 | 20 | 9 | 22 | 15 | 23 | 58 | 1 | 51 | 3 | 47 | 5 | 54 | 9 |
| 10 | 20 | 14 | 22 | 18 | 0 | 2 | 1 | 55 | 3 | 51 | 5 | 58 | 10 |
| 11 | 20 | 18 | 22 | 22 | 0 | 5 | 1 | 59 | 3 | 55 | 6 | 3 | 11 |
| 12 | 20 | 22 | 22 | 26 | 0 | 00 | 2 | 2 | 3 | 59 | 6 | 7 | 12 |
| 13 | 20 | 27 | 22 | 30 | 0 | 13 | 2 | 6 | 4 | 3 | 6 | 11 | 13 |
| 14 | 20 | 31 | 22 | 34 | 0 | 16 | 2 | 10 | 4 | 7 | 6 | 15 | 14 |
| 15 | 20 | 35 | 22 | 38 | 0 | 20 | 2 | 14 | 4 | 11 | 6 | 19 | 15 |
| 16 | 20 | 39 | 22 | 41 | 0 | 24 | 2 | 17 | 4 | 15 | 6 | 23 | 16 |
| 17 | 20 | 44 | 22 | 45 | 0 | 27 | 2 | 21 | 4 | 19 | 6 | 28 | 17 |
| 18 | 20 | 48 | 22 | 49 | 0 | 31 | 2 | 25 | 4 | 23 | 6 | 32 | 18 |
| 19 | 20 | 52 | 22 | 53 | 0 | 34 | 2 | 30 | 4 | 28 | 6 | 36 | 19 |
| 20 | 20 | 56 | 22 | 56 | 0 | 38 | 2 | 33 | 4 | 32 | 6 | 40 | 20 |
| 21 | 21 | 00 | 23 | 00 | 0 | 42 | 2 | 36 | 4 | 36 | 6 | 44 | 21 |
| 22 | 21 | 4 | 23 | 4 | 0 | 45 | 2 | 40 | 4 | 40 | 6 | 48 | 22 |
| 23 | 21 | 8 | 23 | 8 | 0 | 49 | 2 | 44 | 4 | 44 | 6 | 52 | 23 |
| 24 | 21 | 12 | 23 | 11 | 0 | 53 | 2 | 48 | 4 | 48 | 6 | 56 | 24 |
| 25 | 21 | 16 | 23 | 15 | 0 | 56 | 2 | 52 | 4 | 53 | 7 | 00 | 25 |
| 26 | 21 | 20 | 23 | 10 | 1 | 00 | 2 | 56 | 4 | 56 | 7 | 5 | 26 |
| 27 | 21 | 24 | 23 | 22 | 1 | 3 | 2 | 59 | 5 | 00 | 7 | 9 | 27 |
| 28 | 21 | 28 | 23 | 26 | 1 | 7 | 3 | 3 | 5 | 4 | 7 | 13 | 28 |
| 29 | 21 | 32 | | | 1 | 11 | 3 | 7 | 5 | 9 | 7 | 17 | 29 |
| 30 | 21 | 36 | | | 1 | 15 | 3 | 11 | 5 | 13 | 7 | 21 | 30 |
| 31 | 21 | 40 | | | 1 | 18 | | | | | | | 31 |

| Days | *July.* h. | m. | *Auguſt.* h. | m. | *September.* h. | m. | *October.* h. | m. | *ovember.* h. | m. | *December.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 25 | 9 | 27 | 11 | 21 | 13 | 10 | 15 | 10 | 17 | 18 | 1 |
| 2 | 7 | 29 | 9 | 31 | 11 | 24 | 13 | 13 | 15 | 14 | 17 | 22 | 2 |
| 3 | 7 | 33 | 9 | 35 | 11 | 28 | 13 | 17 | 15 | 18 | 17 | 26 | 3 |
| 4 | 7 | 38 | 9 | 38 | 11 | 32 | 13 | 21 | 15 | 22 | 17 | 31 | 4 |
| 5 | 7 | 42 | 9 | 42 | 11 | 35 | 13 | 25 | 15 | 26 | 17 | 35 | 5 |
| 6 | 7 | 46 | 9 | 46 | 11 | 39 | 13 | 28 | 15 | 30 | 17 | 40 | 6 |
| 7 | 7 | 49 | 9 | 50 | 11 | 42 | 13 | 32 | 15 | 34 | 17 | 44 | 7 |
| 8 | 7 | 54 | 9 | 54 | 11 | 46 | 13 | 36 | 15 | 38 | 17 | 49 | 8 |
| 9 | 7 | 58 | 9 | 57 | 11 | 50 | 13 | 40 | 15 | 43 | 17 | 53 | 9 |
| 10 | 8 | 1 | 10 | 1 | 11 | 53 | 13 | 43 | 15 | 47 | 17 | 58 | 10 |
| 11 | 8 | 6 | 10 | 4 | 11 | 57 | 13 | 46 | 15 | 51 | 18 | 2 | 11 |
| 12 | 8 | 10 | 10 | 8 | 12 | 1 | 13 | 51 | 15 | 55 | 18 | 7 | 12 |
| 13 | 8 | 14 | 10 | 11 | 12 | 4 | 13 | 54 | 16 | 00 | 18 | 11 | 13 |
| 14 | 8 | 18 | 10 | 15 | 12 | 8 | 13 | 58 | 16 | 4 | 18 | 16 | 14 |
| 15 | 8 | 21 | 10 | 19 | 12 | 12 | 14 | 1 | 16 | 8 | 18 | 20 | 15 |
| 16 | 8 | 25 | 10 | 22 | 12 | 15 | 14 | 6 | 16 | 13 | 18 | 24 | 16 |
| 17 | 8 | 29 | 10 | 26 | 12 | 19 | 14 | 9 | 16 | 17 | 18 | 29 | 17 |
| 18 | 8 | 33 | 10 | 30 | 12 | 22 | 14 | 13 | 16 | 21 | 18 | 33 | 18 |
| 19 | 8 | 37 | 10 | 33 | 12 | 26 | 14 | 17 | 16 | 25 | 18 | 38 | 19 |
| 20 | 8 | 41 | 10 | 37 | 12 | 29 | 14 | 22 | 16 | 30 | 18 | 42 | 20 |
| 21 | 8 | 45 | 10 | 41 | 12 | 32 | 14 | 26 | 16 | 34 | 18 | 46 | 21 |
| 22 | 8 | 49 | 10 | 44 | 12 | 36 | 14 | 30 | 16 | 39 | 18 | 51 | 22 |
| 23 | 8 | 53 | 10 | 47 | 12 | 40 | 14 | 34 | 16 | 43 | 18 | 55 | 23 |
| 24 | 8 | 56 | 10 | 51 | 12 | 43 | 14 | 38 | 16 | 47 | 19 | 00 | 24 |
| 25 | 9 | 00 | 10 | 55 | 12 | 47 | 14 | 42 | 16 | 52 | 19 | 4 | 25 |
| 26 | 9 | 4 | 10 | 58 | 12 | 51 | 14 | 46 | 16 | 56 | 19 | 9 | 26 |
| 27 | 9 | 8 | 11 | 2 | 12 | 54 | 14 | 50 | 17 | 00 | 19 | 13 | 27 |
| 28 | 9 | 12 | 11 | 7 | 12 | 58 | 14 | 54 | 17 | 4 | 19 | 17 | 28 |
| 29 | 9 | 16 | 11 | 9 | 13 | 2 | 14 | 58 | 17 | 9 | 19 | 22 | 29 |
| 30 | 9 | 20 | 11 | 14 | 13 | 6 | 15 | 2 | 17 | 13 | 19 | 26 | 30 |
| 31 | 9 | 24 | 11 | 16 | | | 5 | 6 | | | 19 | 30 | 31 |

# A *Table* of the *Sun*'s Right Aſcenſion in Hours and Minutes for the Year, 1710.

| Days | *January.* h. | m. | *February.* h. | m. | *March.* h. | m. | *April.* h. | m. | *May.* h. | m. | *June.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 35 | 21 | 43 | 23 | 29 | 1 | 21 | 3 | 15 | 5 | 20 | 1 |
| 2 | 19 | 39 | 21 | 47 | 23 | 32 | 1 | 24 | 3 | 19 | 5 | 24 | 2 |
| 3 | 19 | 43 | 21 | 51 | 23 | 36 | 1 | 28 | 3 | 22 | 5 | 28 | 3 |
| 4 | 19 | 48 | 21 | 55 | 23 | 40 | 1 | 32 | 3 | 26 | 5 | 32 | 4 |
| 5 | 19 | 52 | 21 | 59 | 23 | 43 | 1 | 36 | 3 | 30 | 5 | 36 | 5 |
| 6 | 19 | 56 | 22 | 3 | 23 | 47 | 1 | 39 | 3 | 34 | 5 | 41 | 6 |
| 7 | 20 | 00 | 22 | 6 | 23 | 51 | 1 | 43 | 3 | 38 | 5 | 45 | 7 |
| 8 | 20 | 4 | 22 | 10 | 23 | 54 | 1 | 47 | 3 | 42 | 5 | 49 | 8 |
| 9 | 20 | 8 | 22 | 14 | 23 | 58 | 1 | 51 | 3 | 46 | 5 | 53 | 9 |
| 10 | 20 | 13 | 22 | 18 | 00 | 1 | 1 | 55 | 3 | 50 | 5 | 57 | 10 |
| 11 | 20 | 17 | 22 | 21 | 00 | 4 | 1 | 58 | 3 | 54 | 6 | 2 | 11 |
| 12 | 20 | 21 | 22 | 25 | 00 | 8 | 2 | 1 | 3 | 58 | 6 | 6 | 12 |
| 13 | 20 | 26 | 22 | 29 | 00 | 12 | 2 | 5 | 4 | 2 | 6 | 10 | 13 |
| 14 | 20 | 30 | 22 | 33 | 00 | 16 | 2 | 9 | 4 | 6 | 6 | 14 | 14 |
| 15 | 20 | 34 | 22 | 37 | 00 | 20 | 2 | 13 | 4 | 10 | 6 | 18 | 15 |
| 16 | 20 | 38 | 22 | 40 | 00 | 23 | 2 | 16 | 4 | 14 | 6 | 22 | 16 |
| 17 | 20 | 43 | 22 | 44 | 00 | 26 | 2 | 20 | 4 | 18 | 6 | 27 | 17 |
| 18 | 20 | 47 | 22 | 48 | 00 | 30 | 2 | 24 | 4 | 22 | 6 | 31 | 18 |
| 19 | 20 | 51 | 22 | 52 | 00 | 34 | 2 | 28 | 4 | 27 | 6 | 35 | 19 |
| 20 | 20 | 55 | 22 | 55 | 00 | 38 | 2 | 32 | 4 | 31 | 6 | 39 | 20 |
| 21 | 20 | 59 | 22 | 59 | 00 | 41 | 2 | 35 | 4 | 35 | 6 | 43 | 21 |
| 22 | 21 | 3 | 23 | 3 | 00 | 44 | 2 | 39 | 4 | 39 | 6 | 47 | 22 |
| 23 | 21 | 7 | 23 | 7 | 00 | 48 | 2 | 43 | 4 | 43 | 6 | 51 | 23 |
| 24 | 21 | 11 | 23 | 10 | 00 | 52 | 2 | 47 | 4 | 47 | 6 | 55 | 24 |
| 25 | 21 | 15 | 23 | 14 | 00 | 55 | 2 | 51 | 4 | 51 | 6 | 59 | 25 |
| 26 | 21 | 19 | 23 | 18 | 00 | 59 | 2 | 55 | 4 | 55 | 7 | 4 | 26 |
| 27 | 21 | 23 | 23 | 21 | 1 | 2 | 2 | 58 | 4 | 59 | 7 | 8 | 27 |
| 28 | 21 | 27 | 23 | 25 | 1 | 6 | 3 | 2 | 5 | 3 | 7 | 12 | 28 |
| 29 | 21 | 31 | | | 1 | 10 | 3 | 6 | 5 | 8 | 7 | 16 | 29 |
| 30 | 21 | 35 | | | 1 | 14 | 3 | 11 | 5 | 12 | 7 | 20 | 30 |
| 31 | 21 | 39 | | | 1 | 17 | | | 5 | 16 | | | 31 |

| Days | *July.* h. | m. | *Auguſt.* h. | m. | *September.* h. | m. | *October.* h. | m. | *November.* h. | m. | *December.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 24 | 9 | 26 | 11 | 20 | 13 | 9 | 15 | 9 | 17 | 17 | 1 |
| 2 | 7 | 28 | 9 | 30 | 11 | 23 | 13 | 12 | 15 | 13 | 17 | 21 | 2 |
| 3 | 7 | 32 | 9 | 34 | 11 | 27 | 13 | 16 | 15 | 17 | 17 | 25 | 3 |
| 4 | 7 | 36 | 9 | 37 | 11 | 31 | 13 | 20 | 15 | 21 | 17 | 30 | 4 |
| 5 | 7 | 40 | 9 | 41 | 11 | 34 | 13 | 24 | 15 | 25 | 17 | 34 | 5 |
| 6 | 7 | 44 | 9 | 45 | 11 | 38 | 13 | 27 | 15 | 29 | 17 | 39 | 6 |
| 7 | 7 | 48 | 9 | 49 | 11 | 41 | 13 | 31 | 15 | 33 | 17 | 43 | 7 |
| 8 | 7 | 52 | 9 | 53 | 11 | 45 | 13 | 35 | 15 | 37 | 17 | 48 | 8 |
| 9 | 7 | 56 | 9 | 6 | 11 | 49 | 13 | 39 | 15 | 42 | 17 | 52 | 9 |
| 10 | 8 | 1 | 10 | 00 | 11 | 53 | 13 | 42 | 15 | 46 | 17 | 57 | 10 |
| 11 | 8 | 5 | 10 | 4 | 11 | 56 | 13 | 46 | 15 | 50 | 18 | 1 | 11 |
| 12 | 8 | 9 | 10 | 7 | 12 | 00 | 13 | 40 | 15 | 54 | 18 | 5 | 12 |
| 13 | 8 | 13 | 10 | 11 | 12 | 3 | 13 | 54 | 15 | 59 | 18 | 10 | 13 |
| 14 | 8 | 17 | 10 | 15 | 12 | 7 | 13 | 58 | 16 | 3 | 18 | 14 | 14 |
| 15 | 8 | 21 | 10 | 18 | 12 | 11 | 14 | 1 | 16 | 7 | 18 | 19 | 15 |
| 16 | 8 | 25 | 10 | 22 | 12 | 14 | 14 | 5 | 16 | 11 | 18 | 23 | 16 |
| 17 | 8 | 29 | 10 | 26 | 12 | 18 | 14 | 9 | 16 | 16 | 18 | 27 | 17 |
| 18 | 8 | 33 | 10 | 29 | 12 | 21 | 14 | 13 | 16 | 20 | 18 | 32 | 18 |
| 19 | 8 | 36 | 10 | 33 | 12 | 24 | 14 | 17 | 16 | 24 | 18 | 36 | 19 |
| 20 | 8 | 40 | 10 | 37 | 12 | 28 | 14 | 21 | 16 | 29 | 18 | 41 | 20 |
| 21 | 8 | 44 | 10 | 40 | 12 | 31 | 14 | 25 | 16 | 33 | 18 | 45 | 21 |
| 22 | 8 | 48 | 10 | 44 | 12 | 35 | 14 | 29 | 16 | 37 | 18 | 50 | 22 |
| 23 | 8 | 52 | 10 | 47 | 12 | 39 | 14 | 33 | 16 | 42 | 18 | 54 | 23 |
| 24 | 8 | 55 | 10 | 51 | 12 | 43 | 14 | 37 | 16 | 46 | 18 | 58 | 24 |
| 25 | 8 | 59 | 10 | 55 | 12 | 47 | 14 | 41 | 16 | 50 | 19 | 3 | 25 |
| 26 | 9 | 3 | 10 | 58 | 12 | 50 | 14 | 45 | 16 | 54 | 19 | 7 | 26 |
| 27 | 9 | 7 | 11 | 1 | 12 | 54 | 14 | 49 | 16 | 59 | 19 | 12 | 27 |
| 28 | 9 | 11 | 11 | 5 | 12 | 58 | 14 | 53 | 17 | 3 | 19 | 16 | 28 |
| 29 | 9 | 15 | 11 | 9 | 13 | 1 | 14 | 57 | 17 | 8 | 19 | 20 | 29 |
| 30 | 9 | 18 | 11 | 13 | 13 | 5 | 15 | 1 | 17 | 12 | 19 | 25 | 30 |
| 31 | 9 | 22 | 11 | 16 | | | 15 | 5 | | | 19 | 29 | 31 |

# A *Table* of the *Sun*'s Right Aſcenſion in Hours and Minutes for the Year, 1711.

| Days | *January.* h. | m. | *February.* h. | m. | *March.* h. | m. | *April.* h. | m. | *May.* h. | m. | *June.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 34 | 21 | 42 | 23 | 28 | 1 | 21 | 3 | 14 | 5 | 19 | 1 |
| 2 | 19 | 38 | 21 | 46 | 23 | 31 | 1 | 24 | 3 | 18 | 5 | 23 | 2 |
| 3 | 19 | 42 | 21 | 50 | 23 | 35 | 1 | 28 | 3 | 22 | 5 | 27 | 3 |
| 4 | 19 | 47 | 21 | 54 | 23 | 39 | 1 | 31 | 3 | 25 | 5 | 31 | 4 |
| 5 | 19 | 51 | 21 | 58 | 23 | 42 | 1 | 35 | 3 | 29 | 5 | 35 | 5 |
| 6 | 19 | 55 | 22 | 2 | 23 | 46 | 1 | 39 | 3 | 33 | 5 | 40 | 6 |
| 7 | 19 | 59 | 22 | 5 | 23 | 50 | 1 | 43 | 3 | 37 | 5 | 44 | 7 |
| 8 | 20 | 3 | 22 | 9 | 23 | 53 | 1 | 46 | 3 | 41 | 5 | 48 | 8 |
| 9 | 20 | 7 | 22 | 13 | 23 | 57 | 1 | 50 | 3 | 45 | 5 | 52 | 9 |
| 10 | 20 | 12 | 22 | 17 | 00 | 1 | 1 | 54 | 3 | 49 | 5 | 56 | 10 |
| 11 | 20 | 16 | 22 | 20 | 00 | 4 | 1 | 57 | 3 | 53 | 6 | 1 | 11 |
| 12 | 20 | 20 | 22 | 24 | 00 | 8 | 2 | 1 | 3 | 57 | 6 | 5 | 12 |
| 13 | 20 | 25 | 22 | 28 | 00 | 11 | 2 | 5 | 4 | 1 | 6 | 9 | 13 |
| 14 | 20 | 29 | 22 | 32 | 00 | 15 | 2 | 9 | 4 | 5 | 6 | 13 | 14 |
| 15 | 20 | 33 | 22 | 36 | 00 | 19 | 2 | 12 | 4 | 9 | 6 | 17 | 15 |
| 16 | 20 | 37 | 22 | 39 | 00 | 22 | 2 | 16 | 4 | 13 | 6 | 21 | 16 |
| 17 | 20 | 42 | 22 | 43 | 00 | 26 | 2 | 20 | 4 | 17 | 6 | 26 | 17 |
| 18 | 20 | 46 | 22 | 47 | 00 | 29 | 2 | 24 | 4 | 21 | 6 | 30 | 18 |
| 19 | 20 | 50 | 22 | 51 | 00 | 33 | 2 | 28 | 4 | 26 | 6 | 34 | 19 |
| 20 | 20 | 54 | 22 | 54 | 00 | 37 | 2 | 32 | 4 | 30 | 6 | 38 | 20 |
| 21 | 20 | 58 | 22 | 58 | 00 | 40 | 2 | 35 | 4 | 34 | 6 | 42 | 21 |
| 22 | 21 | 2 | 23 | 2 | 00 | 44 | 2 | 39 | 4 | 38 | 6 | 46 | 22 |
| 23 | 21 | 6 | 23 | 6 | 00 | 48 | 2 | 43 | 4 | 42 | 6 | 50 | 23 |
| 24 | 21 | 10 | 23 | 9 | 00 | 51 | 2 | 47 | 4 | 46 | 6 | 54 | 24 |
| 25 | 21 | 14 | 23 | 13 | 00 | 55 | 2 | 51 | 4 | 50 | 6 | 58 | 25 |
| 26 | 21 | 18 | 23 | 17 | 00 | 59 | 2 | 54 | 4 | 54 | 7 | 3 | 26 |
| 27 | 21 | 22 | 23 | 20 | 1 | 2 | 2 | 58 | 4 | 58 | 7 | 7 | 27 |
| 28 | 21 | 26 | 23 | 24 | 1 | 6 | 3 | 2 | 5 | 2 | 7 | 11 | 28 |
| 29 | 21 | 30 | | | 1 | 10 | 3 | 6 | 5 | 7 | 7 | 15 | 29 |
| 30 | 21 | 34 | | | 1 | 13 | 3 | 10 | 5 | 11 | 7 | 19 | 30 |
| 31 | 21 | 28 | | | 1 | 17 | | | 5 | 15 | | | 31 |

| Days | *July.* h. | m. | *Auguſt.* h. | m. | *September.* h. | m. | *October.* h. | m. | *November.* h. | m. | *December.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 23 | 9 | 25 | 11 | 19 | 13 | 8 | 15 | 8 | 17 | 16 | 1 |
| 2 | 7 | 27 | 9 | 29 | 11 | 22 | 13 | 11 | 15 | 12 | 17 | 20 | 2 |
| 3 | 7 | 31 | 9 | 33 | 11 | 26 | 13 | 15 | 15 | 16 | 17 | 24 | 3 |
| 4 | 7 | 35 | 9 | 36 | 11 | 30 | 13 | 19 | 15 | 20 | 17 | 29 | 4 |
| 5 | 7 | 39 | 9 | 40 | 11 | 33 | 13 | 23 | 15 | 24 | 17 | 32 | 5 |
| 6 | 7 | 43 | 9 | 44 | 11 | 37 | 13 | 26 | 15 | 28 | 17 | 38 | 6 |
| 7 | 7 | 47 | 9 | 48 | 11 | 40 | 13 | 30 | 15 | 32 | 17 | 42 | 7 |
| 8 | 7 | 51 | 9 | 52 | 11 | 44 | 13 | 34 | 15 | 36 | 17 | 47 | 8 |
| 9 | 7 | 55 | 9 | 55 | 11 | 48 | 13 | 38 | 15 | 41 | 17 | 51 | 9 |
| 10 | 7 | 59 | 9 | 59 | 11 | 51 | 13 | 41 | 15 | 45 | 17 | 55 | 10 |
| 11 | 8 | 3 | 10 | 3 | 11 | 55 | 13 | 45 | 15 | 49 | 18 | 00 | 11 |
| 12 | 8 | 7 | 10 | 6 | 11 | 59 | 13 | 49 | 15 | 53 | 18 | 4 | 12 |
| 13 | 8 | 11 | 10 | 10 | 12 | 2 | 13 | 53 | 15 | 58 | 18 | 9 | 13 |
| 14 | 8 | 15 | 10 | 14 | 12 | 6 | 13 | 57 | 16 | 2 | 18 | 13 | 14 |
| 15 | 8 | 19 | 10 | 17 | 12 | 10 | 14 | 00 | 16 | 6 | 18 | 18 | 15 |
| 16 | 8 | 23 | 10 | 21 | 12 | 13 | 14 | 4 | 16 | 10 | 18 | 22 | 16 |
| 17 | 8 | 27 | 10 | 25 | 12 | 17 | 14 | 8 | 16 | 15 | 18 | 26 | 17 |
| 18 | 8 | 31 | 10 | 28 | 12 | 20 | 14 | 12 | 16 | 19 | 18 | 31 | 18 |
| 19 | 8 | 35 | 10 | 32 | 12 | 24 | 14 | 16 | 16 | 23 | 18 | 35 | 19 |
| 20 | 8 | 39 | 10 | 36 | 12 | 28 | 14 | 20 | 16 | 27 | 18 | 40 | 20 |
| 21 | 8 | 43 | 10 | 39 | 12 | 31 | 14 | 24 | 16 | 32 | 18 | 44 | 21 |
| 22 | 8 | 47 | 10 | 43 | 12 | 35 | 14 | 28 | 16 | 36 | 18 | 49 | 22 |
| 23 | 8 | 51 | 10 | 46 | 12 | 38 | 14 | 32 | 16 | 41 | 18 | 53 | 23 |
| 24 | 8 | 54 | 10 | 50 | 12 | 42 | 14 | 36 | 16 | 45 | 18 | 57 | 24 |
| 25 | 8 | 58 | 10 | 54 | 12 | 46 | 14 | 40 | 16 | 49 | 19 | 2 | 25 |
| 26 | 9 | 2 | 10 | 57 | 12 | 49 | 14 | 44 | 16 | 53 | 19 | 6 | 26 |
| 27 | 9 | 6 | 11 | 1 | 12 | 53 | 14 | 48 | 16 | 58 | 19 | 11 | 27 |
| 28 | 9 | 10 | 11 | 5 | 12 | 57 | 14 | 52 | 17 | 2 | 19 | 15 | 28 |
| 29 | 9 | 14 | 11 | 8 | 13 | 00 | 14 | 56 | 17 | 7 | 19 | 19 | 29 |
| 30 | 9 | 18 | 11 | 12 | 13 | 4 | 15 | 00 | 17 | 11 | 19 | 24 | 30 |
| 31 | 9 | 21 | 11 | 15 | | | 15 | 4 | | | 19 | 28 | 31 |

# A *Table* of the *Sun*'s Right Aſcenſion in Hours and Minutes for the Year, 1712.

| Days | *January.* h. | m. | *February.* h. | m. | *March.* h. | m. | *April.* h. | m. | *May.* h. | m. | *June.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 33 | 21 | 41 | 23 | 30 | 1 | 22 | 3 | 16 | 5 | 22 | 1 |
| 2 | 19 | 37 | 21 | 45 | 23 | 34 | 1 | 26 | 3 | 20 | 5 | 26 | 2 |
| 3 | 19 | 41 | 21 | 49 | 23 | 37 | 1 | 30 | 3 | 24 | 5 | 30 | 3 |
| 4 | 19 | 46 | 21 | 53 | 23 | 41 | 1 | 34 | 3 | 28 | 5 | 34 | 4 |
| 5 | 19 | 50 | 21 | 57 | 23 | 45 | 1 | 38 | 3 | 32 | 5 | 38 | 5 |
| 6 | 19 | 54 | 22 | 1 | 23 | 49 | 1 | 41 | 3 | 36 | 5 | 43 | 6 |
| 7 | 19 | 58 | 22 | 4 | 23 | 52 | 1 | 45 | 3 | 40 | 5 | 47 | 7 |
| 8 | 20 | 2 | 22 | 9 | 23 | 55 | 1 | 49 | 3 | 44 | 5 | 51 | 8 |
| 9 | 20 | 6 | 22 | 13 | 23 | 59 | 1 | 52 | 3 | 48 | 5 | 55 | 9 |
| 10 | 20 | 11 | 22 | 16 | 0 | 3 | 1 | 56 | 3 | 52 | 6 | 00 | 10 |
| 11 | 20 | 15 | 22 | 19 | 0 | 6 | 2 | 00 | 3 | 56 | 6 | 4 | 11 |
| 12 | 20 | 19 | 22 | 23 | 0 | 10 | 2 | 3 | 4 | 00 | 6 | 8 | 12 |
| 13 | 20 | 24 | 22 | 27 | 0 | 14 | 2 | 7 | 4 | 4 | 6 | 12 | 13 |
| 14 | 20 | 28 | 22 | 31 | 0 | 17 | 2 | 11 | 4 | 8 | 6 | 16 | 14 |
| 15 | 20 | 32 | 22 | 35 | 0 | 21 | 2 | 15 | 4 | 12 | 6 | 21 | 15 |
| 16 | 20 | 36 | 22 | 38 | 0 | 25 | 2 | 18 | 4 | 16 | 6 | 25 | 6 |
| 17 | 20 | 41 | 22 | 42 | 0 | 28 | 2 | 22 | 4 | 20 | 6 | 29 | 17 |
| 18 | 20 | 45 | 22 | 46 | 0 | 32 | 2 | 26 | 4 | 24 | 6 | 33 | 18 |
| 19 | 20 | 49 | 22 | 50 | 0 | 35 | 2 | 30 | 4 | 29 | 6 | 37 | 19 |
| 20 | 20 | 53 | 22 | 53 | 0 | 39 | 2 | 34 | 4 | 33 | 6 | 41 | 20 |
| 21 | 20 | 57 | 22 | 57 | 0 | 43 | 2 | 37 | 4 | 37 | 6 | 45 | 21 |
| 22 | 21 | 1 | 23 | 1 | 0 | 46 | 2 | 41 | 4 | 41 | 6 | 49 | 22 |
| 23 | 21 | 5 | 23 | 5 | 0 | 50 | 2 | 45 | 4 | 45 | 6 | 53 | 23 |
| 24 | 21 | 9 | 23 | 8 | 0 | 54 | 2 | 49 | 4 | 49 | 6 | 57 | 24 |
| 25 | 21 | 13 | 23 | 12 | 0 | 57 | 2 | 53 | 4 | 53 | 7 | 2 | 25 |
| 26 | 21 | 17 | 23 | 16 | 1 | 1 | 2 | 57 | 4 | 57 | 7 | 6 | 26 |
| 27 | 21 | 21 | 23 | 19 | 1 | 4 | 3 | 00 | 5 | 1 | 7 | 10 | 27 |
| 28 | 21 | 25 | 23 | 23 | 1 | 8 | 3 | 4 | 5 | 5 | 7 | 14 | 28 |
| 29 | 21 | 29 | 23 | 27 | 1 | 12 | 3 | 8 | 5 | 9 | 7 | 18 | 29 |
| 30 | 21 | 33 | | | 1 | 16 | 3 | 12 | 5 | 14 | 7 | 22 | 30 |
| 31 | 21 | 37 | | | 1 | 18 | | | 5 | 18 | | | 31 |

| Days | *July.* h. | m. | *August.* h. | m. | *September.* h. | m. | *October.* h. | m. | *November.* h. | m. | *December.* h. | m. | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 26 | 9 | 28 | 11 | 21 | 13 | 11 | 15 | 11 | 17 | 19 | 1 |
| 2 | 7 | 30 | 9 | 32 | 11 | 24 | 13 | 15 | 15 | 15 | 17 | 23 | 2 |
| 3 | 7 | 34 | 9 | 36 | 11 | 28 | 13 | 18 | 15 | 19 | 17 | 27 | 3 |
| 4 | 7 | 39 | 9 | 39 | 11 | 32 | 13 | 22 | 15 | 23 | 17 | 32 | 4 |
| 5 | 7 | 43 | 9 | 43 | 11 | 36 | 13 | 26 | 15 | 27 | 17 | 36 | 5 |
| 6 | 7 | 47 | 9 | 47 | 11 | 39 | 13 | 29 | 15 | 31 | 17 | 41 | 6 |
| 7 | 7 | 50 | 9 | 51 | 11 | 43 | 13 | 33 | 15 | 35 | 17 | 45 | 7 |
| 8 | 7 | 54 | 9 | 55 | 11 | 46 | 13 | 37 | 15 | 39 | 17 | 50 | 8 |
| 9 | 7 | 58 | 9 | 58 | 11 | 50 | 13 | 41 | 15 | 44 | 17 | 54 | 9 |
| 10 | 8 | 2 | 10 | 2 | 11 | 54 | 13 | 44 | 15 | 48 | 17 | 59 | 10 |
| 11 | 8 | 6 | 10 | 6 | 11 | 57 | 13 | 48 | 15 | 52 | 18 | 3 | 11 |
| 12 | 8 | 10 | 10 | 9 | 12 | 1 | 13 | 52 | 15 | 56 | 18 | 7 | 12 |
| 13 | 8 | 14 | 10 | 13 | 12 | 5 | 13 | 56 | 16 | 1 | 18 | 12 | 13 |
| 14 | 8 | 18 | 10 | 17 | 12 | 8 | 14 | 00 | 16 | 5 | 18 | 17 | 14 |
| 15 | 8 | 22 | 10 | 20 | 12 | 12 | 14 | 3 | 16 | 9 | 18 | 21 | 15 |
| 16 | 8 | 26 | 10 | 24 | 12 | 16 | 14 | 7 | 16 | 13 | 18 | 25 | 16 |
| 17 | 8 | 30 | 10 | 28 | 12 | 19 | 14 | 11 | 16 | 18 | 18 | 30 | 17 |
| 18 | 8 | 34 | 10 | 31 | 12 | 23 | 14 | 15 | 16 | 22 | 18 | 34 | 18 |
| 19 | 8 | 38 | 10 | 35 | 12 | 26 | 14 | 19 | 16 | 26 | 18 | 39 | 19 |
| 20 | 8 | 42 | 10 | 38 | 12 | 30 | 14 | 23 | 16 | 31 | 18 | 42 | 20 |
| 21 | 8 | 46 | 10 | 42 | 12 | 33 | 14 | 27 | 16 | 35 | 18 | 47 | 21 |
| 22 | 8 | 50 | 10 | 45 | 12 | 37 | 14 | 31 | 16 | 40 | 18 | 52 | 22 |
| 23 | 8 | 54 | 10 | 49 | 12 | 41 | 14 | 35 | 16 | 44 | 18 | 56 | 23 |
| 24 | 8 | 57 | 10 | 52 | 12 | 44 | 14 | 39 | 16 | 48 | 19 | 00 | 24 |
| 25 | 9 | 1 | 10 | 56 | 12 | 48 | 14 | 43 | 16 | 52 | 19 | 5 | 25 |
| 26 | 9 | 5 | 11 | 00 | 12 | 52 | 14 | 47 | 16 | 56 | 19 | 10 | 26 |
| 27 | 9 | 9 | 11 | 3 | 12 | 55 | 14 | 51 | 17 | 1 | 19 | 14 | 27 |
| 28 | 9 | 13 | 11 | 7 | 12 | 59 | 14 | 55 | 17 | 5 | 19 | 18 | 28 |
| 29 | 9 | 17 | 11 | 11 | 13 | 3 | 14 | 59 | 17 | 10 | 19 | 23 | 29 |
| 30 | 9 | 20 | 11 | 14 | 13 | 7 | 15 | 3 | 17 | 14 | 19 | 27 | 30 |
| 31 | 9 | 24 | 11 | 17 | | | 15 | 7 | | | 19 | 31 | 31 |

# A Table of the Sun's Declination for the Year 1709.

| Days | January. Dec. S. | | February. S | | March. S* | | April. N | | May. N | | June. N | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 38 | 13 | 38 | 3 | 15 | 8 | 45 | 18 | 11 | 23 | 12 | 1 |
| 2 | 21 | 27 | 13 | 18 | 2 | 51 | 9 | 7 | 18 | 26 | 23 | 16 | 2 |
| 3 | 21 | 17 | 12 | 58 | 2 | 27 | 9 | 28 | 18 | 41 | 23 | 19 | 3 |
| 4 | 21 | 6 | 12 | 37 | 2 | 3 | 9 | 49 | 18 | 55 | 23 | 22 | 4 |
| 5 | 20 | 55 | 12 | 16 | 1 | 40 | 10 | 11 | 19 | 9 | 23 | 24 | 5 |
| 6 | 20 | 43 | 11 | 55 | 1 | 16 | 10 | 32 | 19 | 23 | 23 | 26 | 6 |
| 7 | 20 | 31 | 11 | 34 | 0 | 52 | 11 | 53 | 19 | 36 | 23 | 27 | 7 |
| 8 | 20 | 18 | 11 | 13 | 0 | 29 | 11 | 14 | 19 | 49 | 23 | 28 | 8 |
| 9 | 20 | 5 | 10 | 52 | 0 | 5 | 11 | 34 | 20 | 2 | 23 | 29 | 9 |
| 10 | 19 | 52 | 10 | 30 | N. | 18 | 11 | 55 | 20 | 14 | 23 | 29 | 10 |
| 11 | 19 | 38 | 10 | 8 | 00 | 42 | 12 | 15 | 20 | 27 | 23 | 29 | 11 |
| 12 | 19 | 24 | 9 | 46 | 1 | 6 | 12 | 35 | 20 | 38 | 23 | 29 | 12 |
| 13 | 19 | 10 | 9 | 24 | 1 | 29 | 12 | 55 | 20 | 50 | 23 | 28 | 13 |
| 14 | 18 | 55 | 9 | 2 | 1 | 53 | 13 | 15 | 21 | 1 | 23 | 27 | 14 |
| 15 | 18 | 40 | 8 | 39 | 2 | 16 | 13 | 34 | 21 | 11 | 23 | 26 | 15 |
| 16 | 18 | 25 | 8 | 17 | 2 | 40 | 13 | 53 | 21 | 21 | 23 | 22 | 16 |
| 17 | 18 | 9 | 7 | 54 | 3 | 3 | 14 | 12 | 21 | 31 | 23 | 19 | 17 |
| 18 | 17 | 53 | 7 | 31 | 3 | 27 | 14 | 31 | 21 | 41 | 23 | 16 | 18 |
| 19 | 17 | 37 | 7 | 9 | 3 | 50 | 14 | 49 | 21 | 50 | 23 | 13 | 19 |
| 20 | 17 | 20 | 6 | 46 | 4 | 13 | 15 | 8 | 21 | 59 | 23 | 9 | 20 |
| 21 | 17 | 3 | 6 | 23 | 4 | 36 | 15 | 26 | 22 | 7 | 23 | 5 | 21 |
| 22 | 16 | 46 | 6 | 00 | 4 | 59 | 15 | 44 | 22 | 15 | 23 | 00 | 22 |
| 23 | 16 | 28 | 5 | 36 | 5 | 22 | 16 | 1 | 22 | 23 | 22 | 55 | 23 |
| 24 | 16 | 10 | 5 | 13 | 5 | 45 | 16 | 18 | 22 | 30 | 22 | 50 | 24 |
| 25 | 15 | 52 | 4 | 50 | 6 | 8 | 16 | 35 | 22 | 37 | 22 | 44 | 25 |
| 26 | 15 | 34 | 4 | 26 | 6 | 31 | 16 | 52 | 22 | 43 | 22 | 38 | 26 |
| 27 | 15 | 15 | 4 | 3 | 6 | 53 | 17 | 8 | 22 | 49 | 22 | 31 | 27 |
| 28 | 14 | 56 | 3 | 39 | 7 | 16 | 17 | 25 | 22 | 55 | 22 | 24 | 28 |
| 29 | 14 | 37 | | | 7 | 38 | 17 | 40 | 23 | 00 | 22 | 17 | 29 |
| 30 | 14 | 18 | | | 8 | 00 | 17 | 56 | 23 | 6 | 22 | 9 | 30 |
| 31 | 13 | 58 | | | 8 | 23 | | | 23 | 9 | | | 31 |

| Days | July. N | | August. N | | September. N* | | October. S | | November. S | | December. S | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 22 | 1 | 15 | 1 | 4 | 10 | 7 | 27 | 17 | 48 | 23 | 9 | 1 |
| 2 | 21 | 52 | 14 | 43 | 3 | 47 | 7 | 50 | 18 | 4 | 23 | 13 | 2 |
| 3 | 21 | 43 | 14 | 24 | 3 | 24 | 8 | 12 | 18 | 20 | 23 | 17 | 3 |
| 4 | 21 | 34 | 14 | 6 | 3 | 1 | 8 | 35 | 18 | 35 | 23 | 20 | 4 |
| 5 | 21 | 24 | 13 | 47 | 2 | 38 | 8 | 57 | 18 | 10 | 23 | 23 | 5 |
| 6 | 21 | 14 | 13 | 28 | 2 | 14 | 9 | 19 | 19 | 5 | 23 | 25 | 6 |
| 7 | 20 | 4 | 13 | 8 | 1 | 51 | 9 | 41 | 19 | 20 | 23 | 27 | 7 |
| 8 | 20 | 53 | 12 | 49 | 1 | 28 | 10 | 3 | 19 | 34 | 23 | 29 | 8 |
| 9 | 20 | 42 | 12 | 29 | 1 | 4 | 10 | 25 | 19 | 48 | 23 | 29 | 9 |
| 10 | 20 | 38 | 12 | 9 | 0 | 41 | 10 | 46 | 20 | 1 | 23 | 29 | 10 |
| 11 | 20 | 19 | 11 | 49 | 00 | 17 | 11 | 8 | 20 | 14 | 23 | 29 | 11 |
| 12 | 20 | 7 | 11 | 29 | S. | 6 | 11 | 29 | 20 | 27 | 23 | 28 | 12 |
| 13 | 19 | 55 | 11 | 8 | 00 | 29 | 11 | 50 | 20 | 39 | 23 | 27 | 13 |
| 14 | 19 | 42 | 10 | 47 | 00 | 53 | 12 | 11 | 20 | 51 | 23 | 25 | 14 |
| 15 | 19 | 29 | 10 | 27 | 1 | 16 | 12 | 31 | 21 | 3 | 23 | 23 | 15 |
| 16 | 19 | 16 | 10 | 6 | 1 | 40 | 12 | 52 | 21 | 14 | 23 | 21 | 16 |
| 17 | 19 | 2 | 9 | 44 | 2 | 3 | 13 | 12 | 21 | 24 | 23 | 18 | 17 |
| 18 | 18 | 48 | 9 | 23 | 2 | 27 | 13 | 32 | 21 | 35 | 23 | 15 | 18 |
| 19 | 18 | 33 | 9 | 2 | 2 | 50 | 13 | 52 | 21 | 45 | 23 | 11 | 19 |
| 20 | 18 | 19 | 8 | 40 | 3 | 14 | 14 | 12 | 21 | 54 | 23 | 7 | 20 |
| 21 | 18 | 4 | 8 | 18 | 3 | 38 | 14 | 31 | 22 | 3 | 23 | 2 | 21 |
| 22 | 17 | 49 | 7 | 56 | 4 | 1 | 14 | 50 | 22 | 12 | 22 | 57 | 22 |
| 23 | 17 | 33 | 7 | 34 | 4 | 24 | 15 | 9 | 22 | 20 | 22 | 51 | 23 |
| 24 | 17 | 17 | 7 | 12 | 4 | 47 | 15 | 28 | 22 | 28 | 22 | 45 | 24 |
| 25 | 17 | 1 | 6 | 50 | 5 | 10 | 15 | 46 | 22 | 35 | 22 | 38 | 25 |
| 26 | 16 | 45 | 6 | 27 | 5 | 33 | 16 | 4 | 22 | 42 | 22 | 31 | 26 |
| 27 | 16 | 28 | 6 | 5 | 5 | 56 | 16 | 22 | 22 | 48 | 22 | 24 | 27 |
| 28 | 16 | 11 | 5 | 42 | 6 | 19 | 16 | 40 | 22 | 54 | 22 | 16 | 28 |
| 29 | 15 | 54 | 5 | 20 | 6 | 42. | 16 | 57 | 22 | 59 | 22 | 8 | 29 |
| 30 | 15 | 37 | 4 | 57 | 7 | 5 | 17 | 14 | 23 | 4 | 21 | 59 | 30 |
| 31 | 15 | 10 | 4 | 23 | | | 17 | 31 | | | 21 | 50 | 31 |

# A Table of the Sun's Declination for the Year 1710.

| Days | January. S. | | February. S | | March. S* | | April. N | | May. N | | June. N | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 40 | 13 | 43 | 3 | 20 | 8 | 39 | 18 | 8 | 23 | 12 | 1 |
| 2 | 21 | 30 | 13 | 23 | 2 | 57 | 9 | 1 | 18 | 23 | 23 | 15 | 2 |
| 3 | 21 | 20 | 13 | 3 | 2 | 33 | 9 | 23 | 18 | 38 | 23 | 18 | 3 |
| 4 | 21 | 9 | 12 | 42 | 2 | 9 | 9 | 44 | 18 | 52 | 23 | 21 | 4 |
| 5 | 20 | 58 | 12 | 21 | 1 | 46 | 10 | 5 | 19 | 6 | 23 | 24 | 5 |
| 6 | 20 | 46 | 12 | 00 | 1 | 22 | 10 | 27 | 19 | 20 | 23 | 26 | 6 |
| 7 | 20 | 34 | 11 | 39 | 0 | 58 | 10 | 48 | 19 | 33 | 23 | 27 | 7 |
| 8 | 20 | 21 | 11 | 18 | 0 | 35 | 11 | 9 | 19 | 46 | 23 | 28 | 8 |
| 9 | 20 | 9 | 10 | 57 | 0 | 11 | 11 | 29 | 19 | 59 | 23 | 29 | 9 |
| 10 | 19 | 55 | 10 | 35 | N. | 12 | 11 | 50 | 20 | 12 | 23 | 29 | 10 |
| 11 | 19 | 42 | 10 | 13 | 00 | 36 | 12 | 10 | 20 | 24 | 23 | 29 | 11 |
| 12 | 19 | 28 | 9 | 51 | 1 | 00 | 12 | 30 | 20 | 36 | 23 | 29 | 12 |
| 13 | 19 | 14 | 9 | 29 | 1 | 23 | 12 | 50 | 20 | 47 | 23 | 28 | 13 |
| 14 | 18 | 59 | 9 | 7 | 1 | 47 | 13 | 10 | 20 | 58 | 23 | 27 | 14 |
| 15 | 18 | 44 | 8 | 45 | 2 | 10 | 13 | 29 | 21 | 9 | 23 | 25 | 15 |
| 16 | 18 | 29 | 8 | 22 | 2 | 34 | 13 | 49 | 21 | 19 | 23 | 23 | 16 |
| 17 | 18 | 13 | 8 | 00 | 2 | 57 | 14 | 8 | 21 | 29 | 23 | 20 | 17 |
| 18 | 17 | 57 | 7 | 37 | 3 | 20 | 14 | 26 | 21 | 38 | 23 | 17 | 18 |
| 19 | 17 | 41 | 7 | 14 | 3 | 44 | 14 | 45 | 21 | 47 | 23 | 15 | 19 |
| 20 | 17 | 24 | 6 | 51 | 4 | 7 | 15 | 3 | 21 | 56 | 23 | 10 | 20 |
| 21 | 17 | 7 | 6 | 28 | 4 | 31 | 15 | 21 | 22 | 5 | 23 | 6 | 21 |
| 22 | 16 | 50 | 6 | 5 | 4 | 54 | 15 | 39 | 22 | 13 | 23 | 1 | 22 |
| 23 | 16 | 33 | 5 | 42 | 5 | 17 | 15 | 57 | 22 | 21 | 22 | 56 | 23 |
| 24 | 16 | 15 | 5 | 19 | 5 | 40 | 16 | 14 | 22 | 28 | 22 | 51 | 24 |
| 25 | 15 | 57 | 4 | 56 | 6 | 3 | 16 | 21 | 22 | 35 | 22 | 45 | 25 |
| 26 | 15 | 38 | 4 | 32 | 6 | 25 | 16 | 48 | 22 | 42 | 22 | 39 | 26 |
| 27 | 15 | 20 | 4 | 8 | 6 | 48 | 17 | 4 | 22 | 48 | 22 | 33 | 27 |
| 28 | 15 | 1 | 3 | 44 | 7 | 10 | 17 | 21 | 22 | 54 | 22 | 26 | 28 |
| 29 | 14 | 42 | | | 7 | 33 | 17 | 37 | 22 | 59 | 22 | 19 | 29 |
| 30 | 14 | 22 | | | 7 | 55 | 17 | 53 | 23 | 4 | 22 | 11 | 30 |
| 31 | 14 | 3 | | | 8 | 17 | | | 23 | 8 | | | 31 |

| Days | July. N | | August. N | | September. N* | | October. S | | November. S | | December. S | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 22 | 3 | 15 | 5 | 4 | 16 | 7 | 22 | 17 | 44 | 23 | 8 | 1 |
| 2 | 21 | 54 | 14 | 47 | 3 | 53 | 7 | 44 | 18 | 00 | 23 | 12 | 2 |
| 3 | 21 | 45 | 14 | 29 | 3 | 30 | 8 | 7 | 18 | 16 | 23 | 16 | 3 |
| 4 | 21 | 36 | 14 | 10 | 3 | 6 | 8 | 29 | 18 | 31 | 23 | 20 | 4 |
| 5 | 21 | 27 | 13 | 51 | 2 | 43 | 8 | 52 | 18 | 47 | 23 | 23 | 5 |
| 6 | 21 | 17 | 13 | 32 | 2 | 20 | 9 | 14 | 19 | 1 | 23 | 25 | 6 |
| 7 | 21 | 7 | 13 | 13 | 1 | 57 | 9 | 36 | 19 | 16 | 23 | 27 | 7 |
| 8 | 20 | 56 | 12 | 53 | 1 | 33 | 9 | 58 | 19 | 30 | 23 | 29 | 8 |
| 9 | 20 | 45 | 12 | 34 | 1 | 10 | 10 | 19 | 19 | 44 | 23 | 29 | 9 |
| 10 | 20 | 34 | 12 | 14 | 0 | 46 | 10 | 40 | 19 | 58 | 23 | 29 | 10 |
| 11 | 20 | 22 | 11 | 54 | 00 | 23 | 11 | 2 | 20 | 11 | 23 | 29 | 11 |
| 12 | 20 | 10 | 11 | 34 | 00 | 00 | 11 | 24 | 20 | 24 | 23 | 28 | 12 |
| 13 | 19 | 58 | 11 | 13 | S. | 24 | 11 | 45 | 20 | 36 | 23 | 27 | 13 |
| 14 | 19 | 45 | 10 | 52 | 00 | 47 | 12 | 5 | 20 | 48 | 23 | 26 | 14 |
| 15 | 19 | 32 | 10 | 32 | 1 | 11 | 12 | 26 | 21 | 00 | 23 | 24 | 15 |
| 16 | 19 | 19 | 10 | 11 | 1 | 34 | 12 | 47 | 21 | 11 | 23 | 21 | 16 |
| 17 | 19 | 5 | 9 | 50 | 1 | 58 | 13 | 7 | 21 | 22 | 23 | 18 | 17 |
| 18 | 18 | 51 | 9 | 28 | 2 | 21 | 13 | 27 | 21 | 32 | 23 | 15 | 18 |
| 19 | 18 | 37 | 9 | 7 | 2 | 44 | 13 | 47 | 21 | 42 | 23 | 11 | 19 |
| 20 | 18 | 22 | 8 | 45 | 3 | 8 | 14 | 7 | 21 | 52 | 23 | 7 | 20 |
| 21 | 18 | 7 | 8 | 24 | 3 | 31 | 14 | 26 | 22 | 1 | 23 | 3 | 21 |
| 22 | 17 | 52 | 8 | 2 | 3 | 55 | 14 | 46 | 22 | 10 | 22 | 58 | 22 |
| 23 | 17 | 37 | 7 | 40 | 4 | 18 | 15 | 5 | 22 | 18 | 22 | 52 | 23 |
| 24 | 17 | 21 | 7 | 18 | 4 | 41 | 15 | 24 | 22 | 26 | 22 | 46 | 24 |
| 25 | 17 | 5 | 6 | 55 | 5 | 4 | 15 | 42 | 22 | 24 | 22 | 40 | 25 |
| 26 | 16 | 49 | 6 | 33 | 5 | 27 | 16 | 00 | 22 | 40 | 22 | 33 | 26 |
| 27 | 16 | 32 | 6 | 11 | 5 | 50 | 16 | 18 | 22 | 46 | 22 | 26 | 27 |
| 28 | 16 | 15 | 5 | 48 | 6 | 13 | 16 | 36 | 22 | 52 | 22 | 18 | 28 |
| 29 | 15 | 58 | 5 | 24 | 6 | 36 | 16 | 53 | 22 | | 22 | 10 | 29 |
| 30 | 15 | 41 | 5 | 2 | 6 | 59 | 17 | 10 | 23 | 3 | 22 | 1 | 30 |
| 31 | 15 | 23 | 4 | 39 | | | 17 | 27 | | | 21 | 52 | 31 |

# A Table of the Sun's Declination for the Year 1711.

| Days | January. S. | | February. S | | March. S* | | April. N | | May. N | | June. N | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 42 | 13 | 48 | 3 | 26 | 8 | 34 | 18 | 4 | 23 | 10 | 1 |
| 2 | 21 | 32 | 13 | 28 | 3 | 2 | 8 | 56 | 18 | 19 | 23 | 14 | 2 |
| 3 | 21 | 22 | 13 | 8 | 2 | 39 | 9 | 17 | 18 | 34 | 23 | 18 | 3 |
| 4 | 21 | 11 | 12 | 47 | 2 | 15 | 9 | 34 | 18 | 48 | 23 | 21 | 4 |
| 5 | 21 | 00 | 12 | 26 | 1 | 52 | 10 | 00 | 19 | 2 | 23 | 28 | 5 |
| 6 | 20 | 49 | 12 | 5 | 1 | 28 | 10 | 22 | 19 | 16 | 23 | 25 | 6 |
| 7 | 20 | 37 | 11 | 44 | 1 | 4 | 10 | 43 | 19 | 30 | 23 | 27 | 7 |
| 8 | 20 | 25 | 11 | 23 | 0 | 41 | 11 | 03 | 19 | 43 | 23 | 28 | 8 |
| 9 | 20 | 12 | 11 | 2 | 0 | 17 | 11 | 24 | 19 | 56 | 23 | 29 | 9 |
| 10 | 19 | 59 | 10 | 41 | N. | 7 | 11 | 45 | 20 | 8 | 23 | 29 | 10 |
| 11 | 19 | 45 | 10 | 19 | 00 | 30 | 12 | 5 | 20 | 20 | 23 | 29 | 11 |
| 12 | 19 | 31 | 9 | 57 | 00 | 54 | 12 | 25 | 20 | 32 | 23 | 29 | 12 |
| 13 | 19 | 17 | 9 | 35 | 1 | 18 | 12 | 45 | 20 | 44 | 23 | 28 | 13 |
| 14 | 19 | 3 | 9 | 13 | 1 | 41 | 13 | 5 | 20 | 55 | 23 | 27 | 14 |
| 15 | 18 | 48 | 8 | 51 | 2 | 5 | 13 | 25 | 21 | 6 | 23 | 26 | 15 |
| 16 | 18 | 33 | 8 | 28 | 2 | 28 | 13 | 44 | 21 | 16 | 23 | 23 | 16 |
| 17 | 18 | 17 | 8 | 5 | 2 | 52 | 14 | 3 | 21 | 26 | 23 | 20 | 17 |
| 18 | 18 | 1 | 7 | 43 | 3 | 15 | 14 | 22 | 21 | 36 | 23 | 17 | 18 |
| 19 | 17 | 45 | 7 | 20 | 3 | 38 | 14 | 41 | 21 | 45 | 23 | 14 | 19 |
| 20 | 17 | 28 | 6 | 57 | 4 | 2 | 14 | 59 | 21 | 54 | 23 | 11 | 20 |
| 21 | 17 | 11 | 6 | 34 | 4 | 25 | 15 | 17 | 22 | 3 | 23 | 7 | 21 |
| 22 | 16 | 54 | 6 | 11 | 4 | 48 | 15 | 35 | 22 | 11 | 23 | 2 | 22 |
| 23 | 16 | 37 | 5 | 48 | 5 | 11 | 15 | 53 | 22 | 19 | 22 | 57 | 23 |
| 24 | 16 | 19 | 5 | 24 | 5 | 34 | 16 | 10 | 22 | 26 | 22 | 52 | 24 |
| 25 | 16 | 1 | 5 | 1 | 5 | 57 | 16 | 27 | 22 | 33 | 22 | 47 | 25 |
| 26 | 15 | 43 | 4 | 38 | 6 | 20 | 16 | 44 | 22 | 40 | 22 | 41 | 26 |
| 27 | 15 | 24 | 4 | 14 | 6 | 42 | 17 | 00 | 22 | 46 | 22 | 34 | 27 |
| 28 | 15 | 5 | 3 | 50 | 7 | 5 | 17 | 17 | 22 | 52 | 22 | 27 | 28 |
| 29 | 14 | 46 | | | 7 | 27 | 17 | 33 | 22 | 57 | 22 | 20 | 29 |
| 30 | 14 | 27 | | | 7 | 50 | 17 | 49 | 23 | 2 | 22 | 12 | 30 |
| 31 | 14 | 8 | | | 8 | 12 | | | 23 | 6 | | | 31 |

| Days | July. N | | August. N | | September. N* | | October. S | | November. S | | December. S | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 22 | 4 | 15 | 9 | 4 | 21 | 7 | 16 | 17 | 40 | 23 | 7 | 1 |
| 2 | 21 | 56 | 14 | 51 | 3 | 58 | 7 | 39 | 17 | 56 | 23 | 11 | 2 |
| 3 | 21 | 48 | 14 | 33 | 3 | 35 | 8 | 2 | 18 | 12 | 23 | 15 | 3 |
| 4 | 21 | 49 | 14 | 15 | 3 | 12 | 8 | 24 | 18 | 28 | 23 | 19 | 4 |
| 5 | 21 | 29 | 13 | 56 | 2 | 49 | 8 | 46 | 18 | 43 | 23 | 22 | 5 |
| 6 | 21 | 19 | 13 | 37 | 2 | 26 | 9 | 8 | 18 | 58 | 23 | 24 | 6 |
| 7 | 21 | 9 | 13 | 18 | 2 | 2 | 9 | 30 | 19 | 13 | 23 | 26 | 7 |
| 8 | 20 | 59 | 12 | 58 | 1 | 39 | 9 | 52 | 19 | 27 | 23 | 28 | 8 |
| 9 | 20 | 48 | 12 | 39 | 1 | 16 | 10 | 14 | 19 | 41 | 23 | 29 | 9 |
| 10 | 20 | 37 | 12 | 19 | 0 | 52 | 10 | 36 | 19 | 54 | 23 | 29 | 10 |
| 11 | 20 | 25 | 11 | 59 | 00 | 29 | 10 | 57 | 20 | 8 | 23 | 29 | 11 |
| 12 | 20 | 13 | 11 | 39 | 00 | 5 | 11 | 19 | 20 | 21 | 23 | 28 | 12 |
| 13 | 20 | 1 | 11 | 18 | S. | 18 | 11 | 40 | 20 | 33 | 23 | 27 | 13 |
| 14 | 19 | 48 | 10 | 58 | 00 | 41 | 12 | 1 | 20 | 45 | 23 | 26 | 14 |
| 15 | 19 | 35 | 10 | 37 | 1 | 5 | 12 | 21 | 20 | 57 | 23 | 25 | 15 |
| 16 | 19 | 22 | 10 | 16 | 1 | 28 | 12 | 42 | 21 | 8 | 23 | 22 | 16 |
| 17 | 19 | 8 | 9 | 55 | 1 | 52 | 13 | 2 | 21 | 19 | 23 | 19 | 17 |
| 18 | 18 | 54 | 9 | 34 | 2 | 15 | 13 | 23 | 21 | 30 | 23 | 16 | 18 |
| 19 | 18 | 40 | 9 | 12 | 2 | 39 | 13 | 42 | 21 | 40 | 23 | 13 | 19 |
| 20 | 18 | 26 | 8 | 51 | 3 | 2 | 14 | 2 | 21 | 50 | 23 | 9 | 20 |
| 21 | 18 | 11 | 8 | 29 | 3 | 26 | 14 | 22 | 21 | 59 | 23 | 4 | 21 |
| 22 | 17 | 56 | 8 | 7 | 3 | 49 | 14 | 41 | 22 | 8 | 22 | 59 | 22 |
| 23 | 17 | 41 | 7 | 45 | 4 | 12 | 15 | 00 | 22 | 16 | 22 | 54 | 23 |
| 24 | 17 | 25 | 7 | 23 | 4 | 35 | 15 | 19 | 22 | 24 | 22 | 48 | 24 |
| 25 | 17 | 9 | 7 | 1 | 4 | 59 | 15 | 38 | 22 | 32 | 22 | 42 | 25 |
| 26 | 16 | 53 | 6 | 39 | 5 | 22 | 15 | 56 | 22 | 39 | 22 | 35 | 26 |
| 27 | 16 | 36 | 6 | 16 | 5 | 45 | 16 | 14 | 22 | 45 | 22 | 28 | 27 |
| 28 | 16 | 19 | 5 | 4 | 6 | 8 | 16 | 32 | 22 | 51 | 22 | 20 | 28 |
| 29 | 16 | 2 | 5 | 1 | 6 | 31 | 16 | 49 | 22 | 57 | 22 | 12 | 29 |
| 30 | 15 | 45 | 5 | 8 | 6 | 54 | 17 | 6 | 23 | 2 | 22 | 3 | 30 |
| 31 | 15 | 27 | 4 | 44 | | | 17 | 23 | | | 21 | 54 | 31 |

# A Table of the Sun's Declination for the Year 1712.

| Days | January. S. | | February. S | | March. S* | | April. N | | May. N | | June. N | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 45 | 13 | 53 | 3 | 8 | 8 | 50 | 18 | 15 | 23 | 14 | 1 |
| 2 | 21 | 35 | 13 | 33 | 2 | 45 | 9 | 12 | 18 | 30 | 23 | 17 | 2 |
| 3 | 21 | 25 | 13 | 13 | 2 | 21 | 9 | 34 | 18 | 45 | 23 | 20 | 3 |
| 4 | 21 | 14 | 12 | 53 | 1 | 57 | 9 | 55 | 18 | 59 | 23 | 23 | 4 |
| 5 | 21 | 3 | 12 | 32 | 1 | 34 | 10 | 16 | 19 | 13 | 23 | 25 | 5 |
| 6 | 20 | 52 | 12 | 11 | 1 | 10 | 10 | 37 | 19 | 57 | 23 | 27 | 6 |
| 7 | 20 | 40 | 11 | 50 | 0 | 45 | 10 | 58 | 19 | 40 | 23 | 28 | 7 |
| 8 | 20 | 28 | 11 | 29 | 0 | 23 | 11 | 19 | 19 | 53 | 23 | 28 | 8 |
| 9 | 20 | 15 | 11 | 7 | 0 | 00 | 11 | 40 | 20 | 6 | 23 | 29 | 9 |
| 10 | 20 | 2 | 10 | 46 | N. | 24 | 12 | 00 | 20 | 18 | 23 | 29 | 10 |
| 11 | 19 | 49 | 10 | 24 | 00 | 48 | 12 | 20 | 20 | 30 | 23 | 29 | 11 |
| 12 | 19 | 35 | 10 | 2 | 1 | 12 | 12 | 40 | 20 | 41 | 23 | 28 | 12 |
| 13 | 19 | 21 | 9 | 40 | 1 | 36 | 13 | 00 | 20 | 52 | 23 | 27 | 13 |
| 14 | 19 | 6 | 9 | 18 | 1 | 59 | 13 | 20 | 21 | 3 | 23 | 26 | 14 |
| 15 | 18 | 51 | 8 | 56 | 2 | 23 | 13 | 39 | 21 | 14 | 23 | 24 | 15 |
| 16 | 18 | 36 | 8 | 33 | 2 | 46 | 13 | 58 | 21 | 24 | 23 | 21 | 16 |
| 17 | 18 | 20 | 8 | 11 | 3 | 10 | 14 | 17 | 21 | 34 | 23 | 18 | 17 |
| 18 | 18 | 5 | 7 | 48 | 3 | 33 | 14 | 36 | 21 | 43 | 23 | 15 | 18 |
| 19 | 17 | 49 | 7 | 25 | 3 | 56 | 14 | 54 | 21 | 52 | 23 | 11 | 19 |
| 20 | 17 | 33 | 7 | 2 | 4 | 19 | 15 | 12 | 22 | 1 | 23 | 7 | 20 |
| 21 | 17 | 16 | 6 | 39 | 4 | 43 | 15 | 30 | 22 | 9 | 23 | 3 | 21 |
| 22 | 16 | 59 | 6 | 16 | 5 | 6 | 15 | 48 | 22 | 17 | 23 | 58 | 22 |
| 23 | 16 | 42 | 5 | 53 | 5 | 29 | 16 | 6 | 22 | 25 | 23 | 53 | 23 |
| 24 | 16 | 24 | 5 | 30 | 5 | 51 | 16 | 23 | 22 | 32 | 22 | 48 | 34 |
| 25 | 16 | 6 | 5 | 7 | 6 | 14 | 16 | 40 | 22 | 39 | 22 | 42 | 25 |
| 26 | 15 | 48 | 4 | 44 | 6 | 37 | 16 | 57 | 22 | 45 | 22 | 30 | 26 |
| 27 | 15 | 29 | 4 | 20 | 6 | 59 | 17 | 13 | 22 | 51 | 22 | 29 | 27 |
| 28 | 15 | 10 | 3 | 56 | 7 | 22 | 17 | 29 | 22 | 56 | 22 | 22 | 28 |
| 29 | 14 | 51 | 3 | 32 | 7 | 44 | 17 | 45 | 23 | 1 | 22 | 18 | 29 |
| 30 | 14 | 32 | | | 8 | 6 | 18 | 00 | 23 | 6 | 22 | 7 | 30 |
| 31 | 14 | 13 | | | 8 | 28 | | | 23 | 10 | | | 31 |

| Days | July. N | | August. N | | September. N* | | October. S | | November. S | | December. S | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 59 | 14 | 56 | 4 | 4 | 7 | 34 | 17 | 52 | 23 | 10 | 1 |
| 2 | 21 | 50 | 14 | 38 | 3 | 41 | 7 | 57 | 18 | 8 | 23 | 14 | 2 |
| 3 | 21 | 41 | 14 | 19 | 3 | 18 | 8 | 19 | 18 | 24 | 23 | 18 | 3 |
| 4 | 21 | 32 | 14 | 00 | 2 | 55 | 8 | 41 | 18 | 39 | 23 | 21 | 4 |
| 5 | 21 | 22 | 13 | 41 | 2 | 32 | 9 | 3 | 18 | 54 | 23 | 24 | 5 |
| 6 | 21 | 12 | 13 | 2 | 2 | 8 | 9 | 25 | 19 | 9 | 23 | 26 | 6 |
| 7 | 21 | 1 | 13 | 23 | 1 | 45 | 9 | 47 | 19 | 24 | 23 | 27 | 7 |
| 8 | 20 | 50 | 12 | 43 | 1 | 21 | 10 | 9 | 19 | 38 | 23 | 28 | 8 |
| 9 | 20 | 39 | 12 | 23 | 0 | 58 | 10 | 31 | 19 | 51 | 23 | 29 | 9 |
| 10 | 20 | 28 | 11 | 3 | 0 | 34 | 10 | 52 | 20 | 4 | 23 | 29 | 10 |
| 11 | 20 | 16 | 11 | 43 | 00 | 11 | 11 | 13 | 20 | 17 | 23 | 29 | 11 |
| 12 | 20 | 4 | 11 | 23 | S. | 12 | 11 | 35 | 20 | 30 | 23 | 28 | 12 |
| 13 | 19 | 51 | 11 | 3 | 00 | 36 | 11 | 56 | 20 | 42 | 23 | 27 | 13 |
| 14 | 19 | 38 | 10 | 42 | 00 | 59 | 12 | 16 | 20 | 54 | 23 | 25 | 14 |
| 15 | 19 | 25 | 10 | 21 | 1 | 23 | 12 | 37 | 21 | 5 | 23 | 23 | 15 |
| 16 | 19 | 12 | 10 | 00 | 2 | 46 | 12 | 57 | 21 | 17 | 23 | 20 | 16 |
| 17 | 18 | 58 | 9 | 39 | 2 | 10 | 13 | 18 | 22 | 27 | 23 | 17 | 17 |
| 18 | 18 | 44 | 9 | 18 | 2 | 33 | 13 | 38 | 21 | 37 | 23 | 14 | 18 |
| 19 | 18 | 30 | 8 | 56 | 2 | 57 | 13 | 57 | 21 | 47 | 23 | 10 | 19 |
| 20 | 18 | 15 | 8 | 34 | 3 | 20 | 14 | 17 | 21 | 56 | 23 | 5 | 20 |
| 21 | 18 | 00 | 8 | 12 | 3 | 43 | 14 | 36 | 22 | 5 | 23 | 00 | 21 |
| 22 | 17 | 45 | 7 | 50 | 4 | 7 | 14 | 56 | 22 | 14 | 22 | 55 | 22 |
| 23 | 17 | 29 | 7 | 28 | 4 | 30 | 15 | 14 | 22 | 22 | 22 | 49 | 23 |
| 24 | 17 | 13 | 7 | 6 | 4 | 53 | 15 | 33 | 22 | 30 | 22 | 43 | 24 |
| 25 | 17 | 57 | 6 | 44 | 5 | 16 | 15 | 51 | 22 | 37 | 22 | 36 | 25 |
| 26 | 16 | 40 | 6 | 22 | 5 | 39 | 16 | 9 | 22 | 43 | 22 | 29 | 26 |
| 27 | 16 | 23 | 5 | 59 | 6 | 2 | 16 | 27 | 22 | 49 | 22 | 22 | 27 |
| 28 | 16 | 6 | 5 | 36 | 6 | 25 | 16 | 45 | 22 | 55 | 22 | 14 | 28 |
| 29 | 15 | 49 | 5 | 14 | 6 | 48 | 17 | 2 | 23 | 1 | 22 | 5 | 29 |
| 30 | 15 | 32 | 4 | 51 | 7 | 11 | 17 | 19 | 23 | 6 | 21 | 56 | 30 |
| 31 | 15 | 14 | 4 | 27 | 7 | | 17 | 36 | | | 21 | 47 | 31 |

# A Table of the Sun's Place in the Ecliptick for the Year 1709.

| Days d. | January. ♑ 0 | 1 | February. ♒ 0 | 1 | March. ♓ 0 | 1 | April. ♈ 0 | 1 | May. ♉ 0 | 1 | June. ♊ 0 | 1 | Days d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | 16 | 23 | 44 | 21 | 48 | 22 | 23 | 21 | 29 | 21 | 11 | 1 |
| 2 | 23 | 17 | 24 | 44 | 22 | 48 | 23 | 22 | 22 | 27 | 22 | 8 | 2 |
| 3 | 24 | 18 | 25 | 45 | 23 | 48 | 24 | 20 | 23 | 25 | 23 | 6 | 3 |
| 4 | 25 | 19 | 26 | 45 | 24 | 47 | 25 | 19 | 24 | 22 | 24 | 3 | 4 |
| 5 | 26 | 21 | 27 | 46 | 25 | 47 | 26 | 17 | 25 | 20 | 25 | 00 | 5 |
| 6 | 27 | 22 | 28 | 46 | 26 | 46 | 27 | 16 | 26 | 18 | 25 | 57 | 6 |
| 7 | 28 | 23 | 29 | 47 | 27 | 46 | 28 | 14 | 27 | 15 | 26 | 55 | 7 |
| 8 | 29 | 24 | ♓ | 47 | 28 | 45 | 29 | 13 | 28 | 13 | 27 | 52 | 8 |
| 9 | ♒ | 25 | 1 | 47 | 29 | 45 | ♉ | 11 | 29 | 11 | 28 | 49 | 9 |
| 10 | 1 | 26 | 2 | 48 | ♈ | 44 | 1 | 10 | ♊ | 8 | 29 | 46 | 10 |
| 11 | 2 | 27 | 3 | 48 | 1 | 44 | 2 | 8 | 1 | 6 | ♋ | 43 | 11 |
| 12 | 3 | 28 | 4 | 48 | 2 | 43 | 3 | 6 | 2 | 3 | 1 | 41 | 12 |
| 13 | 4 | 29 | 5 | 48 | 3 | 42 | 4 | 5 | 3 | 1 | 2 | 38 | 13 |
| 14 | 5 | 30 | 6 | 49 | 4 | 42 | 5 | 3 | 3 | 58 | 3 | 35 | 14 |
| 15 | 6 | 31 | 7 | 49 | 5 | 41 | 6 | 1 | 4 | 56 | 4 | 32 | 15 |
| 16 | 7 | 32 | 8 | 49 | 6 | 40 | 6 | 59 | 5 | 53 | 5 | 29 | 16 |
| 17 | 8 | 33 | 9 | 49 | 7 | 39 | 7 | 58 | 6 | 51 | 6 | 27 | 17 |
| 18 | 9 | 34 | 10 | 49 | 8 | 38 | 8 | 56 | 7 | 48 | 7 | 24 | 18 |
| 19 | 10 | 35 | 11 | 49 | 9 | 38 | 9 | 54 | 8 | 46 | 8 | 21 | 19 |
| 20 | 11 | 35 | 12 | 49 | 10 | 37 | 10 | 52 | 9 | 43 | 9 | 18 | 20 |
| 21 | 12 | 36 | 13 | 49 | 11 | 36 | 11 | 50 | 10 | 41 | 10 | 15 | 21 |
| 22 | 13 | 37 | 14 | 49 | 12 | 35 | 12 | 48 | 11 | 38 | 11 | 12 | 22 |
| 23 | 14 | 38 | 15 | 49 | 13 | 34 | 13 | 46 | 12 | 35 | 12 | 10 | 23 |
| 24 | 15 | 38 | 16 | 49 | 14 | 33 | 14 | 44 | 13 | 33 | 13 | 7 | 24 |
| 25 | 16 | 39 | 17 | 49 | 15 | 32 | 15 | 42 | 14 | 30 | 14 | 4 | 25 |
| 26 | 17 | 40 | 18 | 49 | 16 | 30 | 16 | 40 | 15 | 27 | 15 | 1 | 26 |
| 27 | 18 | 41 | 19 | 49 | 17 | 29 | 17 | 38 | 16 | 25 | 15 | 58 | 27 |
| 28 | 19 | 41 | 20 | 48 | 18 | 28 | 18 | 36 | 17 | 22 | 16 | 55 | 28 |
| 29 | 20 | 42 | | | 19 | 27 | 19 | 33 | 18 | 19 | 17 | 53 | 29 |
| 30 | 21 | 43 | | | 20 | 26 | 20 | 31 | 19 | 16 | 18 | 50 | 30 |
| 31 | 22 | 43 | | | 21 | 24 | | | 20 | 13 | | | 31 |

| Days d. | July. ♋ 0 | 1 | August. ♌ 0 | 1 | September. ♍ 0 | 1 | October. ♎ 0 | 1 | November. ♏ 0 | 1 | December. ♐ 0 | 1 | Days d. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | 47 | 19 | 27 | 19 | 27 | 18 | 59 | 20 | 00 | 20 | 26 | 1 |
| 2 | 20 | 45 | 20 | 25 | 20 | 26 | 19 | 58 | 21 | 1 | 21 | 27 | 2 |
| 3 | 21 | 42 | 21 | 22 | 21 | 25 | 20 | 58 | 22 | 1 | 22 | 28 | 3 |
| 4 | 22 | 39 | 22 | 20 | 22 | 23 | 21 | 57 | 23 | 2 | 23 | 29 | 4 |
| 5 | 23 | 36 | 23 | 18 | 23 | 22 | 22 | 57 | 24 | 3 | 24 | 30 | 5 |
| 6 | 24 | 34 | 24 | 16 | 24 | 21 | 23 | 57 | 25 | 3 | 25 | 31 | 6 |
| 7 | 25 | 31 | 25 | 13 | 25 | 19 | 24 | 57 | 26 | 4 | 26 | 32 | 7 |
| 8 | 26 | 28 | 26 | 11 | 26 | 18 | 25 | 56 | 27 | 5 | 27 | 33 | 8 |
| 9 | 27 | 25 | 27 | 9 | 27 | 17 | 26 | 56 | 28 | 5 | 28 | 35 | 9 |
| 10 | 28 | 23 | 28 | 7 | 28 | 16 | 27 | 56 | 29 | 6 | 29 | 36 | 10 |
| 11 | 29 | 20 | 29 | 5 | 29 | 14 | 28 | 56 | ♐ | 7 | ♑ | 37 | 11 |
| 12 | ♌ | 17 | ♍ | 3 | ♎ | 13 | 29 | 56 | 1 | 7 | 1 | 38 | 12 |
| 13 | 1 | 14 | 1 | 1 | 1 | 12 | ♏ | 56 | 2 | 8 | 2 | 39 | 13 |
| 14 | 2 | 12 | 1 | 59 | 2 | 11 | 1 | 56 | 3 | 9 | 3 | 40 | 14 |
| 15 | 3 | 9 | 2 | 57 | 3 | 10 | 2 | 56 | 4 | 10 | 4 | 42 | 15 |
| 16 | 4 | 7 | 3 | 55 | 4 | 9 | 3 | 56 | 5 | 11 | 5 | 43 | 16 |
| 17 | 5 | 4 | 4 | 53 | 5 | 8 | 4 | 56 | 6 | 12 | 6 | 44 | 17 |
| 18 | 6 | 1 | 5 | 51 | 6 | 7 | 5 | 56 | 7 | 13 | 7 | 45 | 18 |
| 19 | 6 | 59 | 6 | 49 | 7 | 6 | 6 | 56 | 8 | 13 | 8 | 46 | 19 |
| 20 | 7 | 56 | 7 | 47 | 8 | 6 | 7 | 56 | 9 | 14 | 9 | 48 | 20 |
| 21 | 8 | 54 | 8 | 45 | 9 | 5 | 8 | 56 | 10 | 15 | 10 | 49 | 21 |
| 22 | 9 | 51 | 9 | 43 | 10 | 4 | 9 | 56 | 11 | 16 | 11 | 50 | 22 |
| 23 | 10 | 49 | 10 | 42 | 11 | 3 | 10 | 57 | 12 | 17 | 12 | 51 | 23 |
| 24 | 11 | 46 | 11 | 40 | 12 | 3 | 11 | 57 | 13 | 18 | 13 | 52 | 24 |
| 25 | 12 | 44 | 12 | 38 | 13 | 2 | 12 | 57 | 14 | 19 | 14 | 53 | 25 |
| 26 | 13 | 41 | 13 | 37 | 14 | 1 | 13 | 58 | 15 | 20 | 15 | 55 | 26 |
| 27 | 14 | 39 | 14 | 35 | 15 | 1 | 14 | 58 | 16 | 21 | 16 | 56 | 27 |
| 28 | 15 | 36 | 15 | 34 | 16 | 00 | 15 | 58 | 17 | 22 | 17 | 57 | 28 |
| 29 | 16 | 34 | 16 | 32 | 17 | 00 | 16 | 59 | 18 | 24 | 18 | 58 | 29 |
| 30 | 17 | 32 | 17 | 30 | 17 | 59 | 17 | 59 | 19 | 25 | 19 | 59 | 30 |
| 31 | 18 | 29 | 18 | 29 | | | 19 | 00 | | | 21 | 00 | 31 |

# A Table of the Sun's Place in the Ecliptick for the Year 1710.

| Days | January. ♑ | | February. ♒ | | March. ♓ | | April. ♈ | | May. ♉ | | June. ♊ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 22 | 1 | 23 | 29 | 21 | 34 | 22 | 9 | 21 | 15 | 20 | 57 | 1 |
| 2 | 23 | 2 | 24 | 29 | 22 | 33 | 23 | 7 | 22 | 13 | 21 | 54 | 2 |
| 3 | 24 | 4 | 25 | 30 | 23 | 33 | 24 | 6 | 23 | 11 | 22 | 52 | 3 |
| 4 | 25 | 5 | 26 | 31 | 24 | 33 | 25 | 5 | 24 | 8 | 23 | 49 | 4 |
| 5 | 26 | 6 | 27 | 31 | 25 | 32 | 26 | 3 | 25 | 6 | 24 | 46 | 5 |
| 6 | 27 | 7 | 28 | 31 | 26 | 32 | 27 | 2 | 26 | 4 | 25 | 44 | 6 |
| 7 | 28 | 8 | 29 | 32 | 27 | 31 | 28 | 00 | 27 | 1 | 26 | 41 | 7 |
| 8 | 29 | 9 | ♓ | 32 | 28 | 31 | 28 | 59 | 27 | 59 | 27 | 38 | 8 |
| 9 | ♒ | 10 | 1 | 33 | 29 | 30 | 29 | 57 | 28 | 57 | 28 | 35 | 9 |
| 10 | 1 | 11 | 2 | 33 | ♈ | 30 | ♉ | 55 | 29 | 54 | 29 | 32 | 10 |
| 11 | 2 | 12 | 3 | 33 | 1 | 29 | 1 | 54 | ♊ | 52 | ♋ | 30 | 11 |
| 12 | 3 | 13 | 4 | 34 | 2 | 28 | 2 | 52 | 1 | 49 | 1 | 26 | 12 |
| 13 | 4 | 14 | 5 | 34 | 3 | 28 | 3 | 50 | 2 | 57 | 2 | 23 | 13 |
| 14 | 5 | 15 | 6 | 34 | 4 | 27 | 4 | 49 | 3 | 45 | 3 | 21 | 14 |
| 15 | 6 | 16 | 7 | 34 | 5 | 26 | 5 | 47 | 4 | 42 | 4 | 18 | 15 |
| 16 | 7 | 17 | 8 | 34 | 6 | 26 | 6 | 45 | 5 | 40 | 5 | 16 | 16 |
| 17 | 8 | 18 | 9 | 35 | 7 | 25 | 7 | 43 | 6 | 37 | 6 | 13 | 17 |
| 18 | 9 | 19 | 10 | 35 | 8 | 24 | 8 | 42 | 7 | 34 | 7 | 10 | 18 |
| 19 | 10 | 20 | 11 | 35 | 9 | 23 | 9 | 40 | 8 | 32 | 8 | 7 | 19 |
| 20 | 11 | 20 | 12 | 35 | 10 | 22 | 10 | 38 | 9 | 29 | 9 | 4 | 20 |
| 21 | 12 | 21 | 13 | 35 | 11 | 21 | 11 | 36 | 10 | 27 | 10 | 1 | 21 |
| 22 | 13 | 22 | 14 | 35 | 12 | 20 | 12 | 34 | 11 | 24 | 10 | 59 | 22 |
| 23 | 14 | 23 | 15 | 35 | 13 | 19 | 13 | 32 | 12 | 21 | 11 | 56 | 23 |
| 24 | 15 | 24 | 16 | 35 | 14 | 18 | 14 | 30 | 13 | 19 | 12 | 53 | 34 |
| 25 | 16 | 24 | 17 | 35 | 15 | 17 | 15 | 28 | 14 | 16 | 13 | 50 | 25 |
| 26 | 17 | 25 | 18 | 34 | 16 | 16 | 16 | 26 | 15 | 14 | 14 | 47 | 26 |
| 27 | 18 | 26 | 19 | 34 | 17 | 15 | 17 | 23 | 16 | 11 | 15 | 45 | 27 |
| 28 | 19 | 26 | 20 | 34 | 18 | 14 | 18 | 22 | 17 | 8 | 16 | 42 | 28 |
| 29 | 20 | 27 | | | 19 | 13 | 19 | 19 | 18 | 5 | 17 | 39 | 29 |
| 30 | 21 | 27 | | | 20 | 11 | 20 | 17 | 19 | 3 | 18 | 36 | 30 |
| 31 | 22 | 28 | | | 21 | 10 | | | 20 | 00 | | | 31 |

| Days | July. ♋ | | August. ♌ | | September. ♍ | | October. ♎ | | November. ♏ | | December. ♐ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 19 | 33 | 19 | 13 | 19 | 13 | 18 | 44 | 19 | 46 | 20 | 11 | 1 |
| 2 | 20 | 31 | 20 | 11 | 20 | 11 | 19 | 44 | 20 | 46 | 21 | 12 | 2 |
| 3 | 21 | 28 | 21 | 8 | 21 | 10 | 20 | 43 | 21 | 47 | 22 | 13 | 3 |
| 4 | 22 | 25 | 22 | 6 | 22 | 9 | 21 | 43 | 22 | 47 | 23 | 14 | 4 |
| 5 | 23 | 22 | 23 | 4 | 23 | 8 | 22 | 43 | 23 | 48 | 24 | 15 | 5 |
| 6 | 24 | 20 | 24 | 2 | 24 | 6 | 23 | 42 | 24 | 48 | 25 | 16 | 6 |
| 7 | 25 | 17 | 24 | 59 | 25 | 5 | 24 | 42 | 25 | 49 | 26 | 17 | 7 |
| 8 | 26 | 14 | 25 | 57 | 26 | 4 | 25 | 42 | 26 | 50 | 27 | 19 | 8 |
| 9 | 27 | 11 | 26 | 55 | 27 | 2 | 26 | 42 | 27 | 50 | 28 | 20 | 9 |
| 10 | 28 | 9 | 27 | 53 | 28 | 1 | 27 | 41 | 28 | 51 | 29 | 21 | 10 |
| 11 | 29 | 6 | 28 | 51 | 29 | 00 | 28 | 41 | 29 | 52 | ♍ | 22 | 11 |
| 12 | ♌ | 3 | 29 | 49 | 29 | 59 | 29 | 41 | ♐ | 53 | 1 | 23 | 12 |
| 13 | 1 | 1 | ♍ | 47 | ♎ | 58 | ♏ | 41 | 1 | 53 | 2 | 24 | 13 |
| 14 | 1 | 58 | 1 | 45 | 1 | 57 | 1 | 41 | 2 | 54 | 3 | 26 | 14 |
| 15 | 2 | 55 | 2 | 42 | 2 | 56 | 2 | 41 | 3 | 55 | 4 | 27 | 15 |
| 16 | 3 | 53 | 3 | 40 | 3 | 55 | 3 | 41 | 4 | 56 | 5 | 28 | 16 |
| 17 | 4 | 50 | 4 | 38 | 4 | 54 | 4 | 41 | 5 | 57 | 6 | 29 | 17 |
| 18 | 5 | 48 | 5 | 37 | 5 | 53 | 5 | 41 | 6 | 58 | 7 | 30 | 18 |
| 19 | 6 | 45 | 6 | 35 | 6 | 52 | 6 | 41 | 7 | 59 | 8 | 31 | 19 |
| 20 | 7 | 42 | 7 | 33 | 7 | 51 | 7 | 42 | 9 | 00 | 9 | 33 | 20 |
| 21 | 8 | 40 | 8 | 31 | 8 | 50 | 8 | 42 | 10 | 1 | 10 | 34 | 21 |
| 22 | 9 | 38 | 9 | 30 | 9 | 50 | 9 | 42 | 11 | 2 | 11 | 35 | 22 |
| 23 | 10 | 35 | 10 | 28 | 10 | 49 | 10 | 42 | 12 | 3 | 12 | 36 | 23 |
| 24 | 11 | 32 | 11 | 26 | 11 | 48 | 11 | 42 | 13 | 3 | 13 | 37 | 24 |
| 25 | 12 | 30 | 12 | 24 | 12 | 48 | 12 | 43 | 14 | 4 | 14 | 38 | 25 |
| 26 | 13 | 27 | 13 | 23 | 13 | 47 | 13 | 43 | 15 | 6 | 15 | 40 | 26 |
| 27 | 14 | 25 | 14 | 21 | 14 | 46 | 14 | 43 | 16 | 6 | 16 | 41 | 27 |
| 28 | 15 | 22 | 15 | 19 | 15 | 46 | 15 | 44 | 17 | 8 | 17 | 42 | 28 |
| 29 | 16 | 20 | 16 | 18 | 16 | 45 | 16 | 44 | 18 | 9 | 18 | 43 | 29 |
| 30 | 17 | 18 | 17 | 16 | 17 | 44 | 17 | 44 | 19 | 10 | 19 | 44 | 30 |
| 31 | 18 | 15 | 18 | 15 | | | 18 | 45 | | | 20 | 45 | 31 |

# A Table of the Sun's Place in the Ecliptick for the Year 1711.

| Days | January. ♑ | | February. ♒ | | March. ♓ | | April. ♈ | | May. ♉ | | June. ♊ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 47 | 23 | 14 | 21 | 19 | 21 | 55 | 21 | 1 | 20 | 43 | 1 |
| 2 | 22 | 48 | 24 | 15 | 22 | 19 | 22 | 53 | 21 | 59 | 21 | 41 | 2 |
| 3 | 23 | 49 | 25 | 15 | 23 | 19 | 23 | 52 | 22 | 57 | 22 | 38 | 3 |
| 4 | 24 | 50 | 26 | 16 | 24 | 18 | 24 | 50 | 23 | 54 | 23 | 35 | 4 |
| 5 | 25 | 51 | 27 | 16 | 25 | 18 | 25 | 49 | 24 | 52 | 24 | 32 | 5 |
| 6 | 26 | 52 | 28 | 17 | 26 | 17 | 26 | 47 | 25 | 50 | 25 | 30 | 6 |
| 7 | 27 | 53 | 29 | 17 | 27 | 17 | 27 | 46 | 26 | 47 | 26 | 27 | 7 |
| 8 | 28 | 54 | ♓ | 18 | 28 | 16 | 28 | 44 | 27 | 45 | 27 | 24 | 8 |
| 9 | 29 | 55 | 1 | 18 | 29 | 16 | 29 | 43 | 28 | 43 | 28 | 21 | 9 |
| 10 | ♒ | 56 | 2 | 18 | ♈ | 15 | ♉ | 41 | 29 | 40 | 29 | 19 | 10 |
| 11 | 1 | 57 | 3 | 19 | 1 | 15 | 1 | 40 | ♊ | 38 | ♋ | 16 | 11 |
| 12 | 2 | 58 | 4 | 19 | 2 | 14 | 2 | 38 | 1 | 35 | 1 | 13 | 12 |
| 13 | 3 | 59 | 5 | 19 | 3 | 14 | 3 | 36 | 2 | 33 | 2 | 10 | 13 |
| 14 | 5 | 00 | 6 | 19 | 4 | 13 | 4 | 35 | 3 | 31 | 3 | 7 | 14 |
| 15 | 6 | 1 | 7 | 20 | 5 | 12 | 5 | 33 | 4 | 28 | 4 | 5 | 15 |
| 16 | 7 | 2 | 8 | 20 | 6 | 11 | 6 | 31 | 5 | 26 | 5 | 2 | 16 |
| 17 | 8 | 3 | 9 | 20 | 7 | 11 | 7 | 29 | 6 | 23 | 5 | 59 | 17 |
| 18 | 9 | 4 | 10 | 20 | 8 | 10 | 8 | 27 | 7 | 20 | 6 | 56 | 18 |
| 19 | 10 | 5 | 11 | 20 | 9 | 9 | 9 | 26 | 8 | 18 | 7 | 53 | 19 |
| 20 | 11 | 5 | 12 | 20 | 10 | 8 | 10 | 24 | 9 | 15 | 8 | 50 | 20 |
| 21 | 12 | 6 | 13 | 20 | 11 | 7 | 11 | 22 | 10 | 13 | 9 | 48 | 21 |
| 22 | 13 | 7 | 14 | 20 | 12 | 6 | 12 | 20 | 11 | 10 | 10 | 45 | 22 |
| 23 | 14 | 8 | 15 | 20 | 13 | 5 | 13 | 18 | 12 | 8 | 11 | 42 | 23 |
| 24 | 15 | 9 | 16 | 20 | 14 | 4 | 14 | 16 | 13 | 5 | 12 | 39 | 24 |
| 25 | 16 | 10 | 17 | 20 | 15 | 3 | 15 | 14 | 14 | 2 | 13 | 36 | 25 |
| 26 | 17 | 10 | 18 | 20 | 16 | 2 | 16 | 12 | 15 | 00 | 14 | 34 | 26 |
| 27 | 18 | 11 | 19 | 20 | 17 | 1 | 17 | 10 | 15 | 57 | 15 | 31 | 27 |
| 28 | 19 | 12 | 20 | 19 | 18 | 00 | 18 | 8 | 16 | 54 | 16 | 28 | 28 |
| 29 | 20 | 12 | | | 18 | 58 | 19 | 5 | 17 | 52 | 17 | 25 | 29 |
| 30 | 21 | 13 | | | 19 | 57 | 20 | 3 | 18 | 49 | 18 | 22 | 30 |
| 31 | 22 | 14 | | | 20 | 56 | | | 19 | 46 | | | 31 |

| Days | July. ♋ | | August. ♌ | | September. ♍ | | October. ♎ | | November. ♏ | | December. ♐ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 19 | 20 | 18 | 59 | 18 | 59 | 18 | 30 | 19 | 31 | 19 | 56 | 1 |
| 2 | 20 | 17 | 19 | 56 | 19 | 58 | 19 | 29 | 20 | 31 | 20 | 57 | 2 |
| 3 | 21 | 14 | 20 | 54 | 20 | 56 | 20 | 29 | 21 | 32 | 21 | 58 | 3 |
| 4 | 22 | 11 | 21 | 52 | 21 | 55 | 21 | 28 | 22 | 33 | 22 | 59 | 4 |
| 5 | 23 | 8 | 22 | 50 | 22 | 53 | 22 | 28 | 23 | 33 | 24 | 00 | 5 |
| 6 | 24 | 6 | 23 | 48 | 23 | 52 | 23 | 28 | 24 | 34 | 25 | 1 | 6 |
| 7 | 25 | 3 | 24 | 45 | 24 | 51 | 24 | 28 | 25 | 35 | 26 | 3 | 7 |
| 8 | 26 | 00 | 25 | 43 | 25 | 50 | 25 | 27 | 26 | 35 | 27 | 4 | 8 |
| 9 | 26 | 58 | 26 | 41 | 26 | 48 | 26 | 27 | 27 | 36 | 28 | 5 | 9 |
| 10 | 27 | 55 | 27 | 39 | 27 | 47 | 27 | 27 | 28 | 36 | 29 | 6 | 10 |
| 11 | 28 | 52 | 28 | 37 | 28 | 46 | 28 | 27 | 29 | 37 | ♍ | 7 | 11 |
| 12 | 29 | 49 | 29 | 35 | 29 | 44 | 29 | 27 | ♐ | 38 | 1 | 8 | 12 |
| 13 | ♌ | 47 | ♍ | 33 | ♎ | 44 | m | 27 | 1 | 39 | 2 | 10 | 13 |
| 14 | 1 | 44 | 1 | 31 | 1 | 43 | 1 | 27 | 2 | 39 | 3 | 11 | 14 |
| 15 | 2 | 41 | 2 | 29 | 2 | 42 | 2 | 26 | 3 | 40 | 4 | 12 | 15 |
| 16 | 3 | 39 | 3 | 27 | 3 | 41 | 3 | 26 | 4 | 41 | 5 | 13 | 16 |
| 17 | 4 | 36 | 4 | 25 | 4 | 40 | 4 | 27 | 5 | 42 | 6 | 14 | 17 |
| 18 | 5 | 34 | 5 | 23 | 5 | 39 | 5 | 27 | 6 | 43 | 7 | 15 | 18 |
| 19 | 6 | 31 | 6 | 21 | 6 | 38 | 6 | 27 | 7 | 44 | 8 | 17 | 19 |
| 20 | 7 | 28 | 7 | 19 | 7 | 37 | 7 | 27 | 8 | 45 | 9 | 18 | 20 |
| 21 | 8 | 26 | 8 | 17 | 8 | 36 | 8 | 27 | 9 | 46 | 10 | 19 | 21 |
| 22 | 9 | 23 | 9 | 15 | 9 | 35 | 9 | 27 | 10 | 47 | 11 | 20 | 22 |
| 23 | 10 | 21 | 10 | 14 | 10 | 35 | 10 | 28 | 11 | 48 | 12 | 21 | 23 |
| 24 | 11 | 18 | 11 | 12 | 11 | 34 | 11 | 28 | 12 | 49 | 13 | 22 | 24 |
| 25 | 12 | 16 | 12 | 10 | 12 | 33 | 12 | 28 | 13 | 50 | 14 | 24 | 25 |
| 26 | 13 | 13 | 13 | 9 | 13 | 32 | 13 | 28 | 14 | 51 | 15 | 25 | 26 |
| 27 | 14 | 11 | 14 | 7 | 14 | 32 | 14 | 29 | 15 | 52 | 16 | 26 | 27 |
| 28 | 15 | 9 | 15 | 5 | 15 | 31 | 15 | 29 | 16 | 53 | 17 | 27 | 28 |
| 29 | 16 | 6 | 16 | 4 | 16 | 31 | 16 | 30 | 17 | 54 | 18 | 28 | 29 |
| 30 | 17 | 4 | 17 | 2 | 17 | 30 | 17 | 30 | 18 | 55 | 19 | 30 | 30 |
| 31 | 18 | 5 | 18 | 1 | | | 18 | 30 | | | 20 | 31 | 31 |

# A Table of the Sun's Place in the Ecliptick for the Year 1712.

| Days | January. ♑ | | February. ♒ | | March. ♓ | | April. ♈ | | May. ♉ | | June. ♊ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 21 | 32 | 23 | 00 | 22 | 4 | 22 | 39 | 21 | 45 | 21 | 27 | 1 |
| 2 | 22 | 33 | 24 | 00 | 23 | 4 | 23 | 38 | 22 | 43 | 22 | 24 | 2 |
| 3 | 23 | 34 | 25 | 1 | 24 | 4 | 24 | 36 | 23 | 40 | 23 | 21 | 3 |
| 4 | 24 | 35 | 26 | 1 | 25 | 3 | 25 | 35 | 24 | 38 | 24 | 19 | 4 |
| 5 | 25 | 36 | 27 | 2 | 26 | 3 | 26 | 33 | 25 | 36 | 25 | 16 | 5 |
| 6 | 26 | 37 | 28 | 2 | 27 | 3 | 27 | 32 | 26 | 33 | 26 | 13 | 6 |
| 7 | 27 | 38 | 29 | 3 | 28 | 2 | 28 | 30 | 27 | 31 | 27 | 10 | 7 |
| 8 | 28 | 39 | ♓ | 3 | 29 | 2 | 29 | 29 | 28 | 29 | 28 | 7 | 8 |
| 9 | 29 | 40 | 1 | 3 | 30 | 1 | ♉ | 27 | 29 | 26 | 29 | 5 | 9 |
| 10 | ♒ | 41 | 2 | 4 | ♈ | 00 | 1 | 26 | ♊ | 24 | 30 | 2 | 10 |
| 11 | 1 | 42 | 3 | 4 | 2 | 00 | 2 | 24 | 1 | 22 | ♋ | 59 | 11 |
| 12 | 2 | 43 | 4 | 4 | 2 | 59 | 3 | 22 | 2 | 19 | 1 | 56 | 12 |
| 13 | 3 | 44 | 5 | 5 | 3 | 58 | 4 | 20 | 3 | 17 | 2 | 53 | 13 |
| 14 | 4 | 45 | 6 | 5 | 4 | 58 | 5 | 19 | 4 | 14 | 3 | 50 | 14 |
| 15 | 5 | 46 | 7 | 5 | 5 | 57 | 6 | 17 | 5 | 12 | 4 | 48 | 15 |
| 16 | 6 | 47 | 8 | 5 | 6 | 56 | 7 | 15 | 6 | 9 | 5 | 45 | 16 |
| 17 | 7 | 48 | 9 | 5 | 7 | 55 | 8 | 13 | 7 | 7 | 6 | 42 | 17 |
| 18 | 8 | 49 | 10 | 6 | 8 | 55 | 9 | 12 | 8 | 4 | 7 | 39 | 18 |
| 19 | 9 | 50 | 11 | 6 | 9 | 54 | 10 | 10 | 9 | 2 | 8 | 37 | 19 |
| 20 | 10 | 51 | 12 | 6 | 10 | 53 | 11 | 8 | 9 | 59 | 9 | 34 | 20 |
| 21 | 11 | 52 | 13 | 6 | 11 | 52 | 12 | 6 | 10 | 56 | 10 | 31 | 21 |
| 22 | 12 | 53 | 14 | 6 | 12 | 51 | 13 | 4 | 11 | 54 | 11 | 28 | 22 |
| 23 | 13 | 53 | 15 | 6 | 13 | 50 | 14 | 2 | 12 | 51 | 12 | 25 | 23 |
| 24 | 14 | 54 | 16 | 6 | 14 | 49 | 15 | 00 | 13 | 48 | 13 | 23 | 24 |
| 25 | 15 | 55 | 17 | 5 | 15 | 48 | 15 | 58 | 14 | 46 | 14 | 20 | 25 |
| 26 | 16 | 56 | 18 | 5 | 16 | 46 | 16 | 56 | 15 | 43 | 15 | 17 | 26 |
| 27 | 17 | 56 | 19 | 5 | 17 | 45 | 17 | 54 | 16 | 40 | 16 | 14 | 27 |
| 28 | 18 | 57 | 20 | 5 | 18 | 44 | 18 | 51 | 17 | 38 | 17 | 11 | 28 |
| 29 | 19 | 58 | 21 | 5 | 19 | 43 | 19 | 49 | 18 | 35 | 18 | 8 | 29 |
| 30 | 20 | 58 | | | 20 | 42 | 20 | 47 | 19 | 32 | 19 | 6 | 30 |
| 31 | 21 | 59 | | | 21 | 40 | | | 20 | 30 | | | 31 |

| Days | July. ♋ | | August. ♌ | | September. ♍ | | October. ♎ | | November. ♏ | | December. ♐ | | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| d. | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | d. |
| 1 | 20 | 3 | 19 | 43 | 19 | 43 | 19 | 15 | 20 | 17 | 20 | 42 | 1 |
| 2 | 21 | 00 | 20 | 40 | 20 | 42 | 20 | 14 | 21 | 17 | 21 | 43 | 2 |
| 3 | 21 | 57 | 21 | 38 | 21 | 41 | 21 | 14 | 22 | 18 | 22 | 44 | 3 |
| 4 | 22 | 54 | 22 | 36 | 22 | 39 | 22 | 14 | 23 | 18 | 23 | 45 | 4 |
| 5 | 23 | 52 | 23 | 34 | 23 | 38 | 23 | 13 | 24 | 19 | 24 | 47 | 5 |
| 6 | 24 | 49 | 24 | 31 | 24 | 37 | 24 | 13 | 25 | 20 | 25 | 48 | 6 |
| 7 | 25 | 46 | 25 | 28 | 25 | 35 | 25 | 13 | 26 | 20 | 26 | 49 | 7 |
| 8 | 26 | 44 | 26 | 27 | 26 | 34 | 26 | 13 | 27 | 21 | 27 | 50 | 8 |
| 9 | 27 | 41 | 27 | 25 | 27 | 33 | 27 | 12 | 28 | 22 | 28 | 51 | 9 |
| 10 | 28 | 38 | 28 | 23 | 28 | 32 | 28 | 12 | 29 | 22 | 29 | 52 | 10 |
| 11 | 29 | 36 | 29 | 21 | 29 | 30 | 29 | 12 | ♐ | 23 | ♑ | 53 | 11 |
| 12 | ♌ | 33 | ♍ | 19 | ♎ | 29 | m | 12 | 1 | 24 | 1 | 55 | 12 |
| 13 | 1 | 30 | 1 | 17 | 1 | 28 | 1 | 12 | 2 | 25 | 2 | 56 | 13 |
| 14 | 2 | 28 | 2 | 15 | 2 | 27 | 2 | 12 | 3 | 26 | 3 | 57 | 14 |
| 15 | 3 | 25 | 3 | 13 | 3 | 26 | 3 | 12 | 4 | 26 | 4 | 58 | 15 |
| 16 | 4 | 22 | 4 | 11 | 4 | 25 | 4 | 12 | 5 | 27 | 5 | 59 | 16 |
| 17 | 5 | 20 | 5 | 9 | 5 | 24 | 5 | 12 | 6 | 28 | 7 | 00 | 17 |
| 18 | 6 | 17 | 6 | 7 | 6 | 23 | 6 | 12 | 7 | 29 | 8 | 2 | 18 |
| 19 | 7 | 15 | 7 | 5 | 7 | 23 | 7 | 12 | 8 | 30 | 9 | 3 | 19 |
| 20 | 8 | 12 | 8 | 3 | 8 | 22 | 8 | 12 | 9 | 31 | 10 | 4 | 20 |
| 21 | 9 | 9 | 9 | 1 | 9 | 21 | 9 | 13 | 10 | 32 | 11 | 5 | 21 |
| 22 | 10 | 7 | 10 | 00 | 10 | 20 | 10 | 13 | 11 | 33 | 12 | 6 | 22 |
| 23 | 11 | 4 | 10 | 58 | 11 | 19 | 11 | 13 | 12 | 34 | 13 | 8 | 23 |
| 24 | 12 | 2 | 11 | 56 | 12 | 19 | 12 | 13 | 13 | 35 | 14 | 9 | 24 |
| 25 | 12 | 59 | 12 | 54 | 13 | 19 | 13 | 14 | 14 | 36 | 15 | 10 | 25 |
| 26 | 13 | 57 | 13 | 53 | 14 | 17 | 14 | 14 | 15 | 37 | 16 | 11 | 26 |
| 27 | 14 | 55 | 14 | 51 | 15 | 17 | 15 | 14 | 16 | 38 | 17 | 12 | 27 |
| 28 | 15 | 52 | 15 | 49 | 16 | 16 | 16 | 15 | 17 | 39 | 18 | 13 | 28 |
| 29 | 16 | 50 | 16 | 48 | 17 | 16 | 17 | 15 | 18 | 40 | 19 | 15 | 29 |
| 30 | 17 | 47 | 17 | 46 | 18 | 15 | 18 | 16 | 19 | 41 | 20 | 16 | 30 |
| 31 | 18 | 45 | 18 | 45 | | | 19 | 16 | | | 21 | 17 | 31 |

A Table of the *Longitude*, *Latitude*, *Right Aſcenſion* and *Declination* of above 50 of the Principal Stars of the *Firſt*, *Second* and *Third* Magnitude: For the Year 1710.

| *Stars Names.* | Mag. | S. | *Longitude.* ° ′ | *Latitude.* ° ″ | | *Rt. Aſcent.* ° ′ ″ | *Declinat.* ° ′ ″ | |
|---|---|---|---|---|---|---|---|---|
| The Head of *Andromeda* | 2 | ♈ | 10 18 51 | 25 43 12 | N. | 358 22 12 | 27 38 5 | N. |
| The bright Foot of *Andromeda* | 2 | ♈ | 10 13 12 | 27 47 13 | N. | 26 34 58 | 40 56 44 | N. |
| The bright Star of *Aquila* | 1 | ♑ | 27 41 14 | 29 21 32 | N. | 294 8 59 | 8 9 11 | N. |
| The bright Star of *Aries* | 2 | ♉ | 3 37 55 | 9 57 43 | N. | 27 44 28 | 22 5 59 | N. |
| The Right Shoulder of *Aquarius* | 3 | ♒ | 29 20 8 | 10 43 36 | N. | 327 43 36 | 1 10 8 | S. |
| The Left Shoulder of *Aquarius* | 3 | ♒ | 19 22 53 | 8 41 50 | N. | 319 4 51 | 6 46 29 | S. |
| *Capella* | 1 | ♊ | 17 49 6 | 22 52 9 | N. | 73 50 4 | 45 41 25 | N. |
| The Right Shoulder of *Auriga* | 2 | ♊ | 25 51 49 | 21 57 38 | N. | 84 33 59 | 44 55 52 | N. |
| *Arcturus* | 1 | ♎ | 20 11 21 | 31 1 00 | N. | 210 39 27 | 20 45 58 | N. |
| *Sirius*, or the Dog-Star | 1 | ♋ | 10 8 44 | 39 30 5 | S. | 98 8 48 | 16 17 4 | S. |
| The Tail of the Great Dog | 2 | ♋ | 25 32 15 | 50 36 10 | S. | 108 10 41 | 28 42 2 | S. |
| *Procyon* | 1 | ♋ | 21 49 32 | 15 56 11 | S. | 111 4 5 | 5 58 44 | N. |
| The Northern Horn of ♉ | 3 | ♉ | 29 48 57 | 7 3 3 | N. | 300 28 9 | 12 20 40 | S. |
| The bright Star in the Chair of *Caſſiopea* | 3 | ♈ | 1 4 52 | 51 13 35 | N. | 358 26 51 | 58 33 8 | N. |
| *Mandibula*, or the bright Star of the Whale | 2 | ♈ | 0 17 22 | 12 37 00 | S. | 41 48 51 | 2 56 37 | N. |
| The bright Star in the Northern Crown | 2 | ♏ | 8 11 7 | 44 23 20 | S. | 230 36 53 | 27 43 41 | N. |
| The Tail of the Swan | 2 | ♑ | 1 25 5 | 59 57 23 | N. | 307 53 52 | 44 17 41 | N. |
| *Caſtor* | 2 | ♋ | 16 12 34 | 10 4 23 | N. | 109 1 22 | 32 30 33 | N. |
| *Pollux* | 2 | ♋ | 19 13 59 | 6 40 29 | N. | 111 54 35 | 28 43 21 | N. |
| The Head of *Hercules* | 3 | ♐ | 12 6 33 | 37 22 19 | N. | 255 23 19 | 14 46 30 | N. |
| *Hydra*'s Heart | 1 | ♌ | 23 15 38 | 22 23 20 | S. | 138 20 44 | 7 23 50 | S. |
| *Regulus*, or the Lyon's Heart | 1 | ♌ | 25 49 35 | 0 28 45 | N. | 148 14 23 | 13 24 9 | N. |
| The Lyon's Tail | 1 | ♍ | 17 36 6 | 12 18 55 | N. | 173 35 5 | 16 12 54 | N. |
| The Northern Balance | 2 | ♏ | 10 2 45 | 0 26 38 | N. | 218 45 4 | 14 45 40 | S. |
| The Southern Balance | 2 | ♏ | 15 19 43 | 8 34 47 | N. | 225 22 42 | 8 14 33 | S. |
| The bright Star in the Harp | 1 | ♑ | 11 15 33 | 61 47 17 | N. | 276 46 47 | 38 32 49 | N. |
| The Right Shoulder of *Orion* | 1 | ♊ | 24 43 25 | 16 3 52 | S. | 84 53 26 | 7 20 45 | N. |
| The Left Shoulder of *Orion* | 2 | ♊ | 16 55 40 | 16 52 11 | S. | 77 25 50 | 6 3 52 | N. |
| *Regel*, or the bright Foot | 1 | ♊ | 12 49 41 | 31 9 26 | S. | 75 13 3 | 8 31 58 | S. |
| *Marcab Pegaſi* | 2 | ♓ | 19 28 27 | 19 27 37 | N. | 342 38 9 | 13 42 3 | N. |
| *Scheat Pegaſi* | 2 | ♓ | 25 22 15 | 31 10 21 | N. | 342 27 9 | 26 33 32 | N. |
| The Head of *Meduſa Algol* | 2 | ♉ | 22 9 15 | 22 23 17 | N. | 22 23 3 | 39 49 37 | N. |
| The Knot in the Line of the Fiſher | 3 | ♈ | 25 20 45 | 9 4 18 | S. | 26 49 1 | 1 22 29 | N. |
| The Scorpion's Heart | 1 | ♐ | 5 41 3 | 4 27 19 | S. | 242 54 5 | 25 41 40 | S. |
| The Head of *Serpentarius* | 2 | ♐ | 18 21 37 | 35 57 3 | N. | 260 21 32 | 12 51 10 | N. |
| The bright Star in the Neck of the Serpent | 2 | ♍ | 18 1 53 | 25 35 40 | N. | 232 32 42 | 7 3 9 | N. |
| *Aldebaran*, or the Southern Eye of the Bull | 1 | ♊ | 5 45 32 | 5 29 14 | S. | 64 51 9 | 15 55 10 | N. |
| The Bull's Northern Horn. | 2 | ♊ | 18 31 41 | 5 20 36 | N. | 77 00 13 | 28 19 47 | N. |
| The Southern Horn of the Bull | 3 | ♊ | 20 45 7 | 2 15 48 | S. | 80 6 12 | 20 55 21 | N. |
| The Northern Eye of the Bull | 3 | ♊ | 4 26 16 | 2 36 20 | S. | 62 57 49 | 18 31 28 | N. |
| *Spica Virginis* | 1 | ♎ | 19 47 15 | 1 59 55 | S. | 197 29 38 | 9 36 33 | S. |
| The First in the Great Bear's Tail | 2 | ♍ | 4 47 55 | 54 19 00 | N. | 190 19 58 | 57 33 13 | N. |
| The Middlemoſt | 2 | ♍ | 11 31 36 | 56 23 17 | N. | 198 4 7 | 56 28 33 | N. |
| The Laſt in the Great Bear's Tail | 2 | ♍ | 22 47 44 | 54 25 7 | N. | 204 3 1 | 51 18 40 | N. |
| In the Side | 2 | ♌ | 11 6 13 | 49 40 23 | N. | 161 24 25 | 63 19 40 | N. |
| In the Belly | 2 | ♌ | 15 19 50 | 45 7 14 | N. | 161 3 16 | 57 57 18 | N. |
| In the *Coxa* | 2 | ♌ | 26 20 15 | 47 8 00 | N, | 174 36 36 | 55 20 10 | N. |
| In the Back | 3 | ♌ | 26 55 35 | 51 38 35 | N. | 180 15 36 | 58 39 55 | N. |
| The Pole-Star | 2 | ♊ | 24 33 37 | 66 3 00 | N. | 9 9 8 | 87 46 15 | N. |
| The First Star of *Aries* | 4 | ♈ | 29 9 18 | 7 10 2 | N. | 24 25 40 | 17 53 25 | N. |
| The Second Star of *Aries* | 3 | ♈ | 29 56 42 | 8 28 45 | N. | 24 41 20 | 25 38 1 | N. |
| The bright Star of *Aries* | 2 | ♉ | 3 37 55 | 9 57 43 | N. | 27 44 28 | 22 5 59 | N. |
| The Southern Horn of *Capricorn* | 3 | ♒ | 00 00 46 | 4 41 27 | N. | 301 10 27 | 15 36 46 | S. |

RIGLET, is any ſquare, flat, thin, Piece of Wood, like thoſe which are deſigned to make the Frames of ſmall Pictures of; which are ſo called, before they are *Molded*.

RINÆUS, a Muſcle of the Noſe, otherwiſe called *Naſalis*; which ſee

ROD-*Knights*, alias *Rad-Knights* were anciently certain Servitors, which held their Land by ſerving their Lord on Horſe-back; or attending him in his Progreſs or Travels on the *Road*.

ROME-*Scot* was formerly here an annual Tribute of a Penny for every Family, and paid to *Rome* at the Feaſt of St *Peter ad Vincula*, being the Firſt of *Auguſt*.

*Cambden* tells us it was firſt granted by *Offa*; but others attribute its Origiual to *Ina*, King of the Weſt *Saxons*; who being in Pilgrimage at *Rome*, *A. D.* 725. gave it as an Alms. It amounted to three hundred Marks and one Noble yearly. Of this Mark of Slavery to *Rome*, our Anceſtors frequently complained as a Burden and Scandal to the *Engliſh* Nation: It was firſt for bidden to be paid by *Edw.* 3. Tho' before complained of in Parliament as a Grievance in K. *John's* Time, *A. D.* 1206. This Payment was abrogated 25 *H.* 8. 25. But ſervilely reſtored again 1 and 2 *Phil.* and *Mary*; and at laſt utterly aboliſhed, 1 *Eliz.* 1.

ROOT *Binomial*: To raiſe (eaſily) a Binomial Root up to any Power aſſign'd.

Suppoſe $a \pm b$. (1.) If it be $a - b$ 'tis called a *Reſidual*; and the Powers of ſuch a *Reſidual* will be the ſame with the like Powers raiſed from a Binomial (affirmative) as $a + b$; except, that as the Signs of the Powers of a Binomial are all affirmative: Thoſe of the *Reſidual* have the Signs + and — alternately annexed to every other Term; as will eaſily appear from multiplying $a - b$ by it ſelf, and then the Square ſo found by the Root again, *&c.*

2. The Indexes of the Powers of the Leading Quantity, or *Firſt Name* a, in all the Powers of the Binomial $a + b$ do continually decreaſe, and that in an *Arithmetical Progreſſion*; as thoſe of *b*, the *other Names* do after the ſame Manner encreaſe.

So that if the Indexes of the Powers of $a + b$ only were required, when that Binomial is to be raiſed up to the ſeventh Power, you will eaſily perceive that it muſt ſtand thus.

$$a^7 + a^6 b + a^5 b^2 + a^4 . b^3 + a^3 b^4 + a^2 b^5 + a b^6 + b^7.$$

3. Where 'tis eaſy to obſerve that the firſt and laſt Term are pure Powers of the ſingle Quantities *a* and *b*, and are both of the ſame Height: As alſo that the Summ of the Indexes of any two Letters joined together in any of the *Intermediate Terms*, do always make up the Index of the higheſt Power.

4. The next Work therefore is only to find the *Unciæ*; which may be done by conſidering,

(1) That the *Uncia* of every ſingle Letter, and of every ſingle Power, how high ſoever it be, is an Unit, or (1), which neither multiples nor divides. (2) That all the Powers of any Binomial are naturally raiſed by multiplying the *Preceeding Power* into the *Original Root*: Which in Algebraick Multiplication, is done by only joining each Letter in the Root to the Preceeding Power with its *Unciæ*; and then removing the ſaid *Power*, when 'tis ſo *joined* to the *ſecond Letter*, one Place forwards, either to the *Right* or *Left*-hand. Thus $a a + 2 a b + b b$, the *Square* or *Second Power* of $a + b$ is found by joining to $a + b$ each Letter of $a + b$, and removing the Powers to the Right or Left-hand thus; *a* joined to *a* makes *a a*; *a* joined to *b* makes *a b*; and *b* joined to *a* makes another *a b*; and *b* joined to *b* makes *b b*; and it will ſtand thus; $a a \begin{matrix} + a b \\ + a b \end{matrix} + b b$ or $a a + 2 a b + b b$. Now from hence it will follow, (3) That the *Unciæ* of the ſecond Term in any ſuch Power will always be the Summ of ſo many Units added together (more 1.) as there hath been Multiplications of the *Firſt Root*; which will always be determined by the Index of the firſt Term in the Power.

And becauſe the *Unciæ* of all the Intermediate Terms are only *removed* along with their Letters; it alſo follows, that if they are *added* together, their reſpective Summs, muſt produce the true *Unciæ* of the intermediate Terms in the new raiſed Power, as is plain from the following Table, where the Numbers are ſo removed without their Letters,

1 1 } are the 2 *Unciæ* of $a + b$ and $a + b$.
1 1 } Theſe added in the Order as they ſtand, produce the next Rank.

1 2 1 } The *Unciæ* of the Square, and theſe
1 2 1 } added again produce the next Rank or *Unciæ* of the Cube, *&c.*

1 3 3 1 } *Unciæ* of the Cube.
1 3 3 1 }

1 4 6 4 1 } The *Unciæ* of the Biquadrate.
1 4 6 4 1 }

1 5 10 10 5 1 } The *Unciæ* of the fifth
1 5 10 10 5 1 } Power.

1 6 15 20 15 6 1 } The *Unciæ* of the
1 6 15 20 15 6 1 } ſixth Power.

1 7 21 35 35 21 7 1 } The *Unciæ* of the ſeventh Power,

and ſo on, as Mr. *Ward* hath well obſerved in his young Mathematicians Guide, *p.* 157, 158.

If therefore you take the Numbers in the laſt Row of the Table above, and prefix them to the ſeveral and proper Letters in the 7th Power of $a + b$, you will compleat all the Terms with their ſeveral *Unciæ*, and it will ſtand thus;

$$a^7 + 7 a^6 b + 21 a^5 b^2 + 35 a^4 b^3 + 35 a^3 b^4 + 21 a^2 b^5 + 7 a b^6 + b^7$$

And further from obſerving that the *Unciæ* of the firſt Term in all the ſeveral Powers of a Binomial, are a *Series of Units*, whoſe Summ is every where the *Unciæ* of the ſecond Term; and that the *Unciæ* of the ſecond Term, are a Series of Numbers in natural Arithmetical Progreſſion;

sion; as 1,2,3,4,5,6,7,&c. Whose Summ is every where the *Unciæ* of the next Superior Power in the Third Term, &c. He deduces this General Rule for finding the *Unciæ* of any Power of a Binomial, *Viz.*

Multiply the Index of the *First Letter* of any Term into its own *Unciæ*, and divide the Product by the Number of Terms to that Place, and the Question will be the *Unciæ* of the next Subceeding Term, forward. Thus in the last Example,

1. The Index of $a^7$ (the *First Term*) will be the *Uncia* for $7\ a^6\ b$, the Second Term.

2. Then $\frac{7 \times 6}{2} = 21$. That is the Index of $a^5$ in the *Second Term* multiplied by its *Uncia* 7; and the Product 42, divided by 2, the Number of Terms to that Place, quotes 21, the *Uncia* of the *Third Term*.

3. Again, $\frac{21 \times 5}{3} = 35$. The *Uncia* of the *Fourth Term*, and $\frac{35 \times 4}{4} = 35$, will be the *Uncia* of the *Fifth Term*, &c.

4 You may observe here that the *Unciæ* do *increase*, only 'till the *Indeces* of the Two Letters become equal, or *change Places*; and then the Rest of the *Unciæ* do decrease, as the former increased: So that 'tis enough to find the *Unciæ* of half the Number of Terms in any Power, and then the Rest may be easily prefixed.

And when all this is considered, the Value and Expeditiousness of that *Short Theorem* of Sir *Isaac Newton*, for finding the *Unciæ* of a Binomial, will be understood and admired, *Viz.*

Suppose $m$ the Exponent of any Power: Then will $1 \times \frac{m-0}{1} \times \frac{m-1}{2} \times \frac{m-2}{3} \times \frac{m-3}{4} \times \frac{m-4}{5} \times \frac{m-5}{6} \times \frac{m-6}{7}$, &c. be a *Series* for the *Unciæ* of the powers of any Binomial involved infinitely.

As, Suppose you would have the *Unciæ* for the 7th Power of $a+b$. Then $m = 7$, and by the Theorem $1 \times \frac{m-0}{1} = 7$ will be the *Uncia*, and that $7 \times \frac{m-1}{2} = 21$ will be the *Uncia* for the Third Term: And again, That $21 \times \frac{m-2}{3} = 35$ will be the *Uncia* for the Fourth Term. Also that $35 \times \frac{m-3}{4} = 35$ will be the *Uncia* of the Fifth Term; and consequently by going backwards (as in Art. 4. above) you will find that the *Unciæ* of the two Remaining Terms must be 21, 7, and 1.

*A New, Exact and Easie Method, of finding the Roots of any Equations generally, and that without any previous Reduction. By Mr.* Edm. Halley, *Geometry Professor at* Oxford.

The principal Use of the *Analytick Art*, is to bring Mathematical Problems to Equations, and to exhibit those Equations in the most simple Terms that can be. But this Art would justly seem in some degree defective, and not *sufficiently Analytical*, if there were not some Methods, by the help of which, the Roots (be they Lines or Numbers) might be gotten from the Equations that are found, and so the Problems in that respect be solved. The Ancients scarce knew any thing in these Matters, beyond *Quadratick Equations*. And what they writ of the *Geometrick Construction* of solid Problems, by the help of the *Parabola*, *Cissoid*, or any other Curve, were only particular things design'd for some particular Cases. But as to *Numerical Extraction*, there is every where a profound Silence; so that whatever we perform now in this kind, is entirely owing to the Inventions of the Moderns.

And first of all, that great Discoverer and Restorer of the Modern Algebra, *Francis Vieta*, about 100 Years since, shew'd a general Method for extracting the Roots of any Equation, which he publish'd under the Title of, *A Numerical Resolution of Powers*, &c. *Harriot*, *Oughtred*, and others, as well of our own Country, as Foreigners, ought to acknowledge whatsoever they have written upon this Subject, as taken from *Vieta*. But what the Sagacity of Sir *Is. Newton*'s Genius has perform'd in this Business, we may rather conjecture (than be fully assur'd of) from that short Specimen given by Dr. *Wallis* in the 94th. Chapter of his *Algebra*. And we must be forc'd to expect it, 'till his great Modesty shall yield to the Intreaties of his Friends, and suffer those curious Discoveries to see the Light.

Not long since (*viz. A. D.* 1690.) that excellent Person M. *Joseph Raphson*, F. R. S. Publish'd his *Universal Analysis of Equations*, and illustrated his Method by plenty of Examples; by all which he has given Indications of a Mathematical Genius, from which the greatest things may be expected.

By this Example, M. *de Lagney*, an Ingenious Professor of Mathemanicks at *Paris*, was encourag'd to attempt the same Argument, but he being almost altogether taken up in extracting the Roots of pure Powers (especially the Cubick) adds but little about affected Equations, and that pretty much perplex'd too, and not sufficiently demonstrated. Yet he gives two very compendious Rules for the Approximation of a Cubical Root; one a Rational, and the other an Irrational one. Ex. gr. that the side of the Cube $aaa + b$, is between

$$a + \frac{ab}{3aaa+b}, \text{ \& } \sqrt{\tfrac{1}{4}aa + \frac{b}{3a}} + \tfrac{1}{2}a.$$

And the Root of the 5th Power $a^5 + b$, he makes

$$= \tfrac{1}{2}a + \sqrt{\sqrt{\tfrac{1}{4}a^4 + \frac{b}{5a}}} - \tfrac{1}{4}a\,a \text{ (where note, that}$$

that 'tis $\frac{1}{4}aa$, not $\frac{1}{2}aa$, as 'tis erroneously Printed in the French Book.). These Rules were communicated to me by a Friend, I having not seen the Book; but having by Trial found the goodness of them, and admiring the Compendium, I was willing to find out the Demonstration. Which having done, I presently found that the same Method might be accommodated to the Resolution of all sorts of Equations. And I was the rather inclin'd to improve these Rules, because I saw that the whole thing might be Explain'd in a *Synopsis*; and that by this means, at every repeated step of the Calculus, the Figures already found in the Root, would be at least Trebled, which all other ways, are increased but in an equal Number with the given ones. Now, the fore-mention'd Rules are easily demonstrated from the Genesis of the Cube, and the 5th Power. For, supposing the side of any Cube $= a + e$, the Cube arising from thence, is $aaa + 3aae + 3aee + eee$. And consequently, if we suppose $aaa$ the next less Cube, to any given Non-cubick Number, then $eee$ will be less than Unity, and the Remainder $b$, will $=$ the other Members of the Cube, $3aae + 3aee + eee$. Whence rejecting $eee$ upon the account of its smallness, we have $b = 3aae + 3aee$. And since $aae$ is much greater than $aee$, the quantity $\frac{b}{3aa}$ will not much exceed $e$; so that putting $e = \frac{b}{3aa}$ then the quantity $\frac{b}{3aa+3ae}$ (to which $e$ is nearly equal) will be found $= \frac{b}{3aa + \frac{3ab}{3aa}}$ or $\frac{b}{3aa + \frac{b}{a}}$ that is $\frac{ab}{3aa+b} = e$

And so the side of the Cube $aaa + s$ will be $a + \frac{ab}{3aa+b}$, which is the *Rational Formula* of

M. *de Lagney*. But now, if $aaa$ were the next greater Cubick Number to that given, the side of the Cube $aaa - b$, will after the same manner be found to be $a - \frac{ab}{3aa-b}$. And this easy and expeditious Approximation to the Cubick Root, is only (a very small matter) erroneous in point of *defect*, the quantity $e$, the Remainder of the Root thus found, coming something less than really 'tis.

As for the *Irrational Formula*, 'tis derived from the same Principle, *viz.* $b = 3aae + 3aee$, or $\frac{b}{3a} = ae + ee$, and so $\sqrt{\frac{1}{4}aa + \frac{b}{3a}} = \frac{1}{2}a + e$, and $\sqrt{\frac{1}{4}aa + \frac{b}{3a}} + \frac{1}{2}a = a + e$, the Root sought.

Also the side of the Cube $aaa - b$, after the same manner, will be found to be $\frac{1}{2}a + \sqrt{\frac{1}{4}aa - \frac{b}{3a}}$

And this *Formula* comes something nearer to the Scope, being erroneous in point of *excess*, as the other was in *defect*, and is more accommodated to the Ends of Practice, since the Restitution of the Calculus, is nothing else but the continual Addition or Substraction of the Quantity $\frac{aee}{3a}$ according as the quantity $e$ can be known. So that we should rather write $\sqrt{\frac{1}{4}a + \frac{b-eee}{3a}} + \frac{1}{2}a$, in the former case, and in the latter, $\frac{1}{2}a + \sqrt{\frac{1}{4}aa + \frac{eee-b}{3a}}$. But by either of the two *Formula's*, the Figures already known in the Root to be extracted, are at least Tripled; which I conclude will be very grateful to all the Students in Arithmetick; and I congratulate the Inventor upon the Account of his Discovery.

But that the Use of these Rules may be the better perceiv'd, I think it proper to subjoin an Example to two. Let it be propos'd to find the side of the double Cube, or $aaa + b = 2$. Here $a = 1$, and $\frac{b}{3a} = \frac{1}{2}$, and so $\frac{1}{2} + \sqrt{\frac{7}{12}}$, or 1, 26, will be found to be the true side nearly. Now, the Cube of 1, 26, is 2, 000376, and so 0, 63 + $\sqrt{,3969 - \frac{,0000376}{3,78}}$, or 0, 63 + $\sqrt{,39680052}$ . . . . 91005291 = 1, 259921049895 —; which in 13 Figures, gives the side of the double Cube, with very little Trouble, *viz.* By one only Division, and the Extraction of the square Root; when as by the common way of working, how much pains it would have cost, the Skilful very well know. This Calculus a Man may continue as far as he pleases, by encreasing the Square by the Addition of the Quantity $\frac{eee}{3a}$, which Correction, in this case will give, but the encrease of Unity in the 14th Figure of the Root.

*Exemp.* 2. Let it be propos'd to find the sides or a Cube equal to that English Measure commonly call'd a Gallon, which contains 231 solid Ounces. The next less Cube is 216, whose side $6 = a$, and the Remainder $15 = b$; and so for the first Approximation, we have $3 + \sqrt{9 + \frac{5}{6}} =$ the Root. And since $\sqrt{9,8333...}$ is 3, 1358..., 'tis plain that $6, 358 = a + e$. Now, let $6, 1358 = a$; and we shall have then for its

its Cube 231, 000853894712, and according to the Rule, 3,0679 + √ 9,41201041 —,000858394712

18, 4070

is most accurately equal to the side of the given Cube, which within the Space of an Hour, I determin'd by Calculation to be 6. 1357924 3966195897, which is exact in the 18th Figure, defective in the 19th. And this *Formula* is deservedly perferable to the *Rationale*, upon the Account of the great Divisor, which is not to be manag'd without a great deal of Labour; whereas the Extraction of the square Root, proceeds much more easily, as manifold Experience has taught me.

But the Rule for the Root of a pure Surfolid, or the 5th Power, is of something a higher Enquiry, and does much more perfectly yet do the business; for it does at least Quintuble the given Figures in the Root, neither is the Calculus very large or operose. Though the Author no where shews his Method of Invention, or any Demonstration, although it seems to be very much wanting, especially since all things are not right in the printed Book, which may easily deceive the Unskilful. Now the 5th power of the side $a+e$ is compos'd of these Members, $a^5 + 5a^4e + 10a^3e^2 + 10a^2e^3 + 5ae^4 + e^5 = a^5 + b$; from whence $b = 5a^4e + 10a^3e^2 + 10a^2e^3 + 5ae^4$, rejecting $e^5$ because of its smallness.

Whence $\frac{b}{5a} = a^3e + 2a^2e^2 + 2ae^3 + e^4$, and adding on both sides $\frac{1}{4}a^4$, we shall have $\sqrt{\frac{\frac{1}{4}a^4+b}{5a}}$ $= \sqrt{\frac{1}{4}a^4 + a^3e + 2a^2e^2 + 2ae^3 + e^4} = \frac{1}{2}aa + ae + ee$. Then substracting $\frac{1}{2}aa$ from both sides, $\frac{1}{2}a + e$ will $= \sqrt{\sqrt{\frac{\frac{1}{4}a^4+b}{5a}} - \frac{1}{4}aa}$; to which if $\frac{1}{2}a$ be added, then will $a+e = \frac{1}{2}a + \sqrt{\sqrt{\frac{\frac{1}{4}a^4+b}{5a}} - \frac{1}{4}aa}$ = the Root of the Power $a^5 + b$. But if it had $a^5 - b$ (the quantity of $a$ being too great) the Rule would have been thus, $\frac{1}{2}a + \sqrt{\sqrt{\frac{\frac{1}{4}a^4-b}{5a}} - \frac{1}{4}aa}$ and this Rule approaches wonderfully, so that there is hardly any need of Restitution.

But while I considered these things with myself, I light upon a General Method for the *Formula's* of all Powers whatsoever, and (which being handsome and concise enough) I thought I would not conceal from the Publick.

These *Formula's*, (as well the *Rational* as the *Irrational* ones) are thus.

$$\sqrt{aa+b} = \sqrt{aa+b}, \text{ or } a + \frac{ab}{2aa+\frac{1}{2}b}.$$

$$\sqrt[3]{a^3+b} = \frac{1}{2}a + \sqrt{\frac{\frac{1}{4}aa+\frac{b}{3a}}{}}, \text{ or } a + \frac{ab}{3aaa+b}$$

$$\sqrt[4]{a^4+b} = \frac{2}{3}a + \sqrt{\frac{\frac{1}{9}aa+\frac{b}{6aa}}{}}, \text{ or } a + \frac{ab}{4a^4+\frac{3}{2}b}$$

$$\sqrt[5]{a^5+b} = \frac{3}{4}a + \sqrt{\frac{\frac{1}{16}aa+\frac{b}{10a^3}}{}}, \text{ or } a + \frac{ab}{5a^5+2b}.$$

$$\sqrt[6]{a^6+b} = \frac{4}{5}a + \sqrt{\frac{\frac{1}{25}aa+\frac{b}{15a^4}}{}}, \text{ or } a + \frac{ab}{6a^6+\frac{5}{2}b}.$$

$$\sqrt[7]{a^7+b} = \frac{5}{6}a + \sqrt{\frac{\frac{1}{36}aa+\frac{b}{21a^5}}{}}, \text{ or } a + \frac{ab}{7a^7+3b}.$$

And so also of the other higher Powers. But if $a$ were assumed bigger, than the Root sought (which is done with some Advantage, as often as the Power to be resolved, is much nearer the Power of the *next greater* whole Number, than of the *next less*) in this case, *Mutatis Mutandis*, we shall have the same Expressions of the Roots, *Viz.*

$$\sqrt{aa-b} = \sqrt{aa-b}, \text{ or } a - \frac{ab}{2aa-\frac{1}{2}b}.$$

$$\sqrt[3]{a^3-b} = \frac{1}{2} + \sqrt{\frac{\frac{1}{4}aa-\frac{b}{3a}}{}}, \text{ or } a - \frac{ab}{3a^3-b}$$

$$\sqrt[4]{a^4-b} = \frac{2}{3}a + \sqrt{\frac{\frac{1}{9}aa-\frac{b}{6aa}}{}}, \text{ or } a - \frac{ab}{4a^4-\frac{3}{2}b}$$

$$\sqrt[5]{a^5-b} = \frac{3}{4}a + \sqrt{\frac{\frac{1}{16}aa-\frac{b}{10a^3}}{}}, \text{ or } a - \frac{ab}{5a^5-2b}$$

$$\sqrt[6]{a^6-b} = \frac{4}{5}a + \sqrt{\frac{\frac{1}{25}aa-\frac{b}{15a^4}}{}}, \text{ or } a - \frac{ab}{6a^6-\frac{5}{2}b}.$$

$$\sqrt[7]{a^7-b} = \frac{5}{6}a + \sqrt{\frac{\frac{1}{36}aa-\frac{b}{21a^5}}{}}, \text{ or } a - \frac{ab}{7a^7-3b}.$$

Aud within these two Terms, the true Root is ever found, being something nearer to the *Irrational* than the *Rational* Expression. But the qnantity $e$ found by the *Irrational Formula*, is always too great, as the Quotient resulting from the *Rational Formula*, is always too little. And consequently, if we have $+b$, the *Irrational Formula* gives the Root something greater than it should be, and the *Rational* something less. But contrary-wise if it be $-b$.

And thus much may suffice to be said concerning the Extraction of the Roots of pure Powers: which notwithstanding, for common Uses, may be had much more easily by the help of the Logarithms. But when a Root is to be determin'd very accurately, and the Logarithmick Tables will not reach so far; then we must necessarily have recourse to these, or such like Methods. Farther; the Invention and Contemplation of these *Formulæ*, leading me to a certain Universal Rule, for adfected Equations

quations (which I hope will be of uſe to all the Students in *Algebra* and *Geometry*) I was willing here to give ſome account of this Diſcovery, which I will do with all the perſpecuity I can, I had given at N°. 188 of the *Tranſactions*, a very eaſie and general Conſtruction of all adfected Equations, not exceeding the Biquadratick Power; from which time I had a very great deſire of doing the ſame in Numbers. But quickly after Mr. *Raphſon* ſeem'd in great Meaſure to have ſatisfied this Deſire, till Mr. *Lagney* by what he had perform'd in his Book, intimated that the thing might be done more compendiouſly yet. Now, my Method is thus.

Let $z$ the Root of any Equation, be imagin'd to be compos'd of the parts $a + \text{or} - e$, of which let $a$ be aſſum'd as near $z$ as is poſſible; which is notwithſtanding not *neceſſary*, but only *commodious*. Then from the Quantity $a + e$ or $a - e$, let there be form'd all the Powers of $z$, found in the Equation, and the Numerical Co-efficients be reſpectively affix'd to them: Then let the Power to be *reſolv'd*, be ſubſtracted from the Summ of the given Parts (in the firſt Column where $e$ is not found) which they call the *Homogeneum Comparationis*, and let the difference be $\pm b$. In the next place, take the Summ of all the Co-efficients of $e$ in the ſecond Column, to which put $= s$. Laſtly, in the third Column let there be put down the Summ of all the Co-efficients of $ee$, which Summ call $t$. Then will the Root $z$ ſtand thus in the *Rational Formula*, viz. $z = a + \frac{sb}{ss \pm tb}$; and thus in the *Irrational Formula*, viz.

$$z = a \mp \tfrac{1}{2}s \pm \frac{\sqrt{\tfrac{1}{4}ss \mp bt}}{t};$$

which perhaps it may be worth while to Illuſtrate by ſome Examples. And inſtead of an *Inſtrument*, let this *Table* ſerve, which ſhews the Geneſis of the ſeveral Powers of $a \pm e$, and if need be, may eaſily be continued farther; which for its Uſe I may rightly call a *General Analytical Speculum*. The foremention'd Powers ariſing from a continual Multiplication by $a + e\ (= z)$ come out thus with their adjoined Co-efficients: *See the Table*. But now, if it be $a - e = z$, the Table is compos'd of the ſame Members, only the odd Powers of $e$, as $e$, $e^3$, $e^5$, $e^7$ are Negative, and the even Powers, as $e^2$, $e^4$, $e^6$, Affirmative. Alſo let the Summ of the Co-efficients of the ſide $e$, be $= s$; the Summ of the Co-efficients of the Square $ee = t$, the Summ of the Co-efficient of $e^3 = u$; of $e^4 = w$; of $e^5 = x$; of $e^6 = y$, &c. But now, ſince $e$ is ſuppoſed only a ſmall Part of the Root that is to be enquir'd, all the Powers of $e$, will be much leſs than the correſpondent Powers of $a$, and ſo far the firſt Hypotheſis; all the ſuperior ones may be rejected; and forming a new Equation, by ſubſtituting $a \pm e = z$, we ſhall have (as was ſaid) $\pm b = \pm se \pm tee$. The following Examples will make this more clear.

*Example* I.

Let the Equation $z^4 - 3z^2 + 75z = 10000$, be propos'd. For the firſt Hypotheſis, let $a = 10$, and ſo we have this Equation,

$$\begin{array}{rl}
z^4 = & +a^4\ -\ 4a^3e + 6a^2e^2 - 4ae^3 + e^4 \\
-dz^2 = & -da^2\ +\ 2dae - de^2 \\
+cz = & +ca\ -\ ce \\
= & +10000\ -\ 4000e + 600ee - 40e^3 + e^4 \\
& -\ 300\ +\ 60e - 3ee \\
& +\ 750\ -\ 75e \\
& -10000
\end{array}$$

$$+450 - \underset{s}{4015e} + \underset{t}{597ee} - \underset{u}{40e^3} + e^4 = 0$$

The Signs $+$ and $-$ with reſpect to the Quantities $e$ and $e^3$, are left as doubtful, 'till it be known whether $e$ be Negative or Affirmative; which thing creates ſome Difficulty, ſince that in Equations that have ſeveral Roots, the *Hermogenea Comparationis* (as they term them) are oftentimes encreaſed by the minute quantity $a$, and on the contrary, *that* being increaſed, *they* are diminiſhed. But the Sign of $e$ is determin'd from the Sign of the Quantity $b$. For taking away the *Reſolvend* from the *Homogeneal* form'd of $a$; the Sign of $se$ (and conſequently of the prevailing Parts in the Compoſition of it) will always be contrary to the Sign of the difference $b$. Whence 'twill be plain, whether it muſt be $+e$, or $-e$; and conſequently whether $a$ be taken greater or leſs than the *True Root*. Now the quantity $e$ is $= \frac{1}{2}s - \frac{\sqrt{\frac{1}{4}ss - bt}}{t}$, when $b$ and $t$ have the ſame Sign, but when the Signs are different, $e$ is $= \frac{\sqrt{\frac{1}{4}ss + bt}}{t} - \frac{1}{2}s$. But after it is found that it will be $-e$, let the Powers $e$, $e^3$, and $e^5$, *&c.* in the Affirmative Members of the Equation be made Negative, and in the Negative be made Affirmative; that is, let them be written with the contrary Sign. On the other hand, (if it be $+e$) let thoſe fore-mention'd Powers be made Affirmative in the Affirmative, and the Negative in Negative Members of the Equation.

Now we have in this Example of ours, 10450 inſtead of the Reſolvend 10000, or $b = +450$, whence it's plain that $a$ is taken greater than the Truth, and conſequently, that 'tis $-e$. Hence the Equation comes to be, $10450 - 4015e + 597ee - 4e^3 + e^4 = 10000$. That is, $450 - 4015e + 597ee = 0$; and ſo $450 = 4015e - 597ee$, or $b = se - tee$, whoſe Root $e = \frac{1}{2}s - \frac{\sqrt{\frac{1}{4}ss - bt}}{t}$, or $\frac{s}{2t} - \sqrt{\frac{ss}{4tt} - \frac{b}{t}}$; that is in the preſent caſe, $e = \frac{2007\frac{1}{2} - \sqrt{3761406\frac{1}{4}}}{597}$, from whence we have the Root ſought, 9, 886, which is near the Truth. But then ſubſtituting this for a ſecond Suppoſition, there comes $a + e = z$, moſt accurately 9, 8862603936495 .... ſcarce exceeding the Truth by 2 in the laſt Figure, *viz.* when $\frac{\sqrt{\frac{1}{4}ss + bt}}{t} - \frac{1}{2}s = e$.

$-\frac{1}{2}s=e$. And this (if need be) may be yet much farther verified, by ſubſtracting (if it be $+e$) the quantity $\frac{\frac{1}{2}ue^3+\frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss+tb}}$, from the Root before found; or (if it be $-e$) by adding $\frac{\frac{1}{2}ue^3-\frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss-tb}}$ to that Root. Which Compendium is ſo much the more Valuable, in that ſometimes from the firſt Suppoſition alone, but always from the ſecond, a Man may continue the Calculus (keeping the ſame Co-efficients) as far as he pleaſes. It may be noted, that the fore-mentioned Equation, has alſo a Negative Root, *viz.* $z=10{,}26\ldots$. which any one that has a Mind, may determine more accurately.

*Example* II.

Suppoſe $z^3-17z+54z=350$, and let $a=10$. Then according to the Preſcript of the Rule,

$$\begin{array}{l} +z^3=a^3+3a^2e+3ae^2+e^3 \\ -dz^3=da^3-2dae-da^2 \\ +cz=ca+ce \end{array}$$

That is,
$$\begin{array}{lllll} & b & s & t & \\ + & 1000 & +300e & +30e^2 & +e^3 \\ - & 1700 & -340e & -17e^2 & \\ + & 540 & +54e & & \\ - & 350 & & & \end{array}$$

Or, $-510+14e+13ee+e^3=0$. Now, ſince we have $-510$, it is plain, that $a$ is aſſumed leſs than the Trnth, and conſequently that $e$ is Affirmative. And from (the Equation) $510=14e+13e^2$, comes $e=\frac{\sqrt{bt+\frac{1}{4}ss}-\frac{1}{2}s}{t}$ $=\frac{\sqrt{6679}-7}{13}$. Whence $z=15,7\ldots$, which is too much, becauſe of $a$ taken wide; therefore Secondly, let $a=15$, and by the like way of Reaſoning, we ſhall find $e=\frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-tb}}{t}$ $=\frac{109\frac{1}{2}-\sqrt{11710\frac{1}{4}}}{28}$, and conſequently $z=14,954068$. If the Operation were to be repeated the third time, the Root will be found conformable to the Truth as far as the 25th Figure; but he that is contented with fewer, by writing $tb\pm te^2$ inſtead of $tb$, or ſubſtracting or adding $\frac{\frac{1}{2}e^3}{\sqrt{\frac{1}{4}ss\mp tb}}$ to the Root before found, will preſently obtain his End. Note, the Equation propoſed, is not explicable by any other Root, becauſe the *Reſolvend* 350, is greater than the Cube of $\frac{17}{3}$, or $\frac{d}{3}$.

*Example* III.

Let us take the Equation $z^4-80z^3+1998z^2-14937z+5000=0$, which Dr. *Wallis* uſes Cap. 62 of his *Algebra*, in the Reſolution of a very difficult Arithmetical Problem, where by *Vieta*'s Method he has obtain'd the Root moſt accurately; and Mr. *Raphſon* brings it alſo as an Example of his Method, *Page* 25, 26. Now this Equation is of the Form, which may have ſeveral Affirmative Roors, and (which increaſes the Difficulty) the *Co-efficients* are very great in reſpect of the *Reſolvend* given.

But that it may be the eaſier manag'd, let it be divided, and according to the known Rules of *Pointing*, let $-z^4+8z^3-20z^2+15z=0{,}5$ (where the quantity $z$ is $\frac{1}{10}$ of $z$ in the Equation propoſed) and for the firſt Snppoſition, let $a=1$. Then $+^2-5e-2e^2+4e^3-e^4-0{,}5=0$; that is, $1\frac{1}{2}=5e+2ee$; hence $e=\frac{s}{\sqrt{\frac{1}{4}ss+bt}-\frac{1}{2}}$ is $=\frac{\sqrt{37}-5}{t}$, and ſo $z=\frac{\sqrt{37}-5}{4}$ $1,27$; Whence 'tis manifeſt that 12,7, is near the true Root of the Equation propoſed. Now Secondly, let us ſuppoſe $z=12,7$, and then according to the Directions of the Table of Powers, there ariſes

$$\begin{array}{lllll} b & s & t & u & \\ -26014,4641 & -8193,532e & -967,74e^2 & -50,8e^3 & -e^4 \\ +163870,640 & +38709,60e & +3048e^2 & +80e^3 & \\ -322257,42 & -50749,2e & -1998e^2 & & \\ +189699,9 & +14937e & & & \\ -5000. & & & & \end{array}$$

That is, $+298,6559-5296,132e+82,26e^2+29,2e^3-e^4=0$; And ſo $-298,6559=-5296,132e+82,26ee$, whoſe Root $e$ (according to the Rule) $=\frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-bt}}{t}$ comes to

$$\frac{2648,066-\sqrt{6987686,106022}}{82,26}=$$

$,05644080331\ldots=e$ leſs than the Truth. But that it may be corrected, 'tis to be conſider'd that $\frac{\frac{1}{2}ue^3-\frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss-bt}}$, or $\frac{,0026201\ldots}{2643,423\ldots}$ is, $00000099$, and conſequently $e$ corrected, is $=0564470448$. And if you deſire yet more Figures of the Root, from the $e$ corrected let there be made $tue^3-te^4=0$, $43105602423\ldots$, and

$$\frac{\frac{1}{2}s-\sqrt{\frac{1}{4}ss-bt-tue^3+te^4}}{t}$$ or which is all one,

$$\frac{2648,066-\sqrt{6987685,67496597577\ldots}}{82,26}=$$

$,056441794480\,74402=e$; whence $a+e=z$ the Root is moſt accurately 12, 756441794480 74402... as Dr. *Wallis* found in the foremention'd Place; where it may be obſerv'd, that

that the repetition of the *Calculus* does ever triple the true Figures in the assumed $a$, which the first Correction, or $\frac{\frac{1}{2}ue^3 - \frac{1}{2}e^4}{\sqrt{\frac{1}{4}ss - bt}}$, does quintuple; which is also commodiously done by the *Logarithms*. But the other Correction after the first, does also double the Number of Figures, so that it renders the *assumed* altogether Seven-fold; yet the first Correction is abundantly sufficient for Arithmetical Uses, for the most part.

But as to what is said concerning the Number of Places rightly taken in the Root, I would have it understood so, that when $a$ is but $\frac{1}{2}$ part distant from the true Root, then the first Figure is rightly assumed; if it be within $\frac{1}{100}$ part, then the two first Figures are rightly assumed; if within $\frac{1}{10000}$ and then the three first are so; which consequently manag'd according to our Rule, do presently become nine Figures.

It remains now that I add something concerning our *Rational Formula*, viz. $e = \frac{sb}{ss \pm tb}$ which seems expeditious enough, and is not much inferior to the former, since it will triple the given Number of Places. Now having formed an Equation from $a \pm e = z$, as before, it will presently appear, whether $a$ be taken greater or less than the Truth; since $se$ ought always to have a Sign contrary to the Sign of the Difference of the *Resolvend*, and its *Homogeneal* produced from $a$. Then supposing $+b + se + a - tee = o$, the Divisor is $ss - tb$, as often as $t$ and $b$ have the same Signs; but it is $ss + bt$, when they have different ones. But it seems most commodious for Practice, to write the Theorem thus, $e = \frac{b}{s} \pm \frac{tb}{s}$ since this way the thing is done by one Multiplication and two Divisions, which otherwise would require three Multiplications, and one Division.

Let us take now one Example of this Method, from the Root (of the fore-mention'd Equation) 12, 7 . . . . , where

$$\begin{matrix} 298, & 6559 & - & 5296, & 132e & + & 82, & 26ee & + & 29, \\ +b & & -s & & & +t & & & +u & \end{matrix}$$

$2e^3 - e^4 = o$, and so $\frac{b}{s} - \frac{tb}{s} = e$; that is, let it be as $s$ to $t$, so $b$ to $\frac{tb}{s} = 5296, 132 \,)\, 298,$

6559 into 82, 26 (4, 63875 . . . wherefore the Divisor is $s - \frac{tb}{s} = 5291, 49325 \ldots .) 298,$

6559 (0, 056441 . . . . . $= e$, that is, to five true Figures, added to the Root that was taken. But this *Formula* cannot be corrected, as the foregoing *Irrational* one was; and so if more Figures of the Root are desired, 'tis the best to make a new Supposition, and repeat the *Calculus* again: And then a new Quotient tripling the known Figures of the Root, will abundantly satisfie even the most Scrupulous.

ROOTS *of Plants are, either*

1. *Fibrous*, which send out only small Strings from the Bottom of the Plant, distinct from each other.
2. *More thick or Gross*, which have a Body thick and gross, either branched out into Subdivisions or Arms; or else sending out Fibres from it all along.

These last are either

*Carnous*, which are either
1. *Broad and Swelling*.
2. *Long and Slender*, which commonly are more hard and woody.

The *Broad and Swelling* are
1. *Bulbous*, which consist but of one Globe or Head, and send out Fibres from the Bottom, and are either
   - *Squammose*, or *Scaly*, as *Lilies* or *Martagon*.
   - *Coated*, which are involved in *Skins* or *Coats*, as *Cepa*, *Hyacinthus*, *Allium*, &c.
2. *Tuberous*, which are of a carnous, solid, and like-continued Consistence; and these either
   1. *Simple*, with but one Globe or Head, as *Rapa*, *Crocus*, &c.
   2. *Manyfold*, as *Asphodelus*, *Pæonia*, &c.

*Long Roots* are either
1. *Sarmentous* (i. e.) Twiggy or Branching, which shoot or creep out transverse, or in breadth: Of these some are *Geniculatæ*, *Knotty*, or *Jointy*, as *Couch-Grass*, *Mints*, (&c.
2. *Cauliformes* (i.e.) *Stemmy* or *Stalky* which shoot down deep directly; though often shooting out Fibres and Strings from the great Stem; which also itself is sometimes divided or branching.

ROTATION, is a Term commonly used in Geometry for the Circumvolution, or Motion of any Surface round a fixt and immoveable Line, which is called the *Axis* of its *Rotation*. How *Solids* which are thus, by the Rotation of a Plane round an Axis generated, may be *Measured* or *Cubed:* The ingenious Mr. *Abr. de Moivre* shews very expeditiously in his Specimens of the Use of the Doctrine of Fluxions, Printed in *Phil. Trans. N.* and in Vol. 2. of the *Miscellanea Curiosa*, P. 131 thus: For the Fluxions of such Solids take the *Product of the Fluxion of the* Abscissa *multiplied by the Circular Base:* and he gives this Instance: Suppose the *Ratio* of a Square to the Circle inscribed be as $\frac{1}{1} - \frac{n}{1}$: the Equation, expressing the Nature

Nature or Property of any Circle, whose Diameter is $d$; is $yy = dx - xx$. Therefore $\frac{4dxx - xxx}{n}$ is the Fluxion of a Portion of the Sphere; and consequently the Portion it self $4\frac{1}{2}dx\dot{x} - \frac{1}{3}xxx$, And the Circumscribed Cylinder is $\frac{4dxx - x^3}{n}$

Therefore the Portion of the Sphere is to the Circumscribed Cylinder, as $\frac{1}{2}d - \frac{1}{3}x$ to $d - x$.

ROTHERNAILS, or *Rudder-Nails*, are such as have a very full Head; and are used to fasten the *Rudder-Irons* in Ships.

ROUNDNESS, The round Globular or *Spherical* Form, which Pebbles, Fruits, Berries, *&c.* are adorned with; and which Drops of Water or Quick-silver, *&c.* Bubbles of Air under Water or some such Liquor, melted Oil, *&c.* do generally put on, seems to arise from the Incongruity of their Particles, with those of the ambient Fluid; which prevents them from coalescing together, and by pressing upon them, and environing them all round equally, turns them into a round Form. This seems plain, as Dr. *Hook* hath long ago well observed from the way of making small round Shot of several Sizes, without casting the Lead into any Molds, from Drops of Rain being formed in their falling into round Hail-stones; and from a Drop of Water falling upon small Sand, or Dust, which will strait produce an Artificial round Stone: And from the small round red-hot Balls (easily seen with a Microscope) which are formed by the Collision and Fusion of the Flint and Steel in striking Fire, and perhaps the Principle of Gravitation, is principally concerned in this Matter.

ROUNDS, in a Garrison, is a *Night-Watch* commanded by an Officer that goes round the Rampart of the Garrison, in order to listen if any thing be stirring without the Works, to see that the Centries are watchful, and upon Duty, and that all things be in good Order. In strict Garrisons, the Rounds go every quarter of an Hour, that the Rampart may be still furnished. The Centries ought to *challenge* at a Distance; and to rest their Arms as the *Rounds* pass, and to let no one come near them. When the *Round* is near the *Corps de garde*, the Centry calls aloud, *Who comes there?* And when the Answer is *The Round*, he says, *Stand*; and then calls for the Corporal of the Guard, who draws his Sword, and calls also, *Who comes there?* And when 'tis answered, *The Rounds*; he that hath the Word must advance, and deliver the Word to the Corporal who receives it with his Sword pointed at the Giver's Breast.

ROUT, in the Law-sense, is an Assembly of three or more Persons, who are going forcibly to commit an unlawful Act, though they do it not: For if it be done 'tis a *Riot*.

RUDDER *of a Ship:* The French Author of a late Book about the handling or working of Ships at Sea, in *Chapt.* 7. Proposes to demonstrate what the Angle is, which the Rudder of a Ship ought to make with her Keel, in order to *Stay* or *Bear up*, the soonest that is possible: And he saith the Tiller of a Rudder ought to make with the Keel an Angle of nearly 55 Degrees. And in order that this may be precisely done, he advises to put a Cleat on the Sweep in the Gun-Room, and to dispose it so, that the Arch contain'd between the Keel and Cleat may be of this Number of Degrees; and that the Tiller of the Rudder ought to be some-how stopt, so that it cannot go beyond this Mark; for if it passes it, it will do more hurt than good.

RULE-*Sliding*. Of this useful and ready Instrument there are several Sorts made; as one by *Partidge*, another by *Everard*, a third by *Hunt*: The Ground and Reason of all which is one and the same; as may be seen in the several Treatises written by the Authors above-named; to explain and shew the Use of their several *Rules*. I shall give you here in short the several Uses and Advantages of all of them.

*Seth Partidge* calls his the *Double Scale of Proportion*; because the Scales or Lines upon it are all *Double*, which are the Lines usually call'd the *Artificial Lines*, of *Numbers*, *Sines*, and *Tangents*; whose Invention and Use is owing to Mr. *Gunter*: These you will find described, and their Nature explained in this *Lexicon*, under these words. On the Sides of his Double-Scale, are usually set a Line of Inches; or of Foot and Inch-measure; and there may be put a *Gage-Line*, a *Meridian-Line*, and a Scale of Equal Parts, *Lines of Chords*, and for *Board* or *Timber*-Measure, according as any one pleases, or his Occasions require.

*Everard*'s and *Hunt*'s Sliding-Rules, are thicker and squarer, so that there are two Sliding-Pieces, which can be fitted to either Face of the Rule; on *one* of which there are usually Two Double Lines of Numbers, made to slide against such another Double Line placed above them marked o, and a Single Line of Numbers placed below mark'd D. These in *Everard's*, which I shall describe, are marked with B and C, and on the Back of this Sliding-Piece, is a Treble Line of Numbers marked E, together with a Line of Segments.

The other Sliding-Piece hath on one Side a Line of Artificial Sines and Tangents, to slide against two such other on the Sides; and on the other Side is another such Line of Sines, and a Line of versed Sines. Either of these *Sliders* are made to fit in, on each *Face* of the Rule.

On one *Edge* or *Side* of the Rule, are usually placed the Natural Lines of Chords, Sines, Tangents and Secants, for Spherick Projection, with a small Scale of Equal Parts; and one of *Latitudes*, *Hours*, and *Inclination of Meridians* for Dialling: As also a Line of *Rumbs*, and M. L. for Navigation: and on the other Side or Edge, besides Inches and Foot-Measure, is a large Scale of Equal Parts, with a *Meridian Line* placed by, to graduate Sea-Charts, *&c.* The Uses of all which, you will find under their *Names*.

The first Thing to be learned on the Scale, or Rule, is how to count or number, in the several Lines of Numbers; for as for Sines, Tangents, *&c.* there all is easie.

1. Know then that every Line of Numbers is a Line of Geometrick Proportion, divided first into 9 Unequal Parts, which may be called *Primes*; these are marked with the 9 Digits, 1, 2, 3, 4, 5, *&c.* Each of these *Primes* is subdivided into ten other Parts

Parts, called *Tenths:* And each *Tenth* is either *divided*, or ſuppoſed to be ſo, into 10 other Parts which may be called *Centeſms*, or Hundredth-parts.

In *Everard*'s Rule, the Line D being about 11 Inches long, hath each *Tenth* in the firſt Prime, divided actually into 10 Parts. But between 2 and 4 each *Tenth* is divided into but *five* Parts; each of which *there* is one Fifth of an Hundred, or 20. Between 4 and the End of the Line, every *Tenth* is divided only into *Two* Parts, ſo that each Part is 50, or the Half of an Hundred. You may imagine or ſuppoſe alſo that each *Centeſm* is ſubdivided into *Ten* Parts; which therefore will be *Thouſandths*, &c.

The Figures 1, 2, 3, 4, 5, *&c.* by which the Primes are diſtinguiſhed, are all Arbitrary Points; and may each of them repreſent ſo many entire Units, Tens, Hundreds, Thouſands, *&c.* or ſo many Tenths, Hundredths, Thouſandths, or Ten Thouſandth Parts of an Unit.

2. Wherefore in Whole Numbers, if 1, at the beginning of the Line D ſignifie an *Unit:* Then 2, 3, 4, and 5, *&c.* will alſo ſignifie or ſtand for ſo many *Units*, and the *Tenths*, and *Centeſms*, both be accordingly *Decimal*, or *Centeſimal* Parts. If 1, then repreſent Ten Units, then the Primes 2, 3, 4, *&c.* will ſignifie 20, 30, or 40. If 1, ſtand for 10, or 100. Accordingly, the other Figures, will be 200, 300, 400; or 2000, 3000, 4000, *&c.*

3. In *Decimals*, If 10 in the Line D repreſent 1, then each Prime reckon'd backwards towards the Left-hand, will be (1) one Tenth; and in thoſe Primes each *Tenth* will be .01, and in thoſe Tenths, each Centeſm will .001, *&c.* Part of an Unit.

To explain this a little further, draw out the Sliding-piece B: Till 1, at the beginning of B, ſtand exactly at 10, at the End of the Line A, for then you will have a Line of Numbers, 4 times repeated; of which let 1, at the beginning of A, ſtand for 1, or Unity. Then will the next 1, in the Middle of the Line A, ſtand for 10, and 10 at the End of A; or beginniug of B, will repreſent 100, (1) in the Middle of B, will be 1000; and 10 at its End will ſtand for 10000.

On the contrary, if you ſuppoſe 10 at the End of the fourth Radius in B, to repreſent (1) then each Prime in that *Fourth* Radius, will be .1 (one Tenth,) in the *Third* Radius 'twill be .01; as the *Second* .001, and in the *Firſt*, .0001 Parts of an Unit.

So alſo 2, in the Firſt Radius will be .0002; in the Second Radius .002, in the Third .02, and in the Fourth .2 of an Unit.

4. All which being well underſtood, and conſidered, which a little Practice will render eaſie: 'twill be eaſie to diſtinguiſh that Point on the Line where any Number given, *Integer*, or *Decimal Part*, is repreſented. Thus you will find that the Point *a g*, on the Line D, repreſents 1895 Units; and the Point *w g*, repreſents 1715. But on a Line of this Length, you can't diſtinguiſh any Number, if it have above four Places, to any exactneſs: For all the Figures further will be repreſented at the ſame Point: Thus, if 189562 were required, you can have on the Rule only 1895.

All Numbers which after the firſt Figure have only Cyphers, are repreſented at the ſame Point: As 20, 200, 2000, *&c.* are all repreſented by 2. If a Number of three Places, hath a Cypher for the Middle Figure: As ſuppoſe 308; you muſt count 3 on the Line (at the Third Prime) and then counting no Tenths, for the laſt Figure 8, you muſt reckon 8 Centeſms, or Hundredth-parts.

If two Cyphers are in the Middle of a Number of 4 Places; as ſuppoſe 4005: after 4, you muſt neither go on to account Tenths, nor Hundreds, but for the laſt Figure 5, you muſt reckon ſo many Thouſandth-parts.

## Of the Uſes of the Sliding-Rule.

1. *To multiply one Number by another; As, ſuppoſe* 68 *by* 26.

As 1. 26 :: 68. 1768.

Set 1, on the Line A, againſt 26, on B, and then againſt 68 on A, you will find the Product 1768, on B.

You may begin with either Factor, as a Multiplicator; and the Product will have as many *Places* as are in *both* Factors; except the two firſt Figures exceed, or are greater than the leaſt Factor: And then it will have *one* leſs, as in multiplying 68 by 14,

As 1. 14 :: 68. 952.

Where the Product 952 hath but three Places; becauſe the Figures 1 and 4 in 14, are both leſs than 9 and 5 in 952.

2. *To multiply Decimal Fractions, or Mixt Numbers;*

As 27. 8 and .8.

Make the Mixt Number, or Whole one (if ſuch there be,) the Multiplicator; and ſetting it on B, againſt 1: in A: Seek the Product towards the Left-hand againſt .8 on B; which will be 22 in A.

3. *To divide one Number by another; as* 750 *by* 25.

In Diviſion, As 25. 1:: 750. 30, the Quotient.

Set 25 on B, againſt 1 on A; and then againſt 750, on B, will be 30, the Quotient upon A.

*N. B.* Theſe Examples will inſtruct you, that at one ſetting of the Rule, you do both Multiply and Divide.

As ſuppoſe 25 a Multiplicator; ſet 1, on B, againſt 25, on A; and then againſt any Multiplicand in B, you have the Product on A.

And without moving the Rule, if you ſuppoſe 25 to be a Diviſor againſt any Dividend on A, you will have a proper Quotient in B.

4. *Having, Two, Three, Four, &c. Numbers given, to find a Third, Fourth, Fifth, &c. in Geometrical Proportion to them: Let the Numbers be* 2, *and* 4.

Set 2 in B, againſt 4 in A, and then you will find againſt 4 in B, there will be 8 in A; againſt 8 in B, 16 in A; againſt 16 in B, 32 in A, *&c.* and ſo you may go on either forward or backward, as far as you pleaſe.

5. *To reduce Vulgar Fractions to Decimals:*
As, ſuppoſe $\frac{63}{84}$.

Set 84 in B, againſt 63 in A; and then againſt 1 in B, you will have .75, the Decimal required. And 'tis .75, not 75 becauſe 'tis on the Left-hand of Unity, or 1 in A.

6. *To reduce .7625 a Decimal Fraction to the known Parts of an Integer.*

Firſt let the Decimal of a Pound be reduced to Shillings, Pence or Farthings.

Set 1 in the Middle, or 10 at the End of B, againſt 20 (the Shillings in a Pound) in A; and then againſt .7625 in B, you will have 15. 25 in A: That is 15 *s.* 3 *d.*

If you would have reduced it to Pence, you muſt have ſet 1 in B, againſt 240 (the Pence in a Pound) in A, you would have had 183, the Pence in .7625.

If you would have the Farthings, ſet 960 (the Farthings in a Pound) in B, againſt 1 in A, and then againſt the Decimal .7652 in B, you have 732, the Farthings contained in it, on A.

If .7625 were the Decimal of an Ale Barrel, Set 32 (the Gallons in a Barrel of Ale) in B, againſt 1 at the beginning of A; and then againſt .7625 in A, will be 24. 4. the Gallons in that Fraction.

7. *To work the Rule of Three, or Three Numbers, being given to find a Fourth Proportion,* either Directly or Inverſely.

1. *Directly.*

If 6 Quarters of Malt make 18 Barrels of Beer, how much will 30 make?

Set 6 on B, to 18 on A, and then againſt 30 on B, you will have the Fourth Term, 9 on A.

2. *Inverſely.*

If 8 Men can do a Peice of Work in 9 Days, in how many Days would 12 Men diſpatch the ſame Work?

Set 12 on A, to 8 on B; and then againſt 9 on A, will be 6 on B, which is the Fourth Number ſought.

3. If the Queſtion had been in how many Days could 6 Men have done the ſame Work? then 'twould have been, as 6 on B, to 8 on A:: So 9 upon B, to 12 upon A.

8. *Between two Numbers given to find a mean Geometrical Proportional.*

Suppoſe 50 and 72.

Set 50 in C, againſt 50 in D, and then againſt 72 in C, will be 60 in D, the mean required; or ſet 72 on C, againſt 72 on D; and then againſt 50 on C, will be 60 on D.

9. *To extract the ſquare Root of any Number under* 1000000.

Apply the Lines C and D; ſo that 10 at the End of C be againſt 1 in D, and then will the Square Root of any Number in C, be found by Inſpection againſt it in D.

Only obſerve when the Number of Places in the given Number is even, *i. e.* when the Number conſiſts of 2, 4, 6, or 8 Figures (being Integers) you muſt find it in the Second Radius of the Line C; and againſt it you have the Root in D: Thus againſt 16 in C, you will find 4 in D, againſt 81 in C, 9 in D.

Againſt 2304 in C 48 in D; and againſt 784996 in C, you will have 886 in D, as well as thoſe Numbers can be expreſſed on the Rule: And in this Caſe the Root will always conſiſt of half as many Figures as the Number given.

But if the Integers in the Number given are odd, as 1, 3, 5, or 7; then it muſt be ſought in the Firſt Radius on C, and againſt it in D will be the Root ſought. So bring 1 at the beginning of C, to 1 in the Middle of D; and then againſt 576 in C, will be 24 in D, and againſt 20736 in C, will be its Square Root 144 in D.

10. *To extract the Cube-Root of any Number under* 1000000000.

Apply the Triple Line of Numbers E againſt D, as C was in the Square Root; and then againſt any Numbers in E, are the correſponding Cube-Roots in D.

*N. B.* When the Number conſiſts of 1, 4, or 7 Places, you muſt find it in the Firſt Radius in E.

But when it hath 2, 5, or 8 Places, it muſt be found in the Second Radius of E.

As if it have 3, 6, or 9 Integers, it muſt be found in the Third Radius.

11. *Either the Diameter or Cicumference of a Circle being given to find the other.*

When the Diameter is 1 Inch, Yard, Foot, *&c.* the Circumference is 3. 1415 of ſuch Inches, Yards, Feet, *&c.*

Wherefore as 1, to 3. 1415 :: So is the Diameter of any Circle to its Circumference.

Set therefore 1, on A, to 3. 1415 on B; and then againſt any Diameter in A, you have the correſponding Circumference in B, and *vice verſa.*

12. *Having the Diameter to find the Area of a Circle.*

Set 1 on D, to .7854 on C; and then againſt the Diameter in Inches on D: (Suppoſe 20,) you will have the Area in Square Inches, (*viz.* in this Caſe 314. 15.) on C; and ſo againſt any Diameter in D, you will have a correſponding Area in C.

13. *To Three Numbers given to find a Fourth in Triplicate Proportion.*

If a Bullet whoſe Diameter is 4 Inches, weigh 9 *lb.* What will one of the ſame Matter weigh, whoſe Diameter is 8?

Set 4 in A againſt 8 in B; and then againſt 9 in A you have 18 in B, againſt 18 in A 36 in B; and

and againſt 36 in A 72 in B; which Third Number in continual Proportion from 18, is the Number ſought, ſhewing the Weight of ſuch a Bullet to be 72 *lb.*

Simple Intereſt.

14. *Given Principal, Time, and Rate, required the Amount.*

What doth 15 *l.* 5 amount to in 12 Years Time at 6 *per Centum*?

Set 1 in A to 6 in B; and then againſt 12 in A, you have 72 in B; which becauſe it was .06, will be .72 the Intereſt of one Pound for 12 Years at 6 *per Cent.* Then ſet .72 in B, againſt 1 in A; and you will have againſt 15. 5 in A, 26. 66: the Amount in B. And ſo from any Three of theſe given, you may find the Fourth.

15. *Given an Annuity, Time, and Rate; to find the Amount.*

What is the Amount of an Annuity of 62 Pounds *per Annum*, at 6 *per Cent.* at 4 Years End?

1. Set 1 on B to 6 on A; and then againſt 62 in B will be 3. 72, the Intereſt of 62 *l.* for one Year.

2. Set 1 on B to 3. 72 in A; and then againſt 2 in B (*viz.* half the Time given) will be 7. 44, the Intereſt of the Annuity for half the Time in A.

3. Set 1 on B to 7. 44 in A; and then againſt 3 in B (then all the given Years but one) to 22. 32 the Intereſt of the Annuity in A.

To which adding 248, (the Summ of the 4 Annual Payments) the Summ will be 270. 32. The whole Amount.

*Compound Intereſt.*

In Compound Intereſt the Reſpective amounts for each Reſpective Year, are ſo many Geometrick Mean Proportional Numbers.

For as 100 *l.* at the End of the Firſt Year is 106 *l.* at 6 *per Cent.* and that is now become a Principal; and at the Second Years End will amount to 112 *l.* 36. and this being made a Principal will at the Third Years End amount to 119 *l.* 10 16; and theſe 4 Numbers 100. 106. 112. 36, and 119. 10 16, are in Geometrick Proportion continued.

Wherefore 'tis eaſie by the Rule to ſolve this Problem.

16. *Of any Summ of Money to find the Amount in any Time, and at any Rate of Compound Intereſt.*

As ſuppoſe the Amount of 100 *l.* for 5 Years at 6 *per Cent.* Compound Intereſt.

Set 100 on B againſt 106, (or 108, *&c.* according to the Firſt Years Amount at any Rate of Intereſt) and then againſt 106 on B, you will have 112 *l.* 36. the Amount in Two Years; and againſt 112. 36. on B, will be 119 *l.* 10 16 on A, the Amount in Three Years; and againſt 119. 10 16 in B, will be 126. 247, the Amount in 4 Years. And laſtly, againſt 126. 247 in B, you will have 133 *l.* 822 on A, which is the whole Amount at the Five Years End.

And from it 'twill be eaſie to anſwer this Queſtion.

17. *What is a Summ worth now in Ready Money, which is due at any Time to come, and at any Rate of Intereſt?*

As what is the preſent Value of 133 *l.* 822 due Five Years hence, at 6 *per Cent.* Compound Intereſt?

For you need only reverſe the former Practice: Set therefore 106 on A againſt 100 on B; and then againſt 133 *l.* 822 on A, you will have 126. 247 on B; which is the Worth of 133. 822 at the End of the Firſt Year: Then againſt that on A, you will have 119. 10 16 on B, for the preſent Worth at the End of the Second Year; and againſt 119. 10 16 on A, you will have 112. 36 on B, for the Third Year; and againſt that Number on A, you will have 106 on B for the Fourth Year; and at laſt againſt 106 on A, you will have 100 *l.* on B; which is the preſent Worth of 133 *l.* 822 due Five Years hence at Compound Intereſt of 6 *per Cent.*

18. *What are the Arrears due on an Annuity or Rent of* 9 *l.* per Annum, *and forborn* 12 *Years, at the Rate of* 6 per Cent. *Compound Intereſt?*

Set 6 in A to 100 in B; and then againſt 9 in A will be 150 in B; which is a Principal whoſe Intereſt is 9 *l.* Then work as in Problem 16 above, to find the Amount of 150 *l.* in Twelve Years, which will be 301 *l.* 828; from which you muſt deduct 150 *l.* (the principal firſt found) and the Remainder 151. 828 anſwers the Queſtion, and is the Summ of the Arrears ſought.

19. *What is the Ready Money worth of a Rent or Annuity of* 9 *l.* per Annum *to continue for Twelve Years only; allowing the Buyer to have* 6 per Cent. *for his Money, Compound Intereſt?*

By the laſt Queſtion the Arrears of a Rent of 9 *l. per Ann.* and forborn for Twelve Years were 151 *l.* 828.

And the preſent Worth of 151 *l.* 828. (by Queſt. 17.) due at the End of Twelve Years, is 75 *l.* 443. Wherefore ſo much may be given for an Annuity of 9 *l. per Ann.* to continue for Twelve Years.

*N. B.* If the Annuity is not to commence till after a certain Number of Years; as ſuppoſe 6 are expired: Then you muſt add that Term to the Twelve Years, which makes it 18. Then ſeek what the Arrears, of 151 *l.* 828 being forborn Eighteen Years are now worth in Ready Money, which (by Queſt. 18.) you will find 53 *l.* 185, which is the Anſwer; So that a Yearly Rent of 9 *l.* to

to begin Six Years hence, and to continue Twelve Years, is in Ready Money worth but 53*l.* 185; whereas if it were to commence immediately, 'twere worth 73*l.* .443.

*Purchasing of Annuity.*

20. *What Annuity, to continue Twelve Years will* 300*l. buy; allowing the Buyer* 6 per Centum, *Compound Interest for his Purchase Money?*

By Quest. 19. I find that 75*l.* 443 will purchase 9*l. per Ann.* for Twelve Years, (or you may find the *Value* of any other Annuity in Ready Money) and then say as the present *Worth* or Value, is to the Annuity taken :: So is the Summ proposed to the Annuity required.

Set therefore 75*l.* 443 on B to 9 on A; and then against 300*l.* on B, will be 35*l.* 776, or 35*l.* 15*s.* 6*d.* and such an Annuity to continue Twelve Years to come, is worth now in Ready Money 300*l.*

21. *What is the Value of a Free-hold Estate of* 75*l.* per Ann. *allowing the Buyer* 6 per Cent. *for his Money, Compound Interest?*

As the Annual Interest of 1*l.* is to 1*l.* :: So will the Annual Rent be to the Summ required.

Wherefore against .06 on B, set 1 on A; and then against 78 on B, you will have 1300 on A, the Value of the Estate required.

*In Trigonometry.*

It will be very easie to work any Cases or Questions by this Sliding-Rule, in either Plain or Spherick Triangles; of which one Instance in each will be sufficient.

Suppose the common Case in Plain Sailing.

22. *Where* Course *and* Distance *are given; and Difference of Latitude and Departure are required.* (*See* Plain-Sailing *in* Vol. I.)

The Canon is, As Rad. to Distance run in Miles :: So Co-Sine of the Course to Difference of Latitude in Miles :: And so Sine of the Course to Departure in Miles.

Bring then 90° in the Line of Sines against 108 (the Distance run) in A; and then against 56° 15′ (the Co-Sine of the Course) in the said Line of Sines, you will have 90m in A, the Difference of Latitude in Miles.

If you would have the *Departure.*

Bring as before 90° in the Line of Sine against 108 in A; and against 33° 45′ (the Angle of the Course) in the Sines will be 60 Miles in A, the Departure required.

Suppose 2*dly.* The Sun's Place in the Ecliptick to be 30° of ♈, and his greatest Declination to be 20° 30′, I require his present Declination.

The Canon is, As Rad. Sine of the Sun's Longitude or Distance from ♈ :: So Sine of greatest Declination to Sine of the present Declination.

Set therefore 90° in the Sliding-Line of Sines against 30° in the fixt one; and then against 23° 30′ in the Sliding-Line, you will find 11° 30′ in the fixt Line of Sines; which is the Sun's Declination sought.

*In Dialling.*

23. *To calculate the Horary Distances from the Meridian, in either Horizontal or particular Dials.*

The Canon is, As Rad. to Tangent of 15° (one Hours Equinoctial Distance) :: So is the *Sine*, or Co-Sine, of the Latitude, suppose 51° 30′ of the Place, to the Tangent of the Distance sought 11° 51′.

Set 90° in the Sliding-Sine to 15° in the fixt Tangent; and then against 51° 30′ in that Sine, will be 11° 51′ in the Tangent.

RUMBS; Here is a Table of Rumbs or Points of the Compass; shewing how many Degrees and Minutes each Point contains.

A Table

# A Table of *RUMBS.*

*The Distance of the Rumbs, or Points from the Meridian.*

| *North* | *South* | D. | M. | *South* | *North* | *Point.* |
|---|---|---|---|---|---|---|
| | | 2 | 49 | | | |
| | | 5 | 38 | | | |
| | | 8 | 26 | | | |
| *N* by *E* | *S* by *E* | 11 | 15 | *S* by *W* | *N* by *W* | 1 |
| | | 14 | 4 | | | |
| | | 16 | 53 | | | |
| | | 19 | 41 | | | |
| *NNE* | *SSE* | 22 | 30 | *SSW* | *NNW* | 2 |
| | | 25 | 19 | | | |
| | | 28 | 8 | | | |
| | | 30 | 36 | | | |
| *NE* by *N* | *SE* by *S* | 33 | 45 | *SW* by *S* | *NW* by *N* | 3 |
| | | 36 | 34 | | | |
| | | 39 | 23 | | | |
| | | 42 | 11 | | | |
| *NE* | *SE* | 45 | 00 | *SW* | *NW* | 4 |
| | | 41 | 49 | | | |
| | | 50 | 37 | | | |
| | | 53 | 16 | | | |
| *NE* by *E* | *SE* by *E* | 56 | 15 | *SW* by *W* | *NW* by *N* | 5 |
| | | 59 | 4 | | | |
| | | 61 | 52 | | | |
| | | 64 | 41 | | | |
| *ENE* | *ESE* | 67 | 30 | *WSW* | *WNW* | 6 |
| | | 70 | 19 | | | |
| | | 73 | 7 | | | |
| | | 75 | 56 | | | |
| *E* by *N* | *E* by *S* | 78 | 45 | *W* by *S* | *W* by *N* | 7 |
| | | 81 | 34 | | | |
| | | 84 | 22 | | | |
| *East* | | 87 | 11 | *West* | | |
| | | 90 | 00 | | | |

RUMB-*Scale*; how the Scale of Rumbs is made, you will find under the Word *Plain-Scale*, in Vol. I.

How to find the Rumb between two Places by Calculation, and Geometrically, Mr. *Collins* ſhews in his Navigation, *pag.* 39. Thus:

*As the Radius: Is to the Co-ſine of the Middle Latitude: :*
*So is the Difference of Longitude:*
*To the whole Departure from the Meridian, in the Courſe between the two Places propoſed: :*

And in the Second Propottion:

*As the Radius: Is to the half Summ of the Co-ſines of both Latitudes: :*

Or rather for Geometrical Schemes.

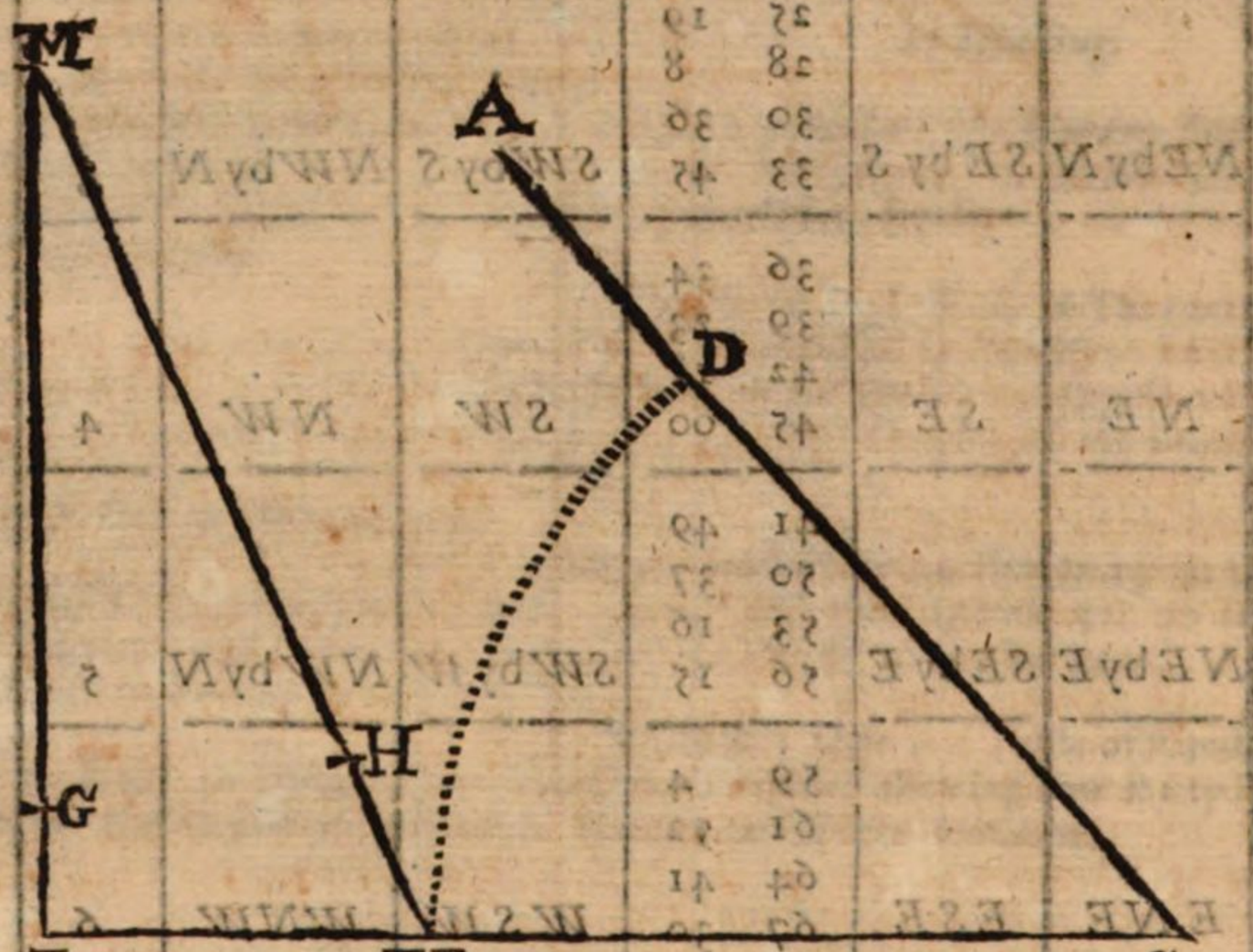
*As the Diameter: Is to the Summ of the Co-ſines of both Latitudes: :*
*So is the Difference of Longitude: To the Departure from the Meridian, in the Courſe between the two Places: :*

The latter Proportion of this Diviſion, of which we make no uſe, is:

*As the Difference of Latitude:*
*Is to the aforeſaid Departure from the Meridian: :*
*So is the Radius: To the Tangent of the Rumb: :*

An Example of the former Proportion.

Let the Rumb be required between *Cape Finiſtre*, Latitude 43 Degrees, Longitude 7 Degrees 20 Minutes, and St. *Nicholas Iſle*, Latitude 38 Degrees, Longitude 352 Degrees, the Middle Latitude is 40 Degrees 30 Minutes, the Complement is 49 Degrees 30 Minutes, and the Difference of Longitude is 15 Degrees 20 Minutes, or 33 Centeſms.



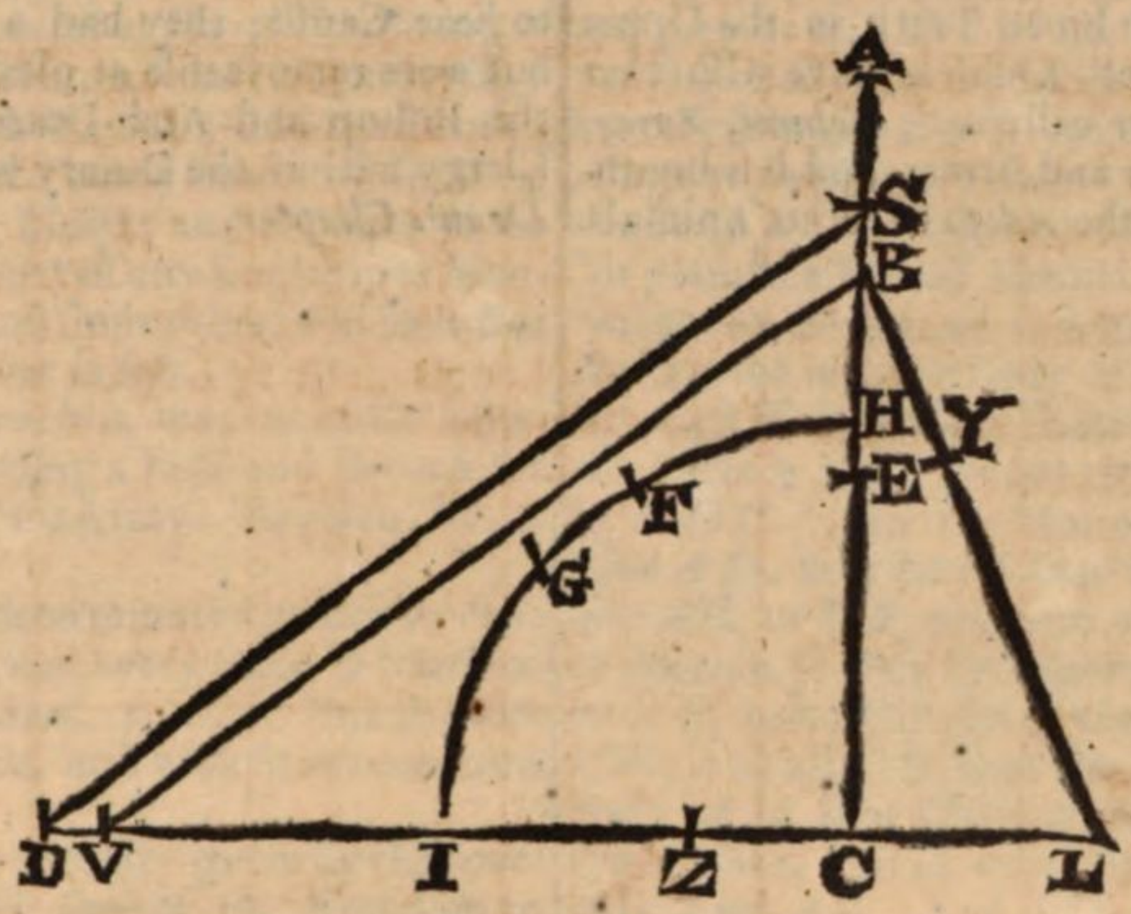

Out of the leſſer equal Parts, prick down 15 Deg. 33 Centeſms from C to L, and deſcribe the Arch BD with 60 Degrees of the Chords, and make it equal to 49 Degrees 30 Minutes, and draw C D continued further to A, from L take the neareſt Diſtance to A C, which is equal to L M, and make it one Leg of a Right-angled Triangle: Make the other Leg the Difference of Latitude 5 Degrees, which prick from the Equal Parts from L to F, then the Extent M F meaſured on the ſaid Parts, ſheweth the Diſtance to be 13 Degrees 39 Centeſms, which allowing 20 Leagues to a Degree, is almoſt 268 Leagues; with the Radius C B ſetting one Foot at M, croſs the Rumb Triangle at G and H, which Extent meaſured on the greater Chord is almoſt 22 Degrees, the Complement whereof is 68 Degrees, and ſo much is the Rumb from the Meridian between theſe two Places, which is 6 Points and about 30 Minutes more, wherefore St. *Michaels Iſle* bears from *Cape Finiſtre* Weſt-South-Weſt, half a Degree more Weſtwardly.

If the two Places had been both in the Latitude of 40 Degrees 30 Minutes, having the ſame Difference of Longitude, to wit, 15 Degrees 20 Minutes, then had the Extent L M been their Diſtance, to wit, 11 Degrees 68 Centeſms, at 20 Leagues to a Degree, is 233 Leagues and a half, and thus we ſupply the want of the Scale of Longitudes,

gitudes, in finding the Diſtance of Places that bear Eaſt and Weſt, as thoſe that are in the ſame Latitude muſt needs do.

*An Example of the latter Proportion.*

Let it be required to find the true Rumb and Diſtance between the *Lizard* and the *Bermudas*. Mr. *Norwood* in his *Sea-man's Practice*, p. 110, maketh the Latitude of the *Lizard* to be 50 Degrees, and of the *Bermudas* 32 Degrees 25 Minutes, or 32 Degrees 41 Centeſms, and the Difference of Longitude between theſe Places to be 55 Degrees.




Draw the Lines A C and C D at Right-angles, now for want of room I uſe the leſſer Chord, and with 60 Degrees thereof I deſcribe the Quadrant H I, and prick the Radius from I to D, ſo is C D the Diameter, then count both Latitudes from H to F and G, the neareſt Diſtance from F to C I, is the Co-ſine of *Bermudas* Latitude, which prick from C to E: Again, the neareſt Diſtance from G to C I, is the Co-ſine of the *Lizard's* Latitude, which place from C to S, ſo is C S the Summ of both Co-ſines; draw D S, and prick down 55 Degrees the Difference of Longitude from C to V, out of the greateſt equal Parts, and draw V B parallel to D S, ſo is C B the Departure from the Meridian in the Courſe between both Places, then making that one Leg of a Right-angled Triangle, prick down 17 Degrees 59 Centeſms, the Difference of Latitude between thoſe Places out of the ſame Equal Parts from C to L, and draw B L, which repreſents the Courſe and Diſtance truly between the *Lizard* and *Bermudas*, and the Extent L B meaſured on the ſame Equal Parts, ſhews the Diſtance to be 44 Degrees 31 Centeſms, which allowing twenty Leagues to a Degree, is 886 Leagues.

Then to find the Courſe: with 60 Degrees of the Chords, ſetting one Foot in L, with the other make a Mark at Y and Z, then the Extent Z Y meaſured on the Chords, ſheweth the Rumb to be 66 Degrees 37 Minutes from the Meridian, which is almoſt 6 Points, and in this Example the Proportion doth not err any thing from the Truth, according to *Mercators Chart*, whereas if you uſe the former Proportion by the middle Latitude, the Rumb would have been 67 Degrees 2 Minutes from the Meridian, and the Diſtance 902 Leagues, if you make C A equal to C V, then a Line joining L A ſhould be the Courſe and Diſtance according to the ſame Longitudes and Latitudes laid down on the *Plain Chart*, and thereby the Courſe ſhould be 72 Degrees 17 Minutes from the Meridian, and the Diſtance 1155 Leagues; however when two Places are laid down true at firſt in their Rumb, Diſtance and Latuides on the *Plain Chart* if you ſail home, in, or near the ſame Rumb, the *Plain Chart* will very well ſerve to keep the reckoning upon, and to ſail by in the greateſt Voyage.

What the Nature of this Rumb Line is on the Globe, and how to Delineate it there, and in a Chart Mr. *Collins* ſhews in the ſame Book, *page* 55, and 64.

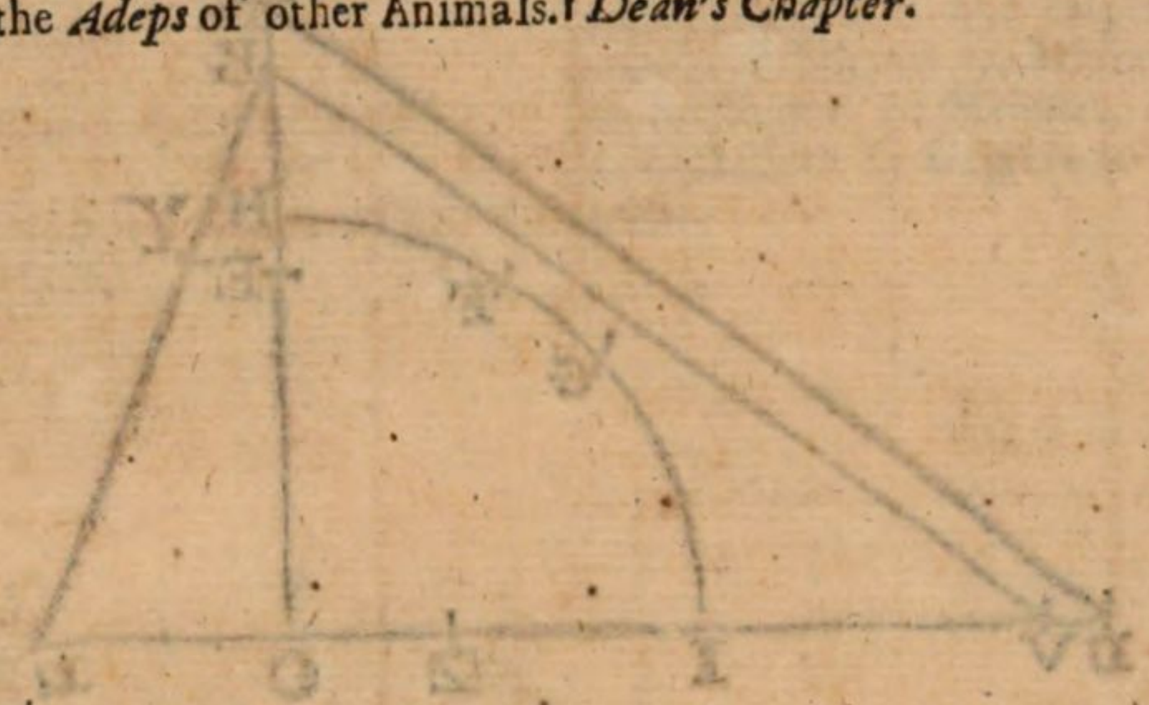
RUMINANT Animals, are ſuch as chew the Cud; and theſe are Quadrupeds, Hairy and Viviparous, and in general, Mr. *Ray* obſerves of them, that ſome have *hallow and perpetual Horns*; others *Deciduous* ones, or ſuch as are ſhed every Year; and all the Horned Ruminant Animals have four Stomachs. 1. The Κοιλία Μεγάλη of *Ariſtotle*; the *Venter Magnus*, or what we call the *Paunch* or *Inward*. This receives the Meat ſlightly chewed, retains it a while, and then delivers it back again into the Mouth, which is what we call the *Cud*, to be re-chewed and rendred more fit to make Chyle, 2. The Κεκρύφαλος, or *Reticulum*, which we call the *Honey-Comb*; from its Internal Coat, being divided

divided ſo into Cells like Honey-Combs. 3. The Ἔχῖνος, which Er. *Ray* thinks hath been wrong Tranſlated, *Omaſus*; and therefore he would have it called the *Echinus*: This is ſo difficult to clear, that our People throw it away, and call it the *Manifold*. 4. The Ὑυσγὸν of *Ariſtotle*, by *Gaza* called the *Abomaſus*. The Stomach in Calves is that which contains the Acid Ferment, which we call the *Runnet*, and is uſed to coagulate Milk into Cheeſe.

Alſo all Horned Ruminant Animals want the *Dentes Primores*, or broad Teeth in the Upper Jaw. Theſe Kind of Animals have alſo that Kind of Fat which we call *Suet*; *Sebum*, Σπαρ, which is much harder and firmer, and leſs liquifiable in them, than the *Adeps* of other Animals.

RUNCINUS, and *Runcilus*, in Doomſday-Book is uſed for a Load-Horſe: Sumpter-Horſe, or Cart-Horſe: This Kind of Horſe, *Chaucer* in his *Seaman's-Tale*, calls a *Rowney*.

RURAL-*Deans*. There were formerly in the Church, *Arch-Presbyters*, as well as *Arch-Deacons*; and they were called *Rural-Deans*. Our Dioceſſes are ſtill divided into Deanries, and he who under the Biſhop and Arch-Deacon, had the peculiar Care and Inſpection of the Clergy and Laity of ſuch a Diſtrict as is now called a *Deanery*, was the *Rural-Dean*. He had Power to viſit and to hear Cauſes, they had a Seal of their Office, but were removeable at pleaſure, but jointly by the Biſhop and Arch-Deacon. The Reſt of the Clergy within the Deanry were called the *Rural-Dean's Chapter*.



SAC or *Sacha*, or as ſome write it, *Saccha* and *Saucha* (according to *Minſhew*) was anciently a Royalty or Privilege touching Plea, or Correction of Treſpaſſes of Men within a Mannor: The *Saxon* word, *Sac*, ſignifying as much as *Cauſa* in *Latin* (whence our *Engliſh Sake*; for whoſe ſake *&c.* but in the Laws of *Edward* the Confeſſor, it is ſaid, *Sacha eſt quod ſi quilibet aliquem nominatim, de aliquo calumniatus fuerit & ille negaverit, foriſfactura Probationis vel Negationis (ſi evenerit) ſua erit.* From ſome old Manuſcripts, it appears alſo that *Saka* was a liberty of Holding Pleas, and Impoſing Mulcts and Forfeitures on Tranſgreſſors in the Court of any Lordſhip or Mannor; though *Raſtal*, and ſome others will have *Sac* to ſignifie the Forfeiture it ſelf.

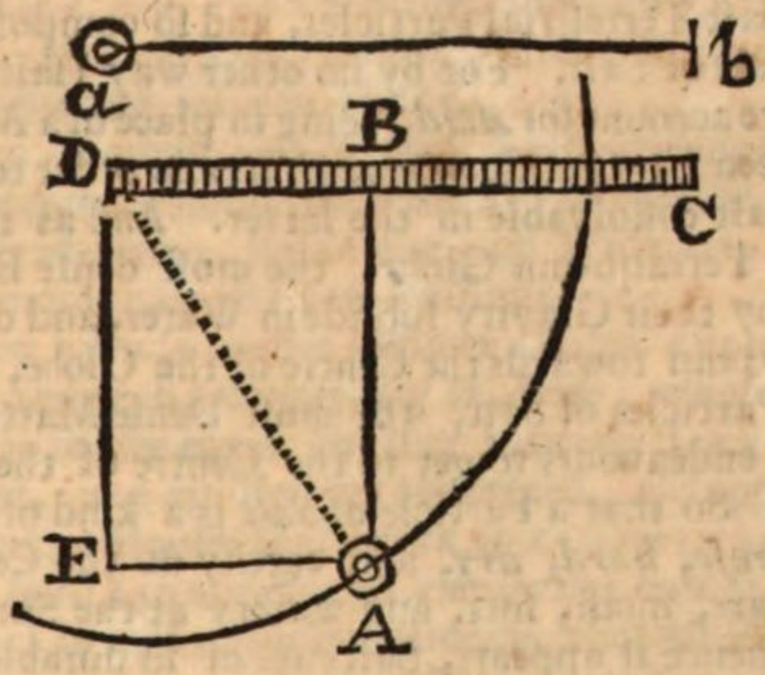
SACCUS *cum Brochia*, was anciently a Service or Tenure of finding a *Sack* and *Broach* for the King for the uſe of his Army. *Bracton, lib.* 2. *Tract.* 1. *c.* 6.

SACK *of Wool* is a determinate Quantity, containing juſt 26 Stone, and every Stone is fourteen Pounds, by 14 *E.* 3. *Stat.* 1. *c.* 2. But in *Scotland* a Sack is 24 Stone, and each Stone contains 16 Pounds.

SAFE *Conduct*, is a Secutity given by the Soveraign under the Great Seal of the Kingdom to any Perſon, for his quiet coming into, or paſſing out of the Realm.

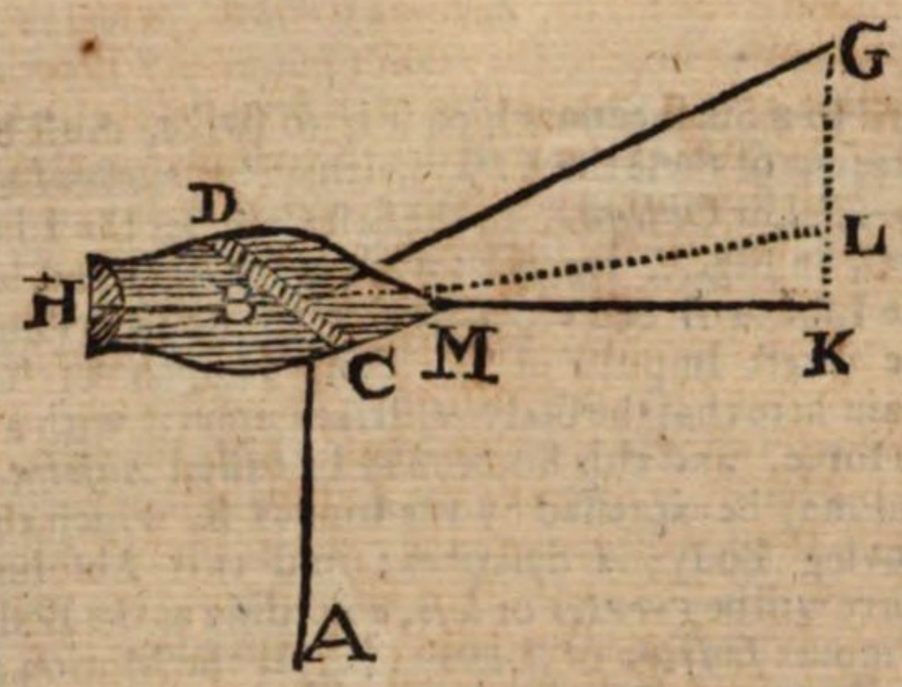
SAFE *Pledge*, is a Security given for a Man's Appearance at a Day aſſigned.

SAGIBARO, or perhaps *Sachbaro*, anciently ſignified the ſame as *Juſticiarius*, from *Sac cauſa*: So that *Sac-baro* is as much as the *Cauſe-hearer*, or the Man that hears Cauſes.




SAILS and *Sailing of a Ship*. In order to compute the Force of the Water againſt a Ships Rudder, Stem or Side; or the force of the Wind againſt her Sails, a late Author, whoſe Book is Printed at *Paris* by the *French* King's expreſs Command, and called the *Theory of the handliug or Working of Ships at Sea*, and lately *Engliſhed*, proceeds on this Foundation; 1. He conſiders all Fluid Bodies, as the *Air* or *Water*, &c. as being compoſed of little Bodies or Particles, which when they act upon, or move againſt any Surface, do all move parallel one to another, or ſtrike againſt the Surface after the ſame manner. 2. He conſiders that the Motion of any Body, with regard to a Surface on which it is to ſtrike, muſt be after one of theſe three ways, either *Perpendicular*, *Parallel*, or *Oblique*. In the firſt Caſe, let the Line *D C*, in Fig. 1. repreſent a Plain Surface, and let the Line *A B* be Perpendicular to it, deſcribing the direct Impulſe of the Body *A* upon it; 'tis plain here that the Body *A* ſtrikes upon it with all its force, and this Force may be called *Abſolute*, and may be expreſſed by the Line *A B*, which the moving Body *A* deſcribes: And this Abſolute Force will be *greater* or *leſs*, according as the Body *A* moves *ſwifter* or *ſlower*. (3.) If the Motion of the Body *a* be Parallel to the Surface *D C*, then 'tis plain the Line of Motion *a b* will not affect the Surface at all becauſe it is no way oppoſed to it; nor can the moving Body ſtrike upon it, or touch it. (4.) If the Line of Motion *A D* be Oblique to the Surface *D C*, ſo that the Angle of Incidence be *A D C*. then the Motion of the Body in the Line *A D*, may be reſolved into two Forces, *viz.* into *A E*, or *D B*, and into *A B*, (*See Compoſition of Motion.*) But the Direction or Line of Motion *A E*, being Parallel to the Surface *D C*, cannot affect it at all; ſo that the whole Motion of the Body *A* in that Oblique manner of Striking on the Surface, will be expounded by the Perpendicular Line *A B*. And if *D A* be made the Radius of a Circle, whoſe Centre is at *D*, B A will be the Sine of the Angle of Incidence *A D C*, and conſequently, you may conclude that the Force of a Particle of *Air* or *Water*, as *A*, ſtriking againſt the Surface *D C*, which may repreſent either a Sail, or the Rudder of a Ship, in the Oblique Direction *A D*, will be to the Perpendicular Force there, as B A is to D A :: that is, *as the Sine of the Angle of Incidence is to Radius*. And ſince what is thus true of one Particle *ſingly* conſidered, will be true of all the Particles of any Fluid Body *Collectively*; it will follow, that the force of the Air or Water falling Perpendicularly upon a Sail or the Rudder, to the force of the ſame in any Oblique Impingency, will be as the Square of the Radius, to the Square of the Sine of the Angle of Incidence: And conſequently, that all Oblique Forces of the Wind againſt the Sails, or of the Water againſt the Rudder, will be to one another *as the Squares of the Sines of the Angles of Incidence*. Here is no regard had to the different Degrees of Velocity, with which the Wind or Water may impinge againſt the Sail or Rudder; but only of the *Poſition* of the Surface ſo ſtruck, with regard to the Impinging Force: But when that Matter is conſidered, it will be found that the different Forces then *will be as the Squares of the Velocities of the moving Air or Water*: that is, that a Wind that blows thrice as ſtrong, or moves thrice as ſwift as another, will have nine times the force upon the Sail: And it being alſo, ſaith he, indifferent, whether you conſider the Motion of a Solid in a Fluid, whoſe Particles are at reſt, or of thoſe Particles moving all Parallel againſt a Solid that is at reſt, the Reciprocal Impreſſions being always the ſame: So that if a Solid be moved with different Velocities in the ſame Fluid Matter (as ſuppoſe Water) the different Reſiſtances which it will re-

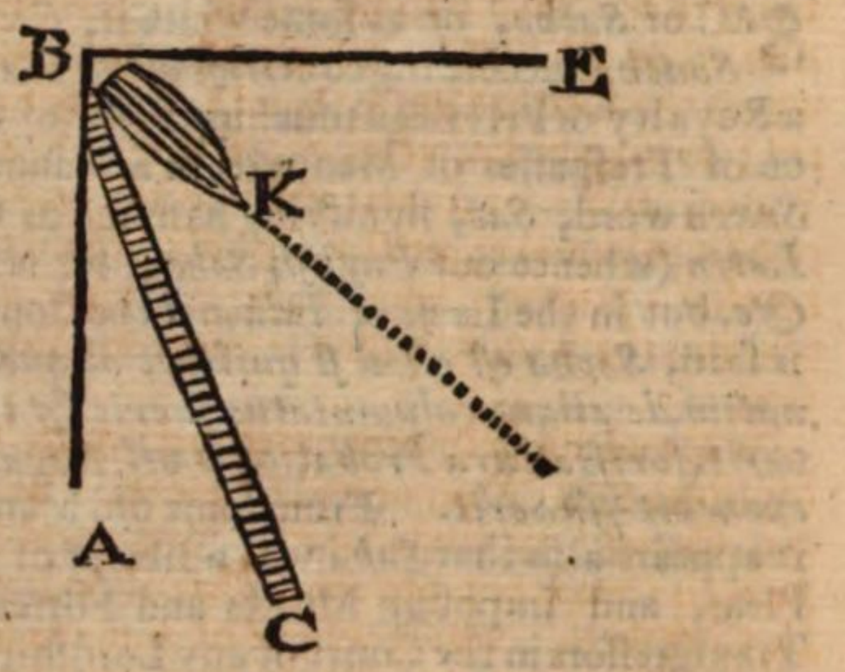
ceive from that Water, will be in the same *Proportion as the Squares of the Velocities of that Body.*




Let H M represent a Ship, *C D* the Position of the Sail, A B the Course of the Wind blowing towards *B*. Draw B G Perpendicular to the Sail *D C*, and G K Perpendicular to the Line of the Keel produced H M K.

By what he hath said above, the Sail *C D* will be driven by the Wind A B, according to the Direction of the Line *B G*: So that if she could divide the Water every way with the same Facility, as she doth with her Head, the Ship would go directly to the Point G, along the Line B G. And if H K represent her direct Course, she would have got forward the length B K, and sideways she would have gone the Quantity G K. But as her Length is much greater than her Breadth, so she will divide the Water, or make her way in it much more difficultly with her *Side*, than with her *Head* or *Stem*; on which account, she will not run sideways so far as K G, but fall short of it in Proportion to the said Difficulty of dividing the Water with her Side: That is, if the Resistance she finds in passing thro' the Water sideways, be to that of passing lengthways, suppose as 10 to 1, then will not the Ship get sideways above a 10th part of the Line G K. Wherefore if K G can be found to G L, in the Ratio of the Resistance of the Side to that of the *Stem*, and the Line *B L* be drawn, the Ship will go to the Point L, along the Line B L, in the same time as it would have gone to G, if it could have divided the Water every way equally. This Part *K L* is called the *Drift*, or *Lee-way* of a Ship, and the Angle *K B L* is her Degrees of *Lee-way*; as the Angle *A B K* expresses how near the Wind she lies. [Now from hence it follows, saith our Author, That if we could but find the Ratio between these two Resistances of a Ship's dividing the Water sidewise and lengthwise, we might determine the *Line of a Ships true way.*] But as this is very difficult to be done, from the knowledge of a Ship's Figure and Proportions, so he gives another Method, whereby he saith, it may be effected, as you may find in *Art.* 2. of *Chap.* 2.

After this he undertakes to demonstrate in *Art.* 3. of *Chap.* 4. That the best Position or Situation of a Ship, so that she may make the best Lee-way, but go to Windward as much as is possible, is this: Let the Sail have what Situation it will *the Ship must always be in a Line bissecting the Complement of the Winds Angle of Incidence upon the Sail.* That is, let the Sail be in the Position *B C*, the Wind blowing from A to B, and consequently the Angle of the Winds Incidence on the Sail *A B C*, therefore its Complement will be C B E; then must the Ship be put into the Position *B K*, or more in the Line B K, bissecting the Angle C B E.




And that the Angle which the Sail ought to make with the Wind or the Angle A B C, *ought to be but of 24 Degrees.* That being the most advantageous Situation to go to Windward the most that is possible, and in order to bring this to bear in Practice, he directs to put Marks to the *Sheets*, *Braces* and *Bowlines* of the lower Sails, to know when they are in their best Situation; and then, even in the Night, when the Marks of a *Brace*, or of a *Sheet* shall come to the Cleat, one may be pretty well assured that the Sail *Trims* well.

SALT, Sir *Is. Newton* shews that *Salt* is compounded of a *dry Earth*, and an *Aqueous Acid* joyned together by *Attraction*, and that Earth can't be turned into Salt, unless by the mixture of so much of an Acid, as may make it capable of a Dissolution in Water. And as it is owing to the *Force of Gravity*, that the Sea flows round the more dense and ponderous Globe of the Earth, so will the Principle of Attraction (see that word) occasion that the *Aqueous Acid* may flow round the more compact Terrestrial Particles, and so compose the Particle of Salt. For by no other way (saith he) can we account for *Acid*, being in place of a *Mean*, between *Earth* and *common Water*, in order to render Salt dissolvable in the latter. And as in the great Terraqueous Globe, the most dense Bodies will by their Gravity subside in Water, and do always tend towards the Centre of the Globe, so in the Particles of Salt, the most Dense Matter always endeavours to get to the Centre of the Particle. So that a Particle of *Salt* is a kind of *Chaos*, *dense*, *hard*, *dry*, and earthy at the Centre, but rare, moist, soft, and watery at the Surface. And hence it appears, Salts are of so durable and lasting a nature as they are: for they can scarce be destroy'd, unless the Aqueous Parts be either drawn off by a great force, or by Putrefaction and a moderate Heat, permitted to get down into the Occult *Meatus*, or Pores of the Central Earthy Parts, and at last dissolve them by cutting them into small pieces.

If *Salt* in a small quantity be dissolved in a great deal of Water, the Saline Particles, tho' specifically heavier, will not subside, but diffuse themselves equally throughout all the Water, and render it equally *Salt* in all places; which seems to shew that the Parts of the Salt do *mutually recede* one from another, and *endeavour* to expand themselves all manner of ways and to part and separate

rate

rate as far as the ſpace will permit: And this *Endeavour* ſhews that they have ſome kind of *Repelling Force*, by which they fly from one another, or at leaſt are more ſtrongly *attracted* by *the Parts* of the Water, than by one another. For as all Bodies *aſcend* in Water, which do gravitate leſs towards the Earths Centre than the Parts of the Water; ſo all the Particles of Salt which ſwim in Water, and are leſs attracted by any one Particle of Salt, than they are by the Water it ſelf, muſt neceſſarily recede from that Particle, and give place to the Water, which is more forcibly attracted.

When a Liquor impregnated with *Salt*, hath its Moiſture ſo far Evaporated by Heat, that a *Pellicle*, *Cuticle*, or little Skin appears upon its Surface, if then it beſet to cool, the Salt will ſhoot into Chryſtals, which will be of ſome regular Figure: From whence it appears, that the Saline Particles before their Concretion, were placed in the Liquor in *ſome certain Order*, and at equal Diſtances or Intervals; and conſequently that they *did act one upon* another by *ſome kind of Force*, which is *equal* at *equal Intervals*, and *unequal at unequal Diſtances*. For the Suppoſition of ſome ſuch Force will occaſion their being diſpoſed every where into ſuch Orders; but without it they would ramble about and be diſperſed, perfectly irregularly in the Fluid.

In the *French* Memoirs of the Academy of Sciences for the Year 1699, there is a Method, by Mr. *Homberg*, of finding the exact quantity of the Volatil Acid Salt that any Liquor contains.

(2) Their way of making Salt at *Nantwyche* in *Cheſhire*, is thus, (ſaith Mr. *Ray*) The Salt-ſpring, or as they call it the *Brine-pit* is near the River, and is ſo plentiful, that were all the Water boiled out that it will afford, it is thought it would yield Salt enough for all *England*.

The Brine-pits belong not all to one Lord; but ſome have one *Lead-walling*, ſome two, three, four, *&c.* A *Lead-walling*, is the Brine of 24 Hours boiling for one Houſe.

Two hundred and ſixteen Lead-wallings, or thereabouts, belong to all the Owners of the Pits. No Tradeſman, Batchellor, or Widower, can Rent more than 18 Lead-wallings.

They have 4 Sworn Officers choſen Annually, which they call *Occupiers of Walling*; whoſe Duty it is to ſee equal Dealing between Lord and Tenant, and all Perſons concerned, to appoint how many Houſes ſhall work at a time (which is 12 at moſt) to appoint a Crier (when Salt is to be made;) to make Proclamation ſo, that all Parties concerned may put to their Fires at the ſame time, and ſo alſo when they ſhall ceaſe: which is at a determinate Hour: And he that doth not leave off then hath his Salt ſpoiled, by throwing Dirt, *&c.* into it.

In the Town are about 50 Houſes, and every Houſe hath 4 Pans, which the Officers are to ſee muſt be all exactly of the ſame Meaſure.

The Salt Water taken out of the Brine-pit, in boiling 2 Hours $\frac{1}{4}$, will be Evaporated, and boiled up into Salt.

When the Liquor is more than luke-warm, they take Strong-ale, Bullock's-blood, an Egg-ſhell full, the White of one Egg, and of Ale a Pint: This Mixture is put into a Pan of 24 Gallons, or thereabouts; the Whites of Eggs, and the Blood ſerve to Clarifie the Brine, by raiſing the Scum; which they take off juſt upon the boiling of the Pans, otherwiſe it boils in and ſpoils the Salt. The older the Blood is the better, *cæteris paribus*, when the Liquor boils too faſt, they don't put in any Blood, but allay it with Brine that hath been before boiled, and drain'd from its Salt. Crude Brine, they ſay, will diminiſh their Salt; and they ſay, the Ale ſerves to harden the *Corn* of the Salt.

After one hours boiling, the Brine will begin to *Corn*, or Granulate. Then they take a ſmall quantity of clear Ale, of which they ſprinkle about an Egg-ſhell full into the Pan, but if you put in too much Ale, it will make the Liquor boil over the Pan; a little while before they put in the laſt Ale, they cauſe the Pan to boil as faſt as they can; but after that very gently, till the Salt be almoſt dry, For they do not Evaporate quite, *ad ſiccitatem*, but leave 2, 3, or 4 Quarts of Brine in the Pan, leſt the Salt ſhould burn, and ſtick to its ſides.

The Brine thus ſufficiently Boiled and Evaporated, they take out the Salt and pour it into Conical Baskets (which they call *Barrows*) and in them let the Water drain from it an hour, more or leſs, and then ſet it to dry in the Hot-houſe behind the Furnace.

A Barrow containing 6 Pecks, is ſold there for 16 Pence.

Out of 2 Pans of 48 Gallons they expect 7 Pecks of Salt, *Wincheſter* Meaſure.

The Houſe in which the Salt is boiled, they call the *Wyche-houſe*; the Veſſel whereinto the Brine is by Troughs conveyed from the Brine-pit, is called the *Ship*. 'Tis raiſed out of the Pit by a Pump. Between the Furnace and the Chimney-tunnels, which convey the Smoke, is their *Hot-houſe*, where they ſet their Salt to dry; along the Floor whereof run 2 Funnels from the Furnaces, almoſt Parallel to the Horizon, and then they ariſe Perpendicularly; in theſe the Flame and Smoak running along from the Furnaces, heat the Room by the way.

At *Droitwyche* in *Worceſterſhire*, the Salt is boiled in ſhallow Leaden-pans.

They firſt put in the Salt-water out of the Brine-pits, and then after an hours boiling they fill up the Pan with the Water that drains from the Salt ſet to dry in the Barrows, and after a ſecond hours boiling, they fill up the Pans again with the ſame. In five hours boiling the Pan grows dry, and then they take out the Salt.

In 24 hours they boil out 5 Pans, and then draw out the Aſhes; after which they put in the White of an Egg to make the Scum ariſe (which is partly Duſt and Aſhes, falling into the Pan when they are taking out the Aſhes.) The Scum they take off with a Scummer, and after 4 hours they begin to take out the Salt, and once in 24 hours they take out a Cake which ſticks to the bottom of the Pan, and which they call *Clod-Salt*, otherwiſe the Pan would melt. They uſe there neither Blood nor Ale, and the Salt made there is extraordinary fine and white.

In *Lancaſhire* they make Salt of Sea-Sand, thus, They pare off in dry Summer-weather, the upper part of the Sand in the Flats and Waſhes (which are cover'd at Full-Sea, and bare when the Tide is out) and lay it up on great heaps.

Of this Sand they put into Troughs, bored with holes at the bottom, a ſufficient quantity, and then pouring Water upon it, they make a Lee or *Lixivium*, and the Water draining thro' the Sand,

carries the Salt with it down into Veſſels placed underneath. As long as this Liquor is ſtrong enough to bear an Egg, they keep pouring more Water ſtill upon the Sand in the Troughs, but as ſoon as the Egg begins to ſink, they caſt the Sand out of the Troughs, and put in new from the Heap.

This Water thus impregnated with Salt, they boil in Leaden-pans, wherein (as above) the Water Evaporating leaves the Salt behind.

At *Newcaſtle*, *Preſton*-pans, in *Scotland*, *Whitehaven* in *Cumberland*, and other Places, they make Salt in great Plenty, by Boiling and Evaporating the Sea-water, and in the Operation they make uſe of Ox's Blood, as at *Nantwyche*.

From Dr. *Jackſon*'s Account of the Salt-works and Springs in *Cheſhire*, in the *Philoſophical Tranſactions*, I find that now they have changed their 6 Leaden-pans into 4 Iron ones, ſomething better than Yard ſquare, and about 6 Inches deep; which are ſet upon Iron-bars, and made up on all ſides very cloſe, to hinder the Flame or Smoke to break thro', with Clay and Bricks. Their Fewel is *Staffordſhire* Pit-coal. They never cover their Pans at all, during the whole time of boiling; and their Houſes are like Barns, open up to the Thatch, with a *Louvre-hole* or two to carry off the Steam, which is ſo great, that probably it would warp Boards, and ruſt Nails, ſo that no Timber covering would laſt long; what Tiles would do, no one yet hath tried there.

The Sweepings of ſuch Salt as is ſhed and ſcatter'd about on the Floor, takes up with it a good deal of Dirt, and is called *Grey-Salt*. This ſells but at half the Price of white Salt, and is only uſed by the Poor to Salt Cheeſe, Bacon, *&c.* *Catts of Salt* are made of the worſt Salt, when yet wettiſh from the Pans, 'tis molded and made up with ſome Cummin-ſeed and Aſhes, and ſo baked into Lumps at the Mouths of their Ovens; they are only uſed in Pigeon-houſes. But *Loaves of Salt* are the fineſt of all for Table uſe.

At *Droitwyche* in *Worceſterſhire*, they uſe no Blood, but only Whites of Eggs (a quarter of one White to a Gallon of Brine) to Clarify their Brine; and to Granulate it, they uſe no Ale, nor any thing elſe; this Salt is much whiter and better than the *Cheſhire* Salt, and a *Wincheſter* Buſhel of it weighs half a hundred Weight.

The way of making *Bay-Salt* in *France*, is deſcribed in *Philoſophical Tranſactions*, N. 51, with Figures. The Water is let in from the Sea into a firſt and ſecond Receptacle, and then into a third, which is called the *Mariſh*. In theſe Beds or *Mariſhes* the Water is not above an Inch and half deep; each Bed of the *Mariſh* is 15 Foot long, and 14 Broad. When it rains much on any day, no Salt can be made in 3 or 4 days after, and then they have Stops to hinder the Sea-water from coming into the *Mariſhes*. But if it rain for 5 or 6 days, they are neceſſitated to empty all the Water out of the Beds by a peculiar Channel, which cannot be opened but at Low-water.

The hotteſt Years make the moſt Salt, and in the hotteſt part of Summer, Salt is made in *France* even in the Night: Leſs Salt is made in Calm then in Windy Weather, and the *Weſt* and *North-weſt* Winds are beſt for that Purpoſe. The People draw the Salt every day, and each day more than an hundred Pound weight.

SALT-SILVER, was one Penny, formerly paid at the Feaſt of St. *Martin*, by the Servile Tenants to their Lord, by way of Commutation, for the Service of carrying their Lord's Salt from Market to his *Lardar*.

SALVAGE-*Money*, is a Recompence allowed by the Civil Law, in lieu of all Damages ſuſtained by that Ship, that ſaves or reſcues another which was ſet upon or taken by the Enemy, or by Pirates.

SALUTE, SALUS, was a Coin of Gold, Stampt by K. *Henry* 5. in *France*, after his Conqueſts there, it had on it the Arms of *England* and *France* quarterly.

SANCTUARY, was formerly a Place Priviledged by the Prince for the Safeguard of Mens Lives that were Capital Offenders: Our ancient Kings of *England*, permitted the Sanctuaries to protect Traytors, Murderers, *&c.* if within 40 Days they acknowledged their Fault, and ſubmitted themſelves to Baniſhment: And during that time, if any Layman Expelled them he was Excommunicated, and a Clerk was made irregular by it. But after 40 days, no Man might relieve them. Of theſe there were many in *England*, and one more famous than the reſt, at St. *John*'s at *Beverly*. How theſe were taken away by degrees, you may find by reading the Statutes of 26 *H.* 8. 13. 28 *H.* 8. 7. 32 *H.* 8. 15. 1 *E.* 6. 12. 2 *E.* 6. 2. and 33. 5 *E.* 6. 10.

SAND-*bags*, in Fortification, are Bags holding about a Cubick Foot of Sand or Earth: They are uſed for raiſing Parapets in haſte, or to repair what is beaten down; they are of uſe when the Ground is Rocky, and affords no Earth to carry on their Approaches; becauſe they can be eaſily brought on and off at pleaſure: There are a leſſer ſort of theſe which hold half what the former do, which are placed upon the upper *Talus* of the Parapet, to cover thoſe which are behind, and who fire thro' the *Embraſures*, or Intervals that are between them.

SAP, in Fortification, is digging deep under the Earth, in order to paſs under the *Glacis*, and to open a way to come under cover to the Paſſage of the *Moat*. When they are got near the foot of the *Glacis*, the Trench is carried on directly forwards, the Workmen covering themſelves as well as they can, with *Blinds*, *Wool-packs*, *Sand-bags*, and Mantelets upon Wheels: When they are got to the foot of the *Glacis*, they make *Epaulments*, or *Traverſes* on each ſide to lodge a good Body of Men. The *Sap* is made 5 or 6 Fathom from the *Saliant Angle* of the *Glacis*, where the Men are only cover'd ſideways; wherefore they lay Planks overhead with Hurdles and Earth above them. When they have forced the Enemy to quit the Cover'd Way, the Pioneers make immediately a Lodgment, and cover themſelves as well as they can from the Fire of the oppoſite Baſtion.

SAPHETA, in Architecture, is the Board over the top of a Window, and placed Parallel, and oppoſite to the Window board at the botom.

SARPLER, otherwiſe called a *Pocket*, is a half Sack of Wooll, a Sack is 80 Tod, a Tod 2 Stone, and a Stone 14 Pounds. This in *Scotland* is called *Serpliath*, and contains 80 Stone.

SATURN, in the *Leipſick* Acts for *September*, 1684. there is a new Syſtem of the Phænomena of Saturn and his Ring, by Mr. *Gallet*, and taken from the *French* Journals of *June*, 1684.

It doth not appear by any Aſtronomical Obſervations, that *Saturn*, like the other Planets, which

which have Satellites, revolves round his own Axis; but the contrary seems to be the Case. For in *Jupiter* and the *Earth*, which do turn round their *Axes*, the Equatorial Diameters are longer than Polar ones, or their *Axes*, but no such thing hath been found in Saturn.

Each Surface of the Ring of Saturn seems to be plain and smooth, without any such Mountainous Inequalities as the Earths Surface, and the Moons hath; because it is not visible, tho' Illuminated by the Sun, but only when the Eye is elevated some few Degrees above its Plane. 'Tis either Fluid therefore like Water, or Polite, like Ice or Glass. If it be a *Fluid*, it moves round Saturn with a Circular Motion; but if it be of a Solid Substance, it is not yet determined, whether it move round the Planet or not. And since the Figure of Saturns Ring is exactly Circular, it must have no *Linea Apsidum*, nor any Progression of it: But because the Plane of the Ring hath a large Elevation above the Plane of the Ecliptick, *viz.* making with it an Angle of 31 Degrees, the *Nodes* will *recede*, but yet very slowly, according to the manner of the other Planets.

SATELLITES. Dr. *Gregory*, in his Excelleent Astronomy, hath demonstrated, that if a Satellite describe an Elliptick Orbit round a Planet, placed in one of the *Foci* of that *Ellipsis*; the greater *Axis*, or the *Line of the Apses* will with an Angular Motion twice advance forwards, *viz.* in the 2 Syzygies, and twice recede backwards, *viz.* when in Quadrature to the Sun.

And that this Force of Progression is near twice as great as that of the Recess, and therefore the Line of the Apses in every Revolution of the Satellite, will advance more forward than it recedes backward; and that by the Excess of this Progression, the Apses will move *in consequentia*, *p.* 298.

If a Satellite move round a Planet in an Eccentrick Orbit, the Eccentricity will be twice changed in every Revolution, and in each Revolution will be greatest, when the Satellite as in the Syzygies with the Sun, and least when it is in the Quadratures; and will be continually encreasing from the Quadratures to the Syzygies, and decreasing from the Syzygies to the Quadratures, *p.* 302.

If a Satellite revolve round a Planet in an Orbit, whose Plane is inclined to the Plane of the Orbit of the Planet round the Sun, then will the Line of the Nodes move *in antecedentia*, with an unequal Angular Motion; swiftest when the Nodes are in Quadrature to the Sun, after this slower, and at last when the Nodes are in the Syzygies, will be quite at rest. In the intermediate Places between the Quadratures and Syzygies, the Nodes will recede slower; and in every Revolution of the Satellite, will either be Retrograde or Stationary, be carried backward, or move *in antecedentia*, and in each Revolution will recede fastest, all things considered, when the Satellite is in the Syzygies, *p.* 304.

The Inclination also of the Plane of the Orbit of the Satellite, to that of the Planet, will be continually changing, and will be *greatest* when the Nodes are in the Syzygies with the Sun, and least *cæteris paribus*, when they are in the Quadratures, *p.* 307.

And all the Inequalities in the Motions of the Satellites will be a little greater when they are in Conjunction with the Sun, than when they are in opposition to him, *p.* 310.

SAW, is an Instrument very well known in the general, as well as its use. But they reckon these several sorts of Saws. 1. *The Pit-saw*, which is used to Saw Timber and Boards, and to cut off Scantlings, Quarters or Battens from any piece of Timber. The Matter to be Sawed is sometimes lain over a Pit, and sometimes on great Trusses above ground. 2. The *Whip-Saw* is used by Joyners, to cut off such pieces of Stuff as the Hand-Saw will not easily notch thro'. 'Tis drawn by two Men, and the Timber is placed on Trusses in order to be cut. 3. The *Hand-Saw*, which is to be used by a single Man, and usually with one hand. 4. The *Frame-Saw*, or *Bow-Saw*, is a Saw with Cheeks made to it, and with a twisted Chord, and Tongue in the middle to draw the upper ends of the Cheeks closer together, that the lower ends may be farther asunder, and so strain the Saw the straighter. 5. The *Tennon-Saw*, which is a thin Saw with a Back to it, to keep it from bending. 6. The *Compass-Saw*, which is design'd to cut a Round, or any Compass-kerf; wherefore its Edge must be made broad, and the Back thin, and the Blade narrow, that the Back may have a wide Kerf to turn in, and so the easier follow the Edge.

SCALES *Proportional*: See *Proportional Scales*.

SCALE *of Musick*, tho' we find mention of several *Distances* of Musick among the *Greeks*, yet I rather think them to be *Leaps* in a single part, than *Concords* in Composition. *The Distances* talk'd of among the *Greeks*, are the Τόνος or Second, the Δίτονον or third, the Διατεσσάρων or fourth, the Διαπέντε or fifth, and Διαπασῶν or eighth. But if these were design'd to denote the Concords, they were in the wrong to place the *fourth*, and more so to place the *second* among them. Or if such were admitted, 'tis a wonder that the *sixth*, which is known to be a *Concord*, was refused. But if they were used to shew the Distances, by which a Voice may rise or fall, it is no wonder that they left out the *sixth* and *seventh* (being Distances not to be used without better Judgment and Design than those Times would admit of) and made mention of the rest, as being common in their Musick.

The Scale of Musick among the *Greeks*, consisted but of *fifteen Notes*, or the *Distances* of two *Octaves*, viz. The first from their Μεσολαμβανόμενος, (which I suppose was the *Key* of their Musick,) to their Μέση, and the second from their Μέση or *Middle Note* to their Νήτη ὑπερβολαίων, or highest Note, by which I suppose they designed only the utmost Extent of a single Natural Voice.

And their *Seven Moods*, so much talk'd of, were no more than the seven different Methods of altering their Tunes, by *Flats* and *Sharps*, placed at the beginning of a Lesson; which therefore they called μεταβολὴ κατὰ τόνον. Besides the Names of their Notes in the upper Octave, have no Affinity with the Names in the other; whereas in *Guido Aretinus* his Scale of 20 Notes (tho' our modern Composers in many Parts often exceed the *Scale*, both above and below) and the Notes in every Octave begin with the same Letter; that we may thereby more readily compute the *Concords and Discords*.

SCARAGE, *Scaragium*, otherwise called *Escherage*, *Shewage* and *Scheawing*; and in a Charter of *H.* 2. to *Canterbury*, 'tis writren *Scewinga*, was formerly a kind of Toll or Custom, exacted by Her Majesties Sheriffs, *&c.* of Merchant Strangers for Wares

Wares, *ſhewed* or offered to Sale within their Precincts. This is now Prohibited by Statute, 19 *H.* 7. *c.* 8. But the City of *London* doth ſtill retain the Cuſtom, *Cowel's Interpreter*. The Officer that Collected this Toll, was called the *Scabaldue*.

SCALA. *William* I. appointed the *Arms*, which before him had been uſually anſwered in Victuals, to be converted into Money numbred, and directed the whole in every County to be charged on the Sheriff, who brought it into the *Exchequer*; adding, that the Sheriff ſhould make the Payment *ad Scalam*, i. e. as *Gervaſe* of *Tilbury* expounds it, he ſhould pay ſix Pence over in every Pound to make up the full Weight, and nearly the Intrinſick Value. And this was agreed on, as an eaſie way to remedy the defective Weight of Money, and to avoid the trouble of weighing all Money which was brought into the *Exchequer*.

SCALENOUS *Cones*. See Cone.

SCEPPE, an old Word, omitted in our Gloſſaries, ſignifying a *Buſhel*.

SCENOGRAPHICK *Projection*, or Perſpective, is the Tranſcription of any given Magnitude, into a Plane which interſects the Optick Pyramid at a proper diſtance: For in Projection, there is to be conſider'd, 1. The *Object*, or Foundation, or Ground of the Projection, from whence the *Pyramid*, *Cone*, or *Pencil of Rays* go. (2.) The *Eye* of the Spectator, and 3 the *Plane Table*, or *Diaphanum*, which interſects the Rays, ſome where between the Object and the Eye: And the Repreſentation or Appearance of the Object in that *Plane*, is the *Projection or Perſpective* of the Object. This *Plane* is always ſuppoſed to be at Right Angles with the Horizon. And from hence it will follow, that (1.) A *Point* will be projected there in the Diaphanous Plane where the Optick Ray cuts it. (2.) That Right Line will be projected where the Optick Triangle and the Plane do mutually Interſect each other. 3. That a *Plane* or Superficies will be repreſented where the *Diaphanous Plane* cuts the Optick Pyramid of Rays coming from that Surface. And that Repreſentation of it called its *Image*.

SCHAR-*Penny*, *Scharn-penny*, and ſometimes *Schorn-penny*. It appears from our old Books, that formerly ſome Cuſtomary Tenants were obliged to pen up their Cattle at Night in the Pound or Yard of their Lord, for the benefit of their Dung, or *Scearn*, as is the *Saxon* Word. And if they did not do this, they were obliged to pay a ſmall Compenſation; which therefore was called by this name of *Scharn-penny*, that is, *Muck-penny*, or *Dung-penny*.

SCHEAME, or *Skeen*, in Architecture, is the Workmens Word for the middle part of an Elliptical Arch.

SCHIRE-MOTE, was anciently a Solemn Meeting of all the Free Tenants and Knights in any County, to do Fealty to the King, and Elect an Annual Sheriff. See *Folk-mote*.

SCHIRE-WYTE, was an Annual Tax or Impoſition, paid to the Sheriff of any County or Shire, for holding the Aſſizes or County-Courts.

SCREW, SCRUE, } See *Cochlea*.

SCRATCH-*work*, in *Italian*, *Sgrafitti*, was a way of Painting in *Freſco*, by preparing of a black Ground, on which was placed a white Plaſter; and this White being taken off with an Iron Bodkin, the Black appears thro' the Holes, and ſerves for Shadows: This kind of Work is laſting, but being very rough, is unpleaſant to the ſight. 'Twas uſed in *Rome* by *Polidoro de Caravagio*.

SCRIBING, when the Joyners would fit a piece of Board, *&c.* to an irregular Surface, or any other irregular Piece: They open their ſtiff Iron Compaſſes to the greateſt diſtance, any where between the 2 Boards, *&c.* and then carrying one Leg along all the irregular Indentings, *&c.* of one, the other Leg moving parallel to it, deſcribes that irregular Figure on the other Board; which being in that manner cut will fit and joyn.

SCUTAGE, all Tenants who held from the King by Military Service, were either bound to attend Perſonally in Wars and Expeditions, or for default of ſuch Service, to pay a *Scutage* or Compoſition in Money, which was Levied on every *Scutum Militare*, or Knights Fee, and the Proportional Parts for the King's Uſe. And the Barons and Knights, which then paid a *Scutage* to the King, had a Power to Levy the ſame Tax on thoſe Tenants who held from them in Military Service.

SCUTAGIO *habendo*, was a Writ that lay for the King, or other Lord, againſt the Tenant that held by Knight-Service, to ſerve by himſelf, or elſe to ſend a ſufficient Man in his Place.

SCULPTURE, may be diſtinguiſhed into three ſeveral Arts, each of which hath its Specifick Difference. For (ſaith Mr. *Evelin* in his Hiſtory of *Chaleography*) beſides *Sculptura*, as it relates to *Chalcography*, there is both *Sculptura* and *Cœlatura*; both which, according to *Quintilian*, differ from the *firſt*, with reſpect to the *Matter*, on or out of which any thing is wrought. For it was applied to cutting or carving in *Wood* or *Ivory*; and then was called *Tomice*, and the Artiſts *Deſectores*; to working in Plaſter, and then called *Paradigrammatice*, and the Artiſts *Gypſochi*; to Cutting or Carving in Stone, and then called *Colaptice*, and the Workmen *Lithoxoi*, and laſtly in Metals, *Glyphice*. And it may be deſcribed *to be an Art, which teaches us to cut or take away all that is ſuperfluous of the ſubject Matter, reducing it to that Form or Body, which was deſigned in the Mind of the Artiſt*.

SCUPPER-*Nails*, ſee *Scopper-holes*.

SCYRE-GEMOTE, was anciently a Court held twice a Year (as the Sheriffs turn is now) by the Biſhop of the Dioceſs and the *Ealderman*, *i. e.* in ſuch Shires as had *Ealdermen*) and by the Biſhops and Sheriffs, in ſuch as were committed to the Sheriffs that were immediate to the King; where both the Eccleſiaſtical and Temporal Laws were given in Charge to the Country.

SEALER, is an Officer in *Chancery*, appointed by the Lord Chancellor, or Keeper of the Great Seal, to Seal the Writs and Inſtruments there made in his Preſence.

SECTOR, beſides the Uſes of the ſeveral Lines *Circular* and *others*; which you will find diſperſed under their proper Names. Some Problems may properly come in here under the general Word Sector. As 1. *To open the Sector to any given Angle*.

Here muſt be noted, that 'tis one thing to open the ſeveral pairs of Lines thereon drawn to the ſame Angle; for in *Gunter*'s Sector the *Line of Lines* on the one ſide, and the *Line of Sines* on the other, make an Angle of 2°, when the Edges of the Sector are cloſe ſhut. So alſo the *Line of Superficies*,

*perſicies*, and the Lines of Solids make an Angle of 10°, tho' the Edges are cloſe ſhut.

The *Lines of Lines* may be opened to a Right Angle, if the whole lateral Length be applied over between 8 and 6. Becauſe □8 × □6 = 100, by 47. è 1. *Eucild.*

The *Line of Sines* may be opened to a Right Angle, if the Lateral Sine of 90 be applied over Parallelly between 45°. and 45°. in the Sines, or if the Sine of 45°. be applied over in the between 30°. and 30, in the Line of Sines.

If you would open the Lines of Sines to any particular Oblique Angles, take out the Chord of the Angle required, and apply it over in the *Semi-Radius*, or at the end of the Line of Chords of 60 Degrees: V. gr. to open the Sines to an Angle of 40 Degrees, take out the Lateral Chord of 40°. and to it open the Sector in the Parallel Chord of 60°. or if you apply the ſame Chord of 40°. over between 50 and 50 in the *Line of Lines*, it will open *them* to the ſame Angle.

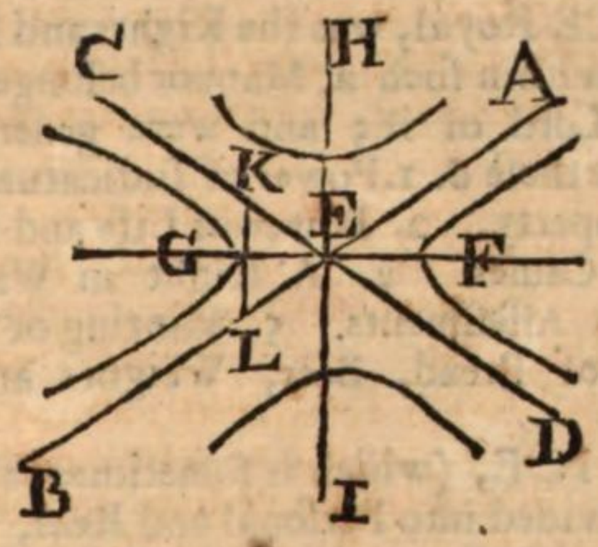
On the contrary, if the Sector be opened to an Angle at a venture, you may find the quantity of that Angle, thus: Take the *Parallel* Chord of 60°. and meaſure it in the *Lateral* Chord, and it ſhall there give the Angle, *i. e.* the Angle that thoſe Lines of Chords are opened to: But that will be different from the Angle of the Edges of the Sector. N. B. If you can apply the Centre of a *Protrator* to the Centre of the Sector, you may eaſily and readily find the Quantity of any of theſe Angles.

SECTA *Curiæ*, is Suit and Service done by Tenants at the Court of their Lord.

SECTA *Schirarum & Hundredorum*, was the Attendance, Suit and Service done by Tenants in the County and Hundred Courts; and *Quietos eſſe de hâc Sectâ*, was a Privilege to be exempt from ſuch Cuſtomary Service.

SECTIONS *Conick*, ſee *Conick Sections.*

SECTIONES *Sequentes*, is a Term in Conicks ariſing thus:




Let there be two Right Lines, as A B, C D, mutually interſecting each other in *E*; which Point *E*, is ſuppoſed to be the Common Centre of the oppoſite Hyperbolick Sections, F G, H I, and whoſe common Aſymptotes the propoſed Lines A B, C D, alſo are. In this partieular Caſe, the Sections G F, and H I, are called *Sectiones Sequentis*, becauſe they are placed following one another in the Contiguous Angles of two Interſecting Right Lines.

And if the determinate Diameter H G, of one of the *Sectiones Sequentes* (which is coincident with the ſuppoſed Indeterminate Diameter of its Oppoſite) be equal to the Vertical Tangent K L, applied betwen the Aſymptotes in the Point G, of the Diameter G F, then *Apollonius* calls ſuch Sections *Conjugate Sections.*

SEGMENTS, on *Gunter*'s Sector there are uſually placed two Lines, called *Lines of Segments*, they are numbred with 5, 6, 7, 8. 9, 10, and lie between the Lines of *Sines*, and thoſe of *Superficies.* They repreſent the Diameter of a Circle ſo divided into 100 parts, as that a right Line drawn thro' thoſe Parts, and normal to the Diameter, ſhall cut the Circle into 2 Segments, of which the greater ſhall have that Proportion to the whole Circle; as the Parts cut have to 100. Their uſes are

1. *To divide a given Circle into two Segments, which ſhall have a given Ratio*, which is done by opening the Sector, and applying the given Circles Diameter in the Points of 100 in theſe Lines; for then a Parallel taken from any Points proportional to the greater Segment required, ſhall give the *depth* of the greater Segment, accounted on a Diameter biſſecting the Segment.

2. *To find the Proportion between the Circle and any given Segments of it.*

Open the Sector, as before, and then take the *depth* of the greater Segments, and apply Parallel to the Diameter, and the Points where it fits in exactly, will ſhew the Proportion to 100.

SEEING. The Senſe of Seeing is probably cauſed thus, the Rays of Light exhibiting all Colours; fall upon the bottom of the Eye, and there cauſe or excite *Vibrations* in the *Tunica Retinæ*: which Vibrations being communicated, or propagated along the Solid Fibres of the Optick Nerves into the Brain, do there cauſe that Senſation, which we call Viſion or Seeing. For becauſe denſe Bodies conſerve their Heat a long while, and the Denſeſt, the longeſt time, the Vibrations of their Parts are of a laſting nature, and therefore may be propagated along ſolid Fibres of Uniform Denſity to a great diſtance, for conveying into the Brain, the Impreſſions made upon all the Organs of the Senſe. For that Motion which can continue long in one and the ſame part of a Body, can be propagated a long way from one part to another, ſuppoſing the Body Homogeneal, ſo that the Motion may not be reflected, refracted, interrupted, or diſordered by any unevenneſs of the Body. *Newton*'s *Opticks*, *Book* 3.

The ſame Author renders it probable, that the Species of Objects ſeen with both Eyes, are united in that Place where the Optick Nerves meet and joyn, before they come into the Brain: The Fibres on the right ſide of both Nerves uniting there, and after Union, going thence into the Brain in the Nerve, which is on the right ſide of the Head; and the Fibres on the left ſide of both Nerves uniting in the ſame place, and after Union going into the Brain in the Nerve, which is on the left ſide of the Head: And theſe two latter Nerves meet and unite in the Brain, in ſuch a manner that their Fibres make but one entire Species or Picture: Half of which. *viz.* that on the right ſide of the *Senſorium*, comes from the right ſide of both Eyes, thro' the ſide of both the Optick Nerves, to the Place where theſe Nerves meet, and from thence on the right ſide of the Head into the Brain: But the other half, *viz.* that on the left ſide of the *Senſorium*, comes in like manner from the left ſide of both Eyes. For the Optick Nerves of ſuch Animals as look the ſame way with both Eyes, (as of Men, Dogs, Sheep, Oxon. *&c.*) meet before they come into the Brain; but the Optick Nerves of ſuch Animals as do oot look the ſame

ſame way with both Eyes (as of Fiſhes, and of the Chamælion, do not ſo meet and unite. If I am rightly informed.

When a Man in the dark, preſſes either corner of his Eye with his Finger, and at the ſame time turns his Eye a contrary way, he will ſee a Circle of Colours, like thoſe in the Feather of a Peacock's Tail; which variegated Circle of Colours, ſeems to ariſe from the ſame kind of Motions excited in the bottom of the Eye by the Preſſure of the Finger, as at other times are excited there by *Light* for cauſing Viſion. And when a Man by a ſtroke upon his Eyes ſees a Flaſh of Light, are not the like Motions excited in the *Retina* by that Stroke?

SEIGNOURAGE, 9 *H.* 5. *Stat.* 2. *c.* 1. ſeems to have been a Royalty or Prerogative of the Prince, whereby he challenged allowance of Gold and Silver brought into the Maſs for his Exchange for Coin. Out of every Pound Weight of Gold, the King had for his Coin five Shillings, out of which he paid to the Maſter of the Mint for his Work, ſometimes 1 Shilling, and ſometimes 18 Pence. Upon every Pound Weight of Silver the *Seignourage*, anſwered to the King, in *Edw.* 3. Time was eighteen Penny-weight *pondere*, which about that time amounted to about a Shilling, and out of which he paid ſometimes 8, ſometimes 9 Pence to the Mint-maſter. In *H.* the 5th's Time the King's *Seignourage* for every Pound Weight of Silver was 15 Pence.

SELL, in Architecture, is the Term both for the loweſt piece of Timber in a Timber-building, or for that on which the whole Superſtructure is erected, and alſo for the bottom-pieces in a Window-frame; the former is called a *Ground-ſell*, the latter a *Window-ſell*.

SEME, *Summa*, is an Horſe-load, a *Seme of Corn* is 8 Buſhels,

SENESCHAL, was the Word anciently for the Chief Steward or Head Bailiff of a Baron, that kept his Courts, and managed his Demeſne-lands, and hath been the Title of the Lord High Steward, and of the Steward of the King's Houſhold, *&c.*

SEPTUAGESIMA, is always the third Sunday before *Quadrageſima* excluſive: from which, until the Octaves after *Eaſter*, Marriage is forbidden by the Canon-Law. It takes its name from its being above 70 Days before *Eaſter*.

SEPTUM *Medium*, is properly the inſide of the left Ventricle of the Heart, becauſe its Fibres are continued with the Fibres of the oppoſite ſide of the ſame Ventricle; it divides the left Ventricle of the Heart from the right.

SEQUELA *Cauſæ*, is the Proceſs and depending Iſſue of a Cauſe or Trial.

SEQUELA *Molendini*, is owing Suit to a particular Mill, or being bound to grind Corn in that Place only; which formerly was a Duty and Service laid upon many Tenants; wherefore *Concidere Sequelam Molendini*, was to grant all the Toll and Profits ariſing from ſuch Cuſtomary Rights.

SERGEANT; is a word diverſely uſed in our Law, and applied to ſundry Offices and Callings. A *Sergeant* at Law, or of the Coif, is the greateſt Degree taken in that Profeſſion, as that of a Doctor is in the Civil Law. As theſe are the moſt Learned and Experienced, there is one Court appropriated to Plead in by themſelves, which is the *Common-pleas*, where the Common Law of *England* is moſt ſtrictly obſerved: But tho' they have this Court to themſelves, they are not prohibited Pleading in other Conrts; where the Judges (who muſt be firſt Sergeants) call them *Brothers*. Theſe Sergeants are call'd by the King's Mandate, or Writ directed to them, and commanding them, under a great Penalty, to take upon them that Degree by a Day Aſſigned. Out of theſe one is (more may be) made the *King's Sergeant*, to Plead for him in all Cauſes, eſpecially in Treaſon.

SERGEANT *at Arms*, is an Officer appointed to attend the Perſon of the King, *An.* 7 *H.* 8. *c.* 3. to Arreſt Traytors, *&c.* and Perſons of Quality Offending, and to attend the Lord High Steward when he ſits in Judgment on any Traytor, *&c.* By the Stat. 13 *Richard* 2. *c.* 6. There cannot be above 30 in the Realm. Two of theſe by the King's Allowance attend the two Houſes of Parliament. The Office of him in the *Houſe* of *Commons* is to keep the Door, and to execute ſuch Commands as the Houſe ſhall direct, eſpecially as to the apprehenſion of Offenders, *&c.*

Another of theſe attends on the Lord Chancellor or Keeper in the *Chancery*, and one on the Lord High Treaſurer, one to attend on the Lord Preſident of *Wales*, and another on the Lord Preſident of the *North*. Another ſort of *Sergeants*, are chief Officers executing ſeveral Functions in the King's Houſehold; of which you may find many in Stat. 33 *H.* 8. *c.* 12. There is alſo an inferiour kind of *Sergeants of the Mace*, whereof there is a Troop in the City of *London*, attending the Lord Mayor.

SERJEANTRY, was a Service formerly done for the holding of Lands, and was either *Grand Serjeantry*, which was ſome Honourable Military Service paid only to the King; as to carry his Banner, bear his Sword, *&c.* Or *Petty-Serjeantry*, which was ſome leſs Noble Service paid to the King, or any other Lord. Some will have *Grand Serjeantry*, to be where a Man holds Lands of the King by Service, which he ought to perform in Perſon, and *Petty-Serjeantry*, to be where he holds his Lands of the King, to yield him Yearly ſome ſmall thing towards his Wants.

SERVICE-Royal, was the Rights and Prerogatives that within ſuch a Mannor belonged to the King, if Lord of it; and were generally reckoned to be theſe 6. 1. Power of Judicature in Matters of Property. 2. Power of Life and Death in Criminal Cauſes. 3. A Right in Wayfs and Strays. 4. Aſſeſſments. 5. Minting of Money, 6. Aſſize of Bread, Beer, Weights and Meaſures.

SERVICE, (which is ſometimes called *Servage*) is divided into Perſonal and Real, and into Military and Baſe; as alſo into *Intrinſick* and *Extrinſick*. Intrinſick Service they reckon due to the Capital Lord of the Mannor. Service is again divided into *Frank* and *Baſe*, the one is termed *Liberum Servitium*, the other *Villenagium*. 'Tis alſo divided into *Continual* or *Annual*, and into *Caſual* or *Accidental*; the former being the *Seiſin* of Rent, and the latter Seiſin of Reliefe.

SERVICE, in a Legal Senſe, is a right by which one thing is ſubject to another thing or Perſon. And of theſe ſome are,

SERVICES *Predial* or *Real*, which are *Rights that one Eſtate ſometimes owes another*: And theſe *Predial* Services, they reckon to be ſome *Ruſtical* or *Rural*, ſuch as the Right of Riding or Walking, or going with a Carriage thro' another Man's Ground;

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Ground; the Right of drawing Water, or bringing it thro' his Ground, *&c.* And ſome Services are called *Urbanæ*, which are the Rights that are preferred to Mens Houſes, built contiguous to one another, *&c.*

SERVICES *perſonal*, are thoſe *Services which are due from a Thing to a Perſon*; and of theſe they account 3 by name, *viz. Uſufruct*, *Uſe* and *Habitation*; but there are very many and various ones which have no diſtinct Names.

SERVITIUM *Regale*, Royal Service, are the Rights and Prerogatives that within ſuch a Mannor belong to the King as Lord of it; and theſe are generally reckon'd 6. As, 1. Power of Judicature in Matters of Property. 2. Power of Life and Death in Caſes of Felony and Murder. 3. A Right in Waifs and Strays. 4. Aſſeſſments. 5. Minting of Mony. And 6. Aſſize of Bread and Beer, Weights and Meaſures.

All theſe entire Privileges were annexed to ſome Mannors, in their Grants from the King, and were ſometimes conveyed in the Charters of Donation to Religious Houſes.

SERVITORS *of Bills*, are ſuch Servants or Meſſengers of the Marſhal of the *King's-bench*, as were ſent abroad with Bills or Writs, to Summon Men to that Court. They are now commonly called *Tip-ſtaves*.

SESAMOIDÆA *Oſſa*, the Uſe of theſe Bones, which are placed at the Articulations of the Bones of the Fingers and Toes, is that they may ſerve as ſo many Pullies about which the Tendons paſs, at ſome diſtance from the Centre of the Articulation, whereby the Directions of the Motions of theſe Tendons are kept always at the ſame diſtance from the Centre of Motion of the Articulation.

SEWERS, are Paſſages, Canals, or Gutters to carry Water into the Sea or ſome River. And therefore the Commiſſioners of the *Sewers* are ſuch Perſons, as by Authority under the Great Seal of *England*, do ſee Ditches and Drains in Marſhes and Fenny-places, well kept and maintained for the better preſerving the Graſs upon the Land for feeding of Cattle, *&c.* by conveying the Water off the Ground into the Sea or River.

SEXTANT. *The Deſcription of a New* Sextant, *lately made for the Obſervatory in* Trinity-*College*, Cambridge, *by Mr.* John Rowley.

*a a a* Iron Bars ſet edge and flat-ways, compoſing and framing the Body of the *Sextant*, whoſe Radius is five Foot.

*b b* Are two Telleſcopes, the one fixt on the right Edge of the *Sextant*, from which the Diviſions on the Limb are numbred, and the other moveable with the Index.

*c c* Two large Braſs Semi-circles on the Back-ſide of the *Sextant*, which by Nuts and Screws can bring the Inſtrument into any Poſition in any Plane, *Horizontal*, *Vertical*, or *Reclining*.

*d d* The Place of the Croſs-Hairs within the Telleſcope, which are made to be moved (from the Out-ſide) for the better adjuſting them to the Inſtrument.

*e* The Revolution-Work, which proves the Index gradually (by the help of a Screw) and ſenſibly ſhews its Progreſs, to the thouſandth Part of an Inch.

*f* The Centre of the Inſtument, from which a Plumb-Line falling on the Line (*i*) at the lower End of the Right Edge of the *Sextant*, takes Diſtances from the Zenith.

*g* Is another Centre, from which a Plum Line falling on the Line (*h*) takes Altitudes from the Horizon.

*k* Is the Braſs Limb of the Inſtrument, being Diagonally divided into every 5 Minutes, and by proportional Parts on the Index, ſhews every 10 Seconds.

*l* Is a *Lignum-Vitæ* Axis, upon which the *Sextant* turns; and is made ſo, as to be plac'd either parallel to the Axis of the Equator, or of the Horizon.

*m m* Is a Contrivance by the Motion of Wheels, Nuts and Screws, ſo as to make the whole *Sextant* move anſwerably to the apparent Diurnal Motion of the Heavens.

*n n n* Three ſtrong Iron Feet, fix'd to an Iron Collar, to hold the aforeſaid Axis (*l.*)

*o o o* Are Three Pieces of Timber, to which the Iron Feet are ſcrew'd, and which ſerve to compleat the Pedeſtal of the Inſtrument.

*p* An Arch of Iron, which ſhifts the Axis (*l*) to its Paralleliſm with either the Axis of the Equator or Horizon.

*The Limb of this Noble Inſtrument is very accurately divided, Diagonally, and by the way of unequal Diviſions, uſed by* Hevelius; *ſo that the Angle may be taken either of thoſe ways, as well as be found by the Revolution-Work.*

SEXTAR of Wheat or other Corn (from *Sextarius*) was that quantity anciently which we now call a *Quarter*, containing a Buſhel. In ſome Countries 'tis called a *Seame*.

SHAFT, is the hollow Entrance into a Mine which is *ſunk* or *dug* to come at the Ore. In the Tin Mines, after this is ſunk about a Fathom, they leave a little long ſquare Place, which is called a *Shamble*.

SHAMBLE, ſee *Shaft*.

SHELF, is what the *Miners* (eſpecially in the Tin-Mines) call the *Faſt-Countrey*, by which they mean an Imaginary Surface of the Earth, which at the Concuſſion of the Waters in the general Deluge of *Noah*, was never moved; and to the *Shelf*, they think all the *Loads* or *Mineral Veins* at firſt lay even and parallel; tho' after the Flood they were ſome elevated, ſome depreſſed, *&c.* And by *Shelf* now they mean that hard Surface or Coat of the Earth which lies under the *Mold*, uſually about a Foot deep; for they ſuppoſe, that ſince the Flood the Earth hath gotten a new Coat of Vegetable Earth, or ſuch as is made by the Corruption of Vegetables and Animals.

SHERIVE or *Sheriff*, *Vice-Comes*, is the Chief Officer of the King in any Shire or County, formerly the Sheriff was choſen by the People in the County-Court by Vote, as the Knights of the Shire for Parliament now are; but now the Sheriff is nominated by the King. *Camden* in his

*Britannia*, deſcribes this Office, and the Antiquity and Authority of this Officer. See *Co. Rep. lib.* 4. And *Spelman*'s Gloſſary under the word *Vice-Comes*. His Oath is extant in *Reg. Orig. fol.* 331.

SHERIFF-TOOTH, ſeems anciently to have been a Tenure by the Service or Duty of providing Entertainment for the Sheriff at his County-Turns or Courts. For it appears by *Ryley*'s *Placita Parliament. fol.* 653. that in *Derbyſhire* the King's Bayliffs did formerly take 6 Pence of every *Bovate* of Land, in Name of *Sheriff-tooth*.

SHILLING, *Solidus* in the *Latin* is a word of very uncertain Signification, and differs almoſt in every Nation. But the word *Scylling* or *Shilling* in *England*, never ſignified any thing but 5*d.* with the *Saxons*, and 12*d.* ever ſince. When it firſt went for 12*d.* 'tis hard to find: But there was no 12 Penny Piece of that name Coined in *England* till 1504. and then *Stow* calls them *Groats*: tho' *Fabian* mentions them under the name of *Shillings*. In 34 *H.* 8. there were 12 Penny Pieces ſtruck, but they were called *Teſtons*.

SHINGLING *Tongs*, are uſed in the *Finery* of an Iron-forge, to take out the *Loop*, in order to bring it under the Hammer into a *Bloom*.

SHIP. The Deſcription of the ſeveral Parts and Rigging of a Firſt Rate *Ship*, lying at Anchor.

*H* Her Hull.

A *The Cut-water.*
B *The Stem.*
C *The Hawſe Holes.*
D *The Cat-Head.*
E *Waſte Cloaths.*
F *The Fore Chain-wale.*
G *The Main Chain-wale.*
H *The Mizzen Chain-wale.*
I *The Cheſs Tree.*
K *The Entring Port.*
L *The Head.*
M *The Gallery.*
N *The Tafferel.*
O O O *The Three Poop Lanterns.*
P *The Enſign Staff.*
Q *Its Truck.*
R *The Enſign or Antient.*

*Z* The Mizzen Maſt and Rigging.

1 *The Mizzen Maſt.*
2 *The Mizzen Yard and Sail.*
3 *The Mizzen Sheet.*
4 *The Mizzen Shrowds and Laniards.*
5 *The Mizzen Bow-lines.*
6 *The Mizzen Brayles.*
7 *The Geer.*
8 *The Mizzen Peek Halliards.*
9 *The Croſs Jack-Yard.*
10 *The Lifts.*
11 *The Braces.*
12 *The Mizzen Puttock Shrowds.*
13 *The Mizzen Top.*
14 *The Mizzen Top Armour.*
15 *The Cap.*
16 *Crow-feet.*
17 *The Mizzen Stay and Sail.*
18 *The Halliards.*

Mizzen Top-Maſt and Rigging.

19 *Mizzen Top-Maſt.*
20 *Its Sails furl'd.*
21 *Its Braces.*
22 *Its Lifts.*
23 *Its Shrouds.*
24 *Its Halliards.*
25 *Its Back-Stay.*
26 *Its Bow-lines.*
27 *Its Sheet.*
28 *The Clew-lines.*
29 *The Stay.*
30 *The Croſs-Trees.*
31 *The Cap.*
32 *The Stump.*
33 *Its Stay.*
34 *Its Truck.*
35 *The Spindle.*
36 *The Vane.*
37 *The Slings of the Croſs Jack-Yard.*

*M* The Main Maſt and its Rigging.

38 *The Main Maſt.*
39 *Runners and Tackles.*
40 *Tackle.*
41 *The Main Shrouds and Laniards.*
42 *The Main Stay and Sail.*
43 *The Stay-Sail Halliards.*
44 *The Main Yard and Sail.*
45 *The Geers.*
46 *The Main Sheets.*
47 *The Main Tacks.*
48 48 *The Bunt-lines.*
49 49 *The Main Bow-lines.*
50 *The Main Braces.*
51 51 *The Leech-lines.*
52 *The Main Puttock Shrouds.*
53 *The Crow-foot.*
54 54 *The Main Lifts.*
55 *The Main Top.*
56 *The Top Armour.*
57 *The Top Rope.*
58 *The Main Cap.*
59 *The Main Yard Tackles.*

Main Top-Maſt and Rigging.

60 *The Main Top-maſt.*
61 61 *Tackles.*
62 *The Main Top-maſt Shrouds.*
63 *The Back Stays.*
64 *The Main Top-ſail Halliards.*
65 *The Main Top-ſail Stay and Sail.*
66 *The Main Top-Stay-ſail Halliards.*
67 *The Main Top-ſail Yard and Sail.*
68 *The Main Top-ſail Braces.*
69 *The Main Top-ſail Bow-lines.*
70 *The Main Top-ſail Sheets.*
71 71 *The Main Top-ſail Clew-lines.*
72 72 *The Main Top-ſail Lifts.*
73 *The Runner.*
74 *The Bunt-lines.*
75 *The Croſs Tree.*
76 *The Cap.*
77 *The Stump.*

78 *The*

*Place this, and the other Plate of y^e Section of a Ship at the word* Ship.

78 *The Stay.*
79 *The Truck.*
80 *The Pendant.*

*F* The Fore-Maſt and Rigging.

81 *The Fore-Maſt.*
82 82 *Its Runner and Tackles.*
83 *The Tackle.*
84 *The Fore Shrouds and Laniards.*
85 *The Fore Stay.*
86 *The Fore-Maſt Yard and Sail.*
87 87 *The Fore-Sheets.*
88 88 *The Fore-Tacks.*
89 89 *The Fore-Braces.*
90 90 *The Fore-Bow-lines.*
91 91 *The Bunt-lines.*
92 92 *The Leech-lines.*
93 *The Fore-Yard Tackle.*
94 *The Fore-Geers.*
95 *The Puttock Shrouds.*
96 *The Crow-foot.*
97 *The Fore-Top.*
98 *Its Top Armour.*
99 *The Top Rope.*
100 100 *The Lifts.*
101 *The Cap.*
102 *The Fore-Top-maſt.*
103 *The Tackles.*
104 *The Fore-Top-maſt Shrouds.*
105 *The Back-Stays.*
106 *The Fore Top-ſail Halliards.*
107 *Stay and Sail.*
108 *The Halliards.*
109 *The Fore-Top maſt Yard and Sail.*
110 *The Runner.*
111 111 *The Fore-Top-ſail Lifts.*
112 112 *The Fore-Top-ſail Braces.*
113 *The Fore-Top-ſail Bow-lines.*
114 114 *The Fore-Top-ſail Sheets.*
115 *The Fore-Top-ſail Clew-lines.*
116 *The Fore-Top-ſail Bunt-lines.*
117 *The Croſs Trees.*
118 *The Cap.*
119 *The Stump.*
120 *The Stay.*
121 *The Truck.*
122 *The Spindle.*
123 *The Vane.*

*B* Bow-ſprit and Rigging.

124 *Bow-ſprit.*
125 *The Horſe.*
126 *The Sprit-Yard and Sail.*
127 *The Sprit-ſail Lifts.*
128 128 *The Sprit-ſail Sheets.*
129 129 *Its Clew-lines.*
130 130 *The Sprit-ſail Braces.*
131 *The Bob-Stay.*
132 *The Top.*
133 *The Top Armour.*
134 *The Sprit-ſail Top-maſt.*
135 *The Sprit-ſail Shrouds.*
136 *The Sprit-ſail Halliards.*
137 *The Crane-line.*
138 *The Sprit Top-ſail Yard and Sail.*
139 *The Sprit-ſail Top-ſail Braces.*
140 140 *Its Lifts.*
141 141 *Its Sheets.*

142 *The Croſs-Trees.*
143 *The Cap.*
144 *The Jack-Staff.*
145 *The Truck.*
146 *The Jack.*
147 *The Buoy of the Beſt Bower Anchor.*
148 *The Cable of the Beſt Bower Anchor.*
149 *The ſmall Bower Buoy.*

SHOALD, is the Miners Term in the Tin Mines, for ſuch Fragments of Ore, which by Rains, Currents of Water, *&c.* are torn off from the *Load* or Veins of Ore. Theſe are waſht down from the Mountains, and by finding of them, they gueſs where to look for a *Load* of Ore. Sometimes 'tis called *Squod*, ſometimes *Squad.*

SHORT *Sails*, in a Man of War, are the ſame with the Fighting-ſails, and are the Fore-ſail, Main-ſail, and Fore-top-ſail: Theſe are all that are uſed in a Fight, leſt the reſt ſhould be fired or ſpoiled: And beſides they would be troubleſome to handle, and would hinder the fight and uſe of Arms. When a Ship gives Chaſe to another, if the Chaſe hath a mind to fight, they ſay, the Chaſe *ſtrips* her ſelf into her *ſhort* or *Fighting-Sails*; that is, puts out her Colours in the Poop, her Flag at the Main-top, and her Streamers or Pendants at her Yard-arms; Furls her Sprit-ſail, Peeks her Mizen, and Slings her Main-yard, and when the Chaſer ſees this, he is to prepare for an Engagement.

SIGNALS, are Signs made at Sea by the Admiral or Commander in Chief of any Squadron of Ships, either in the Day or by Night, either for Sailing or Fighting, or for the better Security of the Merchants Ships that are under the Convoy of His Majeſties Men of War. Theſe Signals are appointed and determined by Order of the Lord High Admiral, and are a follows:

SIGNALS by Day, when Ships are at an Anchor, in weighing Anchor, Sailing, *&c.* When the Admiral or Commander in Chief would have the Fleet *prepare for Sailing*, he firſt looſes his *Fore-Top-ſail*, and then the whole Fleet are to do the ſame.

2. When he would have them *Unmoor*, he looſes his *Main-top-ſail*, and fires a Gun; which in the Royal Navy is to be anſwered by every Flagg Ship.

3. When he would have them *Weigh*, he looſes his *Fore-top-ſail*, and fires a Gun, and ſometimes hawls home his Sheets; the Gun is to be anſwered by every Flag Ship, and every Ship to get to Sail as ſoon as it can. If with the Leeward ſide, the Stern-moſt Ship is to weigh firſt.

4. When the Admiral or Commander in Chief would have the Weather-moſt and Head-moſt Ships to *Tack* firſt, he hoiſts the Union-flag at the *Fore-top-maſt-head*, and fires a Gun, which each Flag Ship muſt anſwer.

But if he would have the Sternmoſt and Leeward-moſt Ships to *Tack* firſt, he hoiſts the Union Flag at the Mizen-top-maſt-head, and fires a Gun. And when he would have all the whole Fleet *Tack*, he hoiſts an Union, both on the Fore and Mizen-top-maſt-head, and fires a Gun.

5. When in bad Weather, he would have them *Wear* and *bring to the other Tack*, he hoiſts a Pen-

dant on the Enſign-ſtaff, and fires a Gun: And then the Leeward-moſt and Stern-moſt Ships are to *Wear* firſt, and bring on the other Tack and lie by, or go on with an eaſie Sail till he comes a Head. Every Flag is to anſwer with the ſame Signal.

6. If they are lying by, or Sailing by a Wind, and the Admiral would have them *bear up* and Sail before the Wind, he hoiſts his Enſign, and fires a Gun, which the Flags are to anſwer. And then the Leeward-moſt Ships are to bear up firſt, and to give room for the Weather-moſt to *Wear*, and Sail before the Wind with an eaſie Sail, till the Admiral come a Head.

But if it ſhould happen when the Admiral hath occaſion to *Wear* and Sail before the Wind, that both Jack and Enſign be abroad, he will hawl down the Jack before he fires the Gun to wear, and keep it down till the Fleet is before the Wind.

7. When they are Sailing before the Wind, and he would have them *bring to* with the Starboard Tacks Aboard, he hoiſts *a Red* Flag at the Flag-ſtaff, on the Mizen-top-maſt-head, and Fires a Gun; but if they are to bring too with the Larboard-tack, he hoiſts a *Blue* Flag at the ſame Place, and Fires a Gun. Every Ship to anſwer the Gun.

8. When any Ship diſcovers Land, he is to hoiſt his Jack and Enſign, and keep it aboard till the Admiral or Commander in Chief Anſwer him by hoiſting his; on ſight of which he is to hawl down his Enſign.

9. If any diſcovers Danger, he is to Tack, or bear up from it; and to aw Jack abroad from the Main-top-maſt Croſs-trees downward upon the Back-ſtay, and Fire two Guns: But if he ſhould ſtrike or ſtick faſt, then beſides the ſame Signal with his Jack, he is to keep Firing till he ſees all the Fleet obſerve him, and endeavour to avoid the Danger.

10. When any ſees a Ship or Ships more than the Fleet, he is to put abroad his Enſign, and there keep it, till the Admiral's or Commander's is out, and then to lower it as often as he ſees Ships, and to ſtand in with them, that ſo the Admiral may know which way they are, and how many: But if he be at ſuch a diſtance that the Enſign can't well be diſcovered, he is then to lay his Head towards the Ship or Ships ſo deſcryed, and to *brail* up his low Sails, and continue hoiſting and lowering his Top-ſails, and making a Weſt with his Top-gallant-ſails, till he is perceived by the Admiral.

11. When the Admiral would have the Vice-Admiral, or he that Commands in the ſecond Poſt of the Fleet, to ſend out Ships to Chaſe, he hoiſts a Flag, Striped White and Red, on the Flag-ſtaff, at the Fore-top-maſt-head, and fires a Gun. But if he would have the Rear-Admiral do ſo, he then hoiſts the ſame Signal on the Flag-ſtaff at the Mizen-top-maſt-head, and fires a Gun.

12. When the Admiral would have any Ship to chaſe *to Windward*, he makes a Signal for ſpeaking with the Captain, and hoiſts a *Red Flag* in the Mizen-ſhrouds, and fires a Gun.

But if to chaſe *to Leeward*, a *Blue* Flag; and the ſame Signal is made by the Flag in whoſe Diviſion that Ship is. When he would have them give over Chaſe, he hoiſts a White Flag on his Flag-ſtaff at the Fore-top-maſt-head, and fires a Gun: Which Signal is to be made alſo by that Flag Ship, which is neareſt the Ship that gives Chaſe, till the Chaſing Ship ſees the Signal.

13. In Caſe of Springing a Leak, or any other Diſaſter that diſables their Ship from keeping Company, you are to hale up your Courſes, and fire two Guns.

14. When any Ship would ſpeak with the Admiral, he muſt ſpread an *Engliſh* Enſign from the Head of his *Main* or Fore-top-maſt downwards on the Shrouds, lowering his Main or Fore-top-ſail, and firing Guns till the Admiral obſerve him: And if any Ship perceives this, and judges that the Admiral doth not, that Ship muſt make the ſame Signal, and make the beſt of his way to acquaint the Admiral therewith, who will anſwer by firing one Gun.

15. When the Admiral would have the Fleet to prepare to Anchor, he hoiſts an Enſign ſtriped Red, Blue and White on the Enſign-ſtaff, and fires a Gun; and every Flag-Ship makes the ſame Signal.

16. If he would have the Fleet *Moor*, he hoiſts his Mizen-top-ſail with the Clew-lines haled up, and fires a Gun.

17. If he would have the Fleet Cut or Slip, he looſes both his Top-ſails, and fires two Guns; and then the Leeward Ships are to cut or ſlip firſt, to give room to the Weather-moſt to come to Sail.

So if he would have any particular Ship to cut or ſlip, and to *Chaſe to Windward*, he makes the Signal for ſpeaking with that Ship, hoiſts a *Red* Flag in the Mizen-ſhrouds, and fires a Gun: But if the Ship is to Chaſe to *Leeward*, he hoiſts a *Blue* Flag, as before.

18. If he would have the Fleet Exerciſe their *Small Arms*, he hoiſts a *Red Flag* on the Enſign-Staff, and fires a Gun; but if the *great* Guns, then he puts up a Pendant over the Red Flag.

SIGNALS *by Night*, to be obſerved at an Anchor, in Weighing, Anchoring and Sailing.

1. When the Admiral would have the Fleet to *Unmoor* and *Ride ſhort*, he hangs out 3 Lights one over another in the Main-top-maſt-ſhrouds, over the conſtant Light in the Main-top, and fires two Guns, which are to be anſwered by the Flag-Ships; and each private Ship hangs out a Light in the Mizen-ſhrouds.

*N. B.* All Guns fir'd for Signals in the Night muſt be fir'd on the ſame ſide, that they may make no alteration in the Sound.

2. When he would have them *Weigh*, he hangs a Light in the Main-top-maſt-ſhrouds, and fires a Gun, which is to be anſwered by all the Flags; and every private Ship muſt hang out a Light in his Mizen-ſhroud.

3. When he would have them *Tack*, he hoiſts 2 Lights on the Enſign-ſtaff, one over another, above the conſtant Light in his Poop, and fires a Gun; which is to be anſwered by all the Flags: And every private Ship is to hang out a Light extraordinary, which is not to be taken in till the Admiral takes in his.

After the Signal is made, the Leeward-moſt and Stern-moſt Ships muſt Tack as faſt as they can; and the Stern-moſt Flag-Ship, after he is about upon the other

other Tack, is to lead the Fleet, and him they are to follow, to avoid running thro' one another in the dark.

4. When he is *upon a Wind*, and would have the Fleet *Wear* and *bring to* on the other Tack, he hoists up one Light at the Mizen-peek, and fires 3 Guns: which is to be answered by the Flag-Ships, and every private Ship must answer with one Light at the Mizen-peek. The Stern-most and Leeward-most Ships are to bear up so soon as the Signal is made.

5. When he would have them in blowing Weather to *lie a try*, *short*, or a *Hull*, or with the *Head-sails braced to the Mast*, he will shew 4 Lights of equal height, and fire 5 Guns; which are to be answered by the Flag-Ships, and then every private Ship must shew 4 Lights. And after this, if he would have them to make Sail, he then fires 10 Guns; which are to be answered by all the Flags, and then the Head-most and Weather-most Ships are to make Sail first

6. When the Fleet is Sailing *large*, or before the Wind, and the Admiral would have them bring too, and lie by with their *Star-board* Tacks Aboard, he puts out 4 Lights in the Fore-shrouds: and fires 6 Guns; but if with the *Lar-board* Tacks Aboard, he fires 8 Guns, which are to be answered by the Flag-Ships, and every private Ship must shew 4 Lights. The Wind-most Ships must bring too first.

7. Whenever the Admiral alters his Course, he fires 1 Gun (without altering his Lights) which is to be answered by all the Flag-ships.

8. If any Ship hath occasion to *lie short*, or *by*, after the Fleet has made Sail, he is to fire 1 Gun, and shew 3 Lights in his Mizen-shrouds.

9. When any one first discovers Land or Danger, he is to shew as many Lights as he can, to fire 1 Gun, and to Tack, or bear away from it. And if any one happen to spring a Leak, or any be disabled from keeping company with the Fleet, he hangs out 2 Lights of equal height, and fires Guns till he is relieved by some Ship of the Fleet.

10. If any one discovers a Fleet, he is to fire Guns, make false Fires, put one Light out on the Main-top, 3 on the Poop, to Steer after them, and to continue firing Guns, unless the Admiral call him off, by Steering another Course, and fire 2 or 3 Guns, for then he must follow the Admiral.

11. When the Admiral Anchors he fires 2 Guns, a small space of Time one from the other, which are to be answered by the Flag-ships; and every private Ship must shew 2 Lights.

12. When the Admiral would have the Fleet to *Moor*, he puts a Light on each Top-mast-head, and fires a Gun; which is to be answered by the Flag-ships, and every private Ship is to shew one Light.

13. If he would have them *lower* their Yards and Top-masts, he hoists one Light upon his Ensign-staff, and fires one Gun; which is to be answered by the Flag-ships, and every private Ship must shew 1 Light. And when he would have them *Hoist* their Yards and Top-mast, he puts out 2 Lights, one under the other, in the Mizen-top-mast-shrouds, and fires a Gun; which is to be answered by the Flag-ships, and each private Ship must shew 1 Light in the Mizen-shrouds.

14. If any strange Ship be discovered coming into the Fleet, the next Ship is to endeavour to speak with her, and bring her to an Anchor, and not suffer her to pass thro' the Fleet. And if any one discovers a Fleet, and it blow so hard that he cannot come to give the Admiral notice timely, he is to hang out a great number of Lights, and to continue firing Gun after Gun, till the Admiral answers him with one.

15. When the Admiral would have the Fleet to Cut or Slip, he hangs out 4 Lights, one at each Main-yard-arm, and at each Fore-yard-arm, and fires 2 Guns; which are to be answered by the Flag-ships, and every private Ship is to shew one Light.

SIGNALS used when a Fleet Sails in a Fog.

1. If the Admiral would have them weigh, he fires 10 Guns, which every Flag-ship is to answer.

2. To make them *Tack*, he fires 4 Guns; which are to be answered by the Flag-ships, and then the Leeward-most Ships, and Stern-most Ships must Tack first. And after they are about, to go with the same Sail they tack'd with, and not to lie by, expecting the Admiral to come a Head: And this is to avoid the Danger of running thro' one another in thick Weather.

3. When the Admital *brings to*, and lies with his Head-sails to the Mast; if with the Star-board Tack Aboard, he fires 6 Guns; but if with the Lar-board Tack Aboard, 8 Guns, which the Flag-Ships are to answer. And after this, if he makes Sail, he fires 10 Guns, which the Flag-ships must answer; and then the Head-most and Weather-most Ships are to make Sail first.

4. If it grow thick and foggy Weather, the Admiral will continue Sailing with the same Sail set that he had before it grew foggy, and will fire a Gun every hour; which the Flag-ships must answer, and the private Ships must answer by firing of Muskets, beating of Drums, and ringing of Bells.

But if he be forced to make either more or less Sail than he had when the Fog begun, he will fire a Gun every half hour, that the Fleet may discern whether they come up with the Admiral, or fall a Stern of him; and the Flags and private Ships are to answer, as before.

5. If any one disovers Danger which he can avoid by Tacking and standing from it; he is to make the Signal for tacking in a Fog; but if he should chance to *strike* and stick fast, he is to fire Gun after Gun, till he thinks the rest have avoided the Danger.

6. When the Admiral would have the Fleet to Anchor, he fires 2 Guns, which the Flags are to answer; and after he hath been half an hour at an Anchor, he will fire 2 Guns more, to be answered by the Flags, as before, that all the Fleet may know it.

SIGNALS for calling Officers on Board the Admiral.

1. When the Admiral puts abroad a Union-Flag in the Mizen-shrouds, and fires a Gun, all the *Captains* are to come Aboard him: And if with the same Signal there be also a *Weft* made with the Ensign, then the *Lieutenant* of each Ship is to come on Board.

2. If

2. If an Enſign be put Aboard in the ſame Place, all the Maſters of the Ships of War are to come on Board the Admiral.

3 If a Standard on the Flag-ſtaff be hoiſted at the Mizen-top-maſt-head, and a Gun fired, then all the *Flag-Officers* are to come Aboard the Admiral. If the *Engliſh* Flags only, then a Standard in the Mizen-ſhrouds, and fire a Gun: If the Flags and Land General Officers, then the Admiral puts Aboard a Standard at Mizen-top-maſt-head, and a Pendant at Mizen-peek, and fires a Gun.

4. If a *Red Flag* be hoiſted in the Mizen-ſhrouds, and a Gun fir'd, then the Captains of his own Squadron are to come on Board the Admiral; and if with the ſame Signal there be alſo a Weſt with the Enſign, a *Lieutenant* of each Ship muſt go on Board.

5. If he hoiſts a *White* Flag as before, then the Vice-Admiral, or he that Commands in the ſecond Poſt, and all the Captains of his Squadron are to go on Board the Admiral. If a *Blue-Flag*, &c. then the *Rear-Admiral*, and the Captains of his Squadron muſt come on Board; and if there be a Weſt as before, the *Lieutenants*.

6. When a Standard is hoiſted on the Enſign-ſtaff, and a Gun fired, the Vice and Rear-Admirals muſt both come on Board the Admiral's Ship.

7. When the Admiral would ſpeak with Captains of his own Diviſion, he will hoiſt a Pendant in the Mizen-peek, and fire a Gun; and if with the Lieutenants, a Weſt is made with the Enſign, and the ſame Signal. For whenever he would ſpeak with Lieutenants of any particular Ship, he makes the Signal for the Captain, and makes a *Weſt* alſo with the Enſign.

8. When the Admiral would have all the *Tenders* in the Fleet come under his Stern and ſpeak with him, he hoiſts a Flag, ſtriped *Yellow* and *White*, at the Mizen-peek, and fires a Gun. But if he would ſpeak with any particular Ships Tender, he makes a Signal for ſpeaking with the Captain ſhe tends upon, and a *Weſt* with his *Jack*.

9. If all the Pinnaces and Barges are to come on Board, Manned and Armed, the Signal is a Pendant on the Flag-ſtaff, hoiſted on the Fore-top-maſt-head, and a Gun; and if he would have them Chaſe any Ship, Veſſel, or Boat in View, he hoiſts the Pendant, and fires 2 Guns.

10. The Signal for the *Long-boats* to come on Board him Mann'd and Armed, is the Pendant hoiſted on the Flag-ſtaff at the Mizen-top-maſt-head, and a Gun; and if he would have them Chaſe any Ship, Veſſel, or Boat in open View, without coming on Board him, he hoiſts the Pendant, as aforeſaid, and fires 2 Guns.

When the Admiral would have *all the Boats* in the Fleet come on Board him, Mann'd and Arm'd, he hoiſts a Pendant on the Flag-ſtaff, both on the Fore-top-maſt, and Mizen-top-maſt-head, and fires 1 Gun; but if he would have them Chaſe, he hoiſts his Pendants, as before, and fires 2 Guns.

11. When the Admiral would ſpeak with the Victualler, or his Agent, he puts an *Engliſh* Enſign in the Mizen-top-moſt-ſhrouds; and when with him that hath charge of the Gunner's Stores, he will ſpread an Enſign at his Main-top-ſail yard-arm.

SIGNALS for managing a Sea-fight.

When the Admiral would have the Fleet form a Line of Battle, one Ship a head of another, he hoiſts an Union-flag at the Mizen-peek, and fires a Gun, and every Flag-ſhip does the ſame.

But when they are to form a Line of Battle, one a breaſt of another, he hoiſts a *Pendant* with the Union-flag, *&c.*

2. When he would have the Admiral of the White, or he that Commands in the Second Poſt, and his whole Squadron, to Tack, and endeavour to gain the Wind of the Enemy, he ſpreads a white Flag under the Flag at the Main-top-maſt-head, and fires a Gun; and when he would have the Vice-Admiral of the Blue do ſo, he doth the ſame with a blue Flag.

3. If he would have the Vice-Admiral of the Red do ſo, he ſpreads a Red Flag from the Cap on the Fore-top-maſt-head, downward on the Back-ſtay: If the Vice-Admiral of the Blue is to do ſo, he ſpreads a blue Flag, *&c.* and fires a Gun. If he would have the Rear-Admiral of the Red do ſo, he hoiſts a Red Flag at the Flag-ſtaff at the Mizen-top-maſt-head; if the Rear-Admiral of the White, a white Flag; if the Rear-Admiral of the Blue, a blue Flag, and under it a Pendant of the ſame Colour, with a Gun.

4. If he be to Leeward of the Fleet, or any part of it, and he would have them to bear down into his Wake or Grain, he hoiſts a blue Flag at the Mizen-peek, and fires a Gun.

5. If he would be to Leeward of the Enemy, and his Fleet, or any part of it, be to Leeward of him; in order to bring theſe Ships into the Line, he bears down with a blue Flag at the Mizen-peek, under the Union-flag (which is the Signal for Battle) and fires a Gun; and then thoſe Ships which are to Leeward of him, muſt endeavour to get into his Wake or Grain, according to their Station in the Line of Battle.

6. When the Fleet is Sailing before the Wind, and he would have him that Commands in the ſecond Poſt, and the Ships of the Star-board Quarter to clap by the Wind, and come to the Star-board Tack, he hoiſts a *Red* Flag on the Mizen-top-maſt-head; but a *Blue* one, if he would have Ships of the Lar-board Quarter come to the Lar-board-tack, with a Gun.

7. If the Van are to Tack firſt, he ſpreads the Union-flag at the Flag-ſtaff on the Fore-top-maſt-head, and fires a Gun, if the Red Flag be not abroad; but if it be, then he lowers the Fore-top-ſails a little, and the Union-flag is ſpread from the Cap of the Fore-top-maſt downwards; and every Flag-ſhip doth the ſame.

8. If the Rear be to Tack firſt, he hoiſts the Union-flag on the Flag-ſtaff at the Mizen-top-maſt-head, and fires a Gun, which all the Flag-ſhips are to anſwer.

9. If all the Flag-ſhips are to come into his Wake or Grain, he hoiſts a Red Flag at his Mizen-peek, and fires a Gun, and all the Flag-ſhips muſt do the ſame.

10. If he would have him that Commands in the ſecond Poſt of his Squadron to make more Sail (tho' he himſelf ſhorten Sail) he hoiſts a white Flag on the Enſign-ſtaff: But if he that Commands in the third Poſt be to do ſo, he hoiſts a Blue

a Blue Flag at the ſame places, and fires a Gun, and all the Flag-ſhips muſt make the ſame Signal.

11. When ever he hoiſts a Red Flag on the Flag-ſtaff at the Fore-top-maſt-head, and fires a Gun, every Ship in the Fleet muſt uſe their utmoſt endeavour to engage the Enemy, in the Order preſcribed them.

12. When he hoiſts a white Flag at his Mizen-peek, and fires a Gun, then all the ſmall Frigats of his Squadron that are not of the Line of Battle, are to come under the Stern.

13. If the Fleet be Sailing by a Wind in the Line of Battle, and the Admiral would have them brace their Head-ſails to the Maſt, he hoiſts up a yellow Flag on the Flag-ſtaff, at the Mizen-top-maſt-head, and fires a Gun, which the Flag-ſhips are to anſwer, and then the Ships in the Rear muſt brace firſt.

14. After this, if he would have them fall their Head-ſails and ſtand on, he hoiſts a yellow Flag on the Flag-ſtaff at the Fore-top-maſt-head, and fires a Gun; which the Flag-ſhips muſt anſwer, and then the Ships in the Van muſt fall firſt, and ſtand on. If when this Signal is made, the Red Flag at the Fore-top-maſt-head be abroad, he ſpreads the Yellow Flag under the Red.

15. If the Fleets being near one another, the Admiral would have all our Ships to Tack together, the ſooner to lie in a poſture of Engaging the Enemy, he hoiſts a Union-flag on the Flag-ſtaves at the Fore and Mizen-top-maſt-heads, and fires a Gun, and all the Flag-ſhips in the Fleet are to do the ſame.

16. The Fleet being in a Line of Battle, if he would have the Ship that leads the Van, hoiſt, lower, ſet, or hawl up any of his Sails, the Admiral ſpreads a Yellow Flag under that at his Main-top-maſt-head, and fires a Gun; which Signal the Flag-ſhips are to anſwer, and then the Admiral will hoiſt, lower, ſet, or hawl up the Sail, which he would have the Ship that leads the Van do; which is to be anſwered by the Flag-ſhips of the Fleet.

17. When the Enemy runs, and he would have the whole Fleet follow them, he makes all the Sail he can after them himſelf, takes down the Signal for the Line of Battle, and fires 2 Guns out of his Fore-chaſe, which the Flag-ſhips anſwer, and then every Ship is to endeavour to come up with, and Board the Enemy.

18. When he would have the Chaſe given over, he hoiſts a white Flag at the Fore-top-maſt-head, and fires a Gun.

19. If he would have the Red Squadron draw into a Line of Battle, *one a breaſt* of another, he puts abroad a Flag, ſtriped Red and White on the Flag-ſtaff, at the Main-top-maſt-head, with a Pendant under it, and fires a Gun: If the white or ſecond Squadron are to do ſo, the Flag is ſtriped Red, White and Blue; if the Blue or third Squadron are to do ſo, the Flag is a *Genoueze* Enſign and Pendant. But if they are to draw into a Line of Battle, *one a Head of another*, the ſame Signals are made without a Pendant.

20. If they are to draw into a Line of Battle, *one a Stern* of another, with a large Wind, and he would have the Leaders go with the Star-board-Tacks Aboard by the Wind, he hoiſts a Red and White Flag at the Mizen-peek, and fires a Gun: But if they ſhould go with the Lar-board-tacks Aboard by the Wind, he hoiſts a *Genoueze* Flag at the ſame Place; which Signals muſt be like others, anſwered by the Flag-ſhips.

SIGNET, is one of the King's Seals, wherewith his private Letters are Sealed, and is always in the Cuſtody of the King's Secretaries; and there are 4 Clerks of the Signet Office always attending.

SILVER, of the ways of Smelting and Refining of Silver, I find theſe Accounts. 1. From Mr. *Ray*, at the end of his Catalogue of *Engliſh* Words about the Silver Mines in *Cardiganſhire* in *Wales*.

The Mine firſt beaten into ſmall Pieces, is brought from the Mine to the Smelting-houſe, and there melted with *black and white Coal*, i. e. with Charcoal and Wood ſlit into ſmall Pieces, and dried in a Kiln for that Purpoſe: And they uſe both Wood and Coal, becauſe the Coal alone makes too violent a Fire, and the Wood alone too gentle. After the Fire is made, the Mine is caſt on the Coals, and ſo again, Mine and Coals interchangeably. The Mine, when melted, runs down into the *Sump*, which is a round Pit of Stone lined with Clay within; thence 'tis laden out and caſt into ſquare Bars with ſmaller ends, fit to lift and carry them by.

Theſe Bars they bring to the Refining Furnace, which is covered with a thick Cap of Stone bound about with Iron, and moveable, that ſo they may lift it up, and make the *Teſt* at the Bottom anew, (as they do at every Refining.) In the Middle of the Cap there is a Hole, in which the Bar of Silver hangs in Iron-ſlings above the Furnace, that ſo it may be let down by degrees as it melts off. Beſides this Hole, they have another in the ſide of the Furnace, Parallel to the Horizon, and bottom'd with Iron; at which Hole they thruſt in another Bar. The *Teſt* is of an Oval figure, and fits at the bottom of the Furnace. The Fire is put in by the ſide of the Bellows, when the Furnace is come to a true Temper of Heat, the Lead converted into Litharge, is blown off by the Bellows, the Silver ſubſiding to the bottom of the Teſt.

As ſoon as all the *Glut* (as they call it) of Litharge is blown off, the Silver in the bottom of the *Cuple* or *Teſt* grows cold, and the ſame Degrees of Heat will not keep it melted, as before. The Cake of Silver after it grows cold, *ſprings or riſes up into Branches* (ſaith Mr. *Ray*, but I queſtion his Information as to this Point.) The Teſt is made of Marrow-Bones, burnt to ſmall Pieces, then powdered and made into a Paſt with Water. The Teſt is about a foot thick, laid in Iron: After the Cake of Silver is taken out, that Part of the *Teſt* which is diſcoloured, they mingle with new Ore to be melted; the reſt they pound and powder, and uſe again for another *Teſt*.

The Litharge is brought to a Reducing Furnace, and there with Charcoal only melted into Lead. The Litharge is caſt upon the Charcoal in the *Bing* of the Furnace; and as the Charcoal burns away, and the *Litharge* melts, more Charcoal is thrown on, and *Litharge* put upon it, as at firſt Smelting.

Another Furnace they have, which they call an *Almond Furnace*, in which they melt the *Slugs* (or Refuſe of the Litharge) not ſtamped or pounded with Charcoal only.

The

The Slugs or Cynders of the firſt Smelting, they beat ſmall with great *Stamps*, lifted up by a Wheel moved by Water, and falling down by their own Weight. Firſt they are ſtamped with dry Stamps, then ſifted with an Iron-ſieve in Water. That which lies at the bottom of the Sieve is returned to the Smelting-furnace, without more ado; that which ſwims over the Sieve is beaten with wet Stamps.

What hath paſs'd thro' the Sieve, and alſo what after being beaten with the wet Stamps, paſſes thro' a fine Grate, or Strainer of Iron, goeth to the *Buddle*; which is a Veſſel made like a ſhallow Tumbrel, and ſtands a little ſhelving.

On this the Matter is laid, and Water runs conſtantly over it, the Matter being moved to and fro with an Iron-rake; by which means the Earth and Droſs being carried off by the Water, the Metal remains behind.

That which is thus *Buddled*, they *lue* with a thick Hair-ſieve, cloſe wrought in a Tub of Water, rolling the Sieve about, and inclining it this way and that with their Hands: The light Part which ſwims at top of the Sieve, or rather over it, is returned again to the Buddle; and that which ſubſides goes to the Furnace to be Smelted again.

They have alſo an *Aſſay Furnace*, wherewith they try the Value of the Metal, of what Proportion the Lead bears to the Silver; which they do by cutting off a Piece from every Bar, and melting it in a ſmall Cupel: Firſt they weigh the Piece cut off, and then after the Lead is ſeparated, the Silver. A Tun of Metal ſometimes will yield 10, 15, and if rich, 20 Pound Weight of Silver.

All Lead Ore digg'd in *England*, hath a Proportion of Silver mixt with it; but ſome ſo little, that it will not quit coſt to Refine it.

At the firſt Smelting they mingle ſeveral ſorts of Ore together, ſome Richer, ſome Poorer, elſe they will not melt ſo kindly. The Silver made here is exceeding good and fine. Theſe ſix Mountains in *Cardiganſhire*, not far from one another, afford Silver Ore; *Talabout*, *Geginnon*, *Comſomlack*, *Gedarren*, *Bromeſloid* and *Cummer*. But when Mr. *Ray* was there, they digg'd only at *Talabout*.

Their Way of Digging and Collecting the Ore, was thus: They ſink a Perpendicular ſquare Hole, or *Shaft*, the ſides of which they ſtrengthen round from top to bottom with Wood, that the Earth may not fall in. The Tranverſe Pieces of Wood, they call *Stemples*; and on theſe, catching hold with their Hands and Feet, they deſcend without uſing any Rope: They dig the Ore thus, one holds a little Pique, or Punch of Iron, having a long Handle of Wood, which they call a *Gad*; and another with a great Iron-ſledge drives it into the Vein.

The Vein of Metal runs *Eaſt* and *Weſt*; it riſes *North*, and *dips* or ſlopes to the *South*. There is a white *Fluor* about the Vein, which they call *Spar*, and a black one, which they call *Blinds*: This laſt covers the Vein of Ore; ſo that when it appears, they are ſure to find Ore.

There are ſeveral Silver Mines at *Schemnitz* in *Hungary*, the chiefeſt of which are *Windſchaht* and *Trinity*. Of which Dr. *Edward Brown* gives us this Account in *Philoſophical Tranſactions*, No. 58. *Trinity* Mines are 70 Fathom deep, built and kept open with Under-work at a great Expence. Much of this Mine being in an Earthy Soil, its Ore is much eſteemed. Diverſe Veins lie *North*, and others run to the *North-eaſt*. The blackiſh Ore is eſteemed the beſt; much of it hath a mixture of a yellow ſhining Subſtance, called *Marchaſite*; which if not in too great quantity, diſpoſes the Ore to Fluidity, and makes it melt and run the better. There is often found growing to the Ore a red Subſtance, called *Cinnaber*; this Subſtance, ground with Oil, makes a Vermillion equal to, if not exceeding that Cinnabar which is made by Sublimation of Mercury and Sulphur.

An hundred Pound Weight of Ore ſometimes yields but half an Ounce, or an Ounce of Silver; ſometimes 2, 3, 4, 5 and 20 Ounces.

There is an Officer in the Works, whom they call the *Probeirer* or *Eſſayer*, who proves the Richneſs of the Ore, thus: Of all ſorts of Ore he takes the ſame Quantity, and having firſt dried, burned, and powdred them, then he gives an equal Proportion of Lead to all, melteth and purifieth them; and then by exact Scales he takes notice of the Proportion between the Ore and the Metal contained in it, and reports it to thoſe concerned in the great Melting-furnaces.

If the Ore be found to hold 2 Ounces and a half, or more of Silver in an 100 Pound Weight, they ordinarily melt it, without any previous Preparation by the help of *Iron Stone* (which, by the by, is not Iron Ore, but a Stone found thereabouts, of which the Livered-colour is the beſt.) *Kys*, (which is a ſort of *Pyrites*) and *Slacken*, (a Scum or Lake taken off the Top of the Pan, into which the melted Mineral runs, and is a Subſtance made out of the former, melted by Fuſion) which are thrown with it into the Melting-furnace.

If the Ore be poorer, holding but 2 Ounces in 100 Pound Weight, or leſs: Then 'tis firſt pounded and waſh'd, till it become richer, or hath a greater Proportion of Metal, with reſpect to the Ore, much of the Earthy Parts being waſhed away. Then 'tis thrown into the Furnace with the former Materials; and the *Marchaſite*, which remains ſtill with it, as ſinking always to the bottom with the Silver in the *Waſh-works*, helps to quicken the Fuſion of the Ore.

Whatever is melted in the Melting-furnace, is let out thro' an hole at the bottom thereof into the Pan, which is placed in the Earth before it. And thus expoſed, it immediately acquires an hard Scum, Droſs, Loaf or Cake; which being taken off from the Top, the Metal remaining becomes the purer; to which is added *Lead*, and after ſome time the melted Metal is taken out. Then being again melted in the *Driving-furnace* (as they call it) the Lead, or what elſe remains mixt with the Silver is *driven* off by the Blaſt of two great Bellows, and runs over in the form of Litharge. That which firſt comes over is the *White*, and that which is laſt, being longer in the Fire, is *Red*; the former is called Litharge of Silver, the laſt of Gold; but are both blown off the ſame Metal.

Moſt of this *Schemnitz* Silver Ore holds ſome Gold, which is ſeparated from the Silver by Granulation and Diſſolution in *Aqua Fortis*.

When Silver is generated (as 'tis in ſome Places of *America*, and perhaps elſewhere) in Rockey Stones, abounding with Bituminous Mixtures, ſo as that it can't be forced from its Impuri-

ties

ties by the violent way of Melting; tho' *Lead*, and even Artificial Salts or Fluxes be added: In this Caſe the Uſe of Quickſilver hath been found moſt advantageous. The way of applying it is thus:

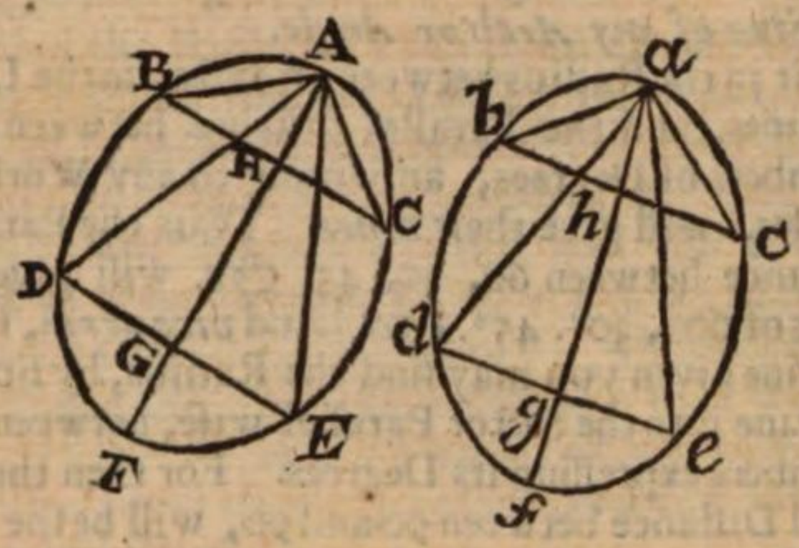
They Calcine the Ore, firſt broken into ſmall pieces, in a Reverberatory Oven; but with a moderate Fire for fear of Fuſion, and driving away into the Air part of the Metal. This Calcination frees the Mineral from ſuch Mixtures as would hinder the Power of the Quickſilver upon it, and alſo renders the Ore more tractable and pliant under the Milſtone; where 'tis reduced to a fine Powder, before the Application of the Mercury upon it. For the Ore being Ground, Calcined, Powder'd, and finely ſifted, they divide it into ſeveral heaps, and then by leſſer Eſſays they find how much Silver is contained in each heap; where 'tis very ordinary to find not above 6 Ounces in 100 Pound Weight, ſometimes 12; but if it ariſes to 18, 'tis eſteemed a very rich Vein: Yet ſometimes there are great Maſſes found of pure Silver, which they call Virgin Metal.

Then proportionable to the quantity of Silver in each heap, they beſprinkle them with Quickſilver, and that not all at once, but at ſeveral times, ſtirring the Ore up and down. If the Mercury give Signs of its being *Tocado* (as they call it) *i. e.* if it appear *mortified*; not in ſmall and clear Spherical Figures (which is a good Prognoſtick) but in the form of long Worms, of a wan, pale, dark and Leadiſh Colour (which indicates that the Ore abounds with *Lead*, &c.) it is cured by certain Magiſtrals, which have for their Baſis or Maſter Ingredient, Calcined Copper mingled with Salt.

The heaps of Ore being thus mingled with Quickſilver, are often ſtirred about, the better to incorporate the Mercury and Silver. They ſeem to have only Conjectural Signs to know when the Quickſilver hath done its Office in ſeparating the Silver from theſe Heterogeneal Subſtances; which occaſions by its uncertainty great Loſſes, eſpecially when they Work this way on Gold. But when by the Colour of the Mercury, Coagulated by the Silver in clear Maſſy Lumps, they conjecture the Work done, they waſh it by means of *three Veſſels*, ſtanding in order, one under another: So that the Matter in the firſt and higheſt, being worked and ſtirred about with a *Molinet*, all the Duſt of the Hoterogeneous Matter that imbody not with the Mercury, is carried away together with the Water into the other Veſſels, and from thence is quite thrown out by the continual Current of the Water: While the Silver in clotted Lumps (called *Pella's*) is by the Weight of the Mercury carried down to the bottom of the Tubs. Then the Mercury, with the Silver is taken out of the Veſſels, and diligently ſqueezed in ſtrong coarſe Linen-cloths, and even with Strokes of a Beetle, that the Quickſilver may be ſeparated as much as may be from the Silver. And this Maſs is afterwards reduced in Molds of the ſhape of the *Indian* Pine-apple, into a Piramidal or Conical Figure, which they call *Pineas de la Plata*: They are thus faſhioned for the eaſier placing them round the edges of a great Earthen, Veſſel of the form of a blind, Alembick: Round about the top of which a Fire is made, and then all the reſt of the Mercury forthwith abandons the Silver and falls to the bottom; from whence its recovered and kept for the like uſe again.

The Silver laſt of all is melted down with *Liga*, as 'tis called, which the King of *Spain* allows, by which he returns to the People in Copper the fifth part, which they allow him of all the Silver. *Philoſ. Tranſ.* No. 41.

SIMILAR *Light*, according to Sir *Iſ. Newton*, is ſuch, whoſe Rays are all equally Refrangible; and this he calls alſo Simple and Homogeneal.




SIMILAR *Sections* in Conicks, are ſuch whoſe Diameters make equal Angles with their Ordinates; and alſo where the Triangles A D E, A B C, are Similar to the Triangles *a d e*, a b c, and the Baſes D E to B C; as d e, b c. Their Diameters alſo, as *A F*, and *a f* are called Similar.

SIMPLE Light. See *Homogeneal*.

SINCERITY, in Ethicks, is defined to be that *Virtue*, *Power*, or *Act* of the Mind, by which the Will is determined to follow and perform that which the Intellect determines to be beſt and moſt proper to be done in all Caſes, and to do it becauſe it is ſo.

SINE-CURES, are Eccleſiaſtical Benefices without Cure of Souls. No Church where there is but one Incumbent, can properly be a Sine-cure: And tho' the Church being down, or the Pariſh being become deſtitute of Pariſhioners, the Incumbent may thereby be neceſſarily acquitted from the actual Performance of Publick Duty, yet he is ſtill under an Obligation to do it, whenever a Church ſhall be built, and there are a competent number of Inhabitants. And in the mean while, if the Church be *Preſentative*, as moſt ſuch Churches are, the Incumbent is Inſtituted *in Curam Animarum*; and ſuch Benefices are rather *Depopulations* than *Sine-cures*, and 'twill be proper for the new Incumbent to read the 39 Articles, and the Liturgy in the Church-yard, *&c.* and to do what other Incumbents uſually do. But a *Rectory* or a *Portion* of it may properly be a *Sine-cure*, if there be a Vicar Endowed, and then it doth not come within the Statute of Pluralities of 21 *H.* 8. *c.* 13. Which declares that no Parſonage which hath a Vicar Endowed, ſhall be comprehended, *&c.* So that here no Diſpenſation is neceſſary to hold this *Sine-cure* with a former Living. Nor need he read the Articles or Divine Service, as required by 13 *Eliz. c.* 12. which extends only to a *Benefice with Cure*. A Sine-cure Donative wants no Inſtitution and Induction. But one *Preſentative* muſt have both; eſpecially if it conſiſt in *Glebe* and *Tithes*, and not in a Portion of Money. But the Inſtitution muſt not run *in Curam Animarum*, but *in Recto-*

*Rectoriam ſive Portionem Rectoriæ de A. B.* &c. By the abovementioned Stat. 21 *H.* 8. not only Prebends and Rectories, with Vicarages Endowed, but Deanries and Archdeaconries are declared to be Benefices without Cure.

SINES on the *Plain Scale*, *Gunter's Scale*, and almoſt all *Scales* have a *Line*, called the *Line of Sines*. This on the *Sector* is double, one on each Leg, and hath there many excellent Uſes; ſome of which are theſe:

1. *The Radius of a Circle being known to find the Sine of any Arch or Angle.*

Fit in the Radius between 90 and 90 in the Lines of Sines, and the Parallel diſtance between the Numbers of Degrees, anſwering to any Works or Angles, will give their *Sines*. Thus the Parallel Diſtance between 60, 30, 45, *&c.* will give the Sines of 60°, 30°. 45°. *&c.* And *vice verſâ*, from the Sine given you may find the Radius, by fitting the Sine into the Sector Parallel-wiſe, between the Numbers expreſſing its Degrees. For then the Parallel Diſtance between 90 and 90, will be the Radius ſought.

2. *The Radius of a Circle being given, and any Right Line leſs than it, to know of what Ark it may be the Sign.*

Apply in the Radius between 90 and 90, in the Lines of Sines, and taking the Length of the Line in the Compaſſes, carry it Parallel to the Radius, till it fall exactly on like Sines on each ſide; and the Degrees and Minutes where it fits, ſhall give you the Sine it repreſents.

SINUS, in the *Dura Mater*, is that ſtrong and thick Membrane which covers all the Cavity of the *Cranium*. There are ſeveral eminent *Sinus*'s or Chanels, which run between its External and Internal Membrane: Of theſe four principal ones are uſually deſcribed; as 1. The *Sinus Longitudinalis*, 2 and 3 *Sinus Laterales*; and 4 *Sines Vertebralis*. (*Keil*, *p.* 133.)

SI *Recognoſcant*, is a Writ that lies for a Creditor againſt his Debtor, for Money Numbred, and owned before the Sheriff in the County-court by the Debtor, to be due to the Creditor.

SIXAIN, is an ancient Order of Battle for 6 Battalions, which ſuppoſing them all in a Line, is formed thus: The 2d and 5th Battalions advance and make the *Van*. The 1ſt and 6th fall into the Rear; leaving the 3d and 4th to Form the main Body. Each Battalion ſhould have a Squadron on its Right, and another on its Left. Any Number of Battalions which are Multiple of 6, may be drawn up by this Order, *i. e.* 12 Battalions may be put into 2 *Sixains*, and 18 Battalions into 3, *&c.*

SIZING, is a curious way of *Dreſſing* the Tin Ore, after it comes from the *Launder* of the Stamping-mill; which is by ſifting it thro' an Hair-Sieve, caſting back the remainder in the Sieve into the *Tails*, to be *Trambled* over again. See *Buddle* and *Tin*.

SKIN. As ſoon as the *Cuticula* or Scarf-skin is ſeparated from the *Cutis* or true Skin of a humane Body, there are theſe three parts appear firſt, an infinite number of *Papillæ Pyramidales*, which are the ends of all the Nerves of the Skin, each of which are encloſed in two or three Covers of a Pyramidal Figure. Between theſe *Papillæ* are an infinite number of Holes, which are nothing but the Orifices of the Excretory Veſſels of the *Miliary Glands* underneath.

*Secondly*, There appears a Web of Nervous Fibres, and other Veſſels, differently interwoven: This is always covered with a Mucous Subſtance, ſerving to ſupport and moiſten the *Papillæ Pyramidales*. And this is the *Parenchyma*, or that part of the Skin that *Parchment* is made of.

The *third* part is an infinite number of *Miliary Glands*, about whom there is much Fat uſually: Theſe Glands ſeparate the Matter by Sweat and Inſenſible Perſpiration. Each Gland receives a *Nerve* and *Artery*, and ſends out a *Vein*, and an *Excretory Duct*; which laſt paſſes thro' the other two Parts to the *Cuticula*, in order to moiſten it and the *Papillæ Pyramidales*, leſt they ſhould be ſo dry as to hinder the Senſe of Feeling; and alſo to diſcharge that Matter out of the Body.

The uſe of the Skin is to cover and wrap up all the Parts of the Body, to be the Organ of Touching or Feeling, and to be the Emunctory of the whole Body. For thro' the Glands of the Skin, paſs not only ſuch Particles of the Veſſels, as decay, by reaſon of the continual Motion of the Blood, but likewiſe the greateſt part of the Liquors which we drink; which having perform'd part of their Office, in conveying the Aliments into the Blood, are in the next place to diſſolve the Saline and Terreſtrial Particles to be carried off thro' the Glands of the Skin and Kidneys. *Sanctorius* computes, that about 50 Ounces a Day are thus carried off thro' the Cutaneous Glands: So that if a Man's Body be ſuppoſed to weigh 160 Pound in 51 Days he may perſpire a Quantity equal to the weight of his whole Body. *Keil*'s *Anatomy*.

Above the *Cutis* or thick Skin of the Body lies the *Cuticula* or *Scarf-skin*, and is compoſed of ſeveral Plates of ſmall *Scales*, which cover one another, more or leſs, or lie thicker, according as it is thicker in one part of the Boey than in another: Between theſe *Scales* the *Excretory Duct* of the *Miliary-Glands* of the *Cutis*, or thick Skin, open. *Lewenhoeck* reckons, that round about one Cuticular 500 ſuch Ducts may lie, and that a Grain of Sand will cover 250 of theſe Scales: So that one Grain of Sand will cover 125000 Orifices of theſe little Ducts; and yet into every one of theſe *Miliary Glands* an Artery, Vein and Nerve do certainly enter. Theſe Glands ſecern the Sweat, and what goes off by inſenſible Perſpiration: And they muſt be very many in number, ſince, as *Sanctorius* obſerves, 15 Ounces of a Fluid Matter paſſes in 24 hours time. Next under the Scarf-Skin lie the *Papillæ Pyramidales*, which alſo are prodigiouſly numerous, being the Extremities of all the Nerves of the Skin, and do more immediately ſerve for the Senſe of Feeling, and to convey the Impulſe received, by means of the Nerves to the Brain. About theſe the Nerves and all other Veſſels make a fine Web, all covered over with a Mucous Subſtance, to moiſten theſe *Papillæ Pyramidales*; and then under theſe the Miliary Glands are placed, protruding their *Secretory Ducts* up to the Surface of the Scarf-skin; on which there are many Parallel Lines, and theſe Interſected by others, and in each Interſection there is an Hair uſually placed. The *Scales* of the Scarf-

Scarf-skin defend the Orifices of the Excretory Ducts of the *Miliary Glands*, and hinder Objects from making too exquisite and painful an Impression upon the Nerves, and so to save them from External Injuries. The Skin itself is designed to enwrap the whole Body, and to sustain the *Papillæ Pyramidales* in their Places, and the Miliary Glands from being disordered; also to receive the Impression of external Objects, and to be the Organ of the Sense of Touching and Feeling.

SLAM; a Term used in the *Alum-Works*: which see.

SLEDGE; is a large Smith's Hammer to be used with both Hands: Of this there are two sorts, *The Uphand Sledge*, which is used by under Workmen, when the Work is not of the largest sort: This is used with both the Hands before, and they seldom raise it higher than their Head. But the other, which is called the *About-Sledge*, and which is used for battering or *drawing out* the largest Work, is held by the handle with both Hands, and swung round over their Heads, at their Arms-end, to strike as hard a Blow as they can.

SLOOP, is a Vessel of the Shallop-kind. In our Navy such attend upon the Men of War. They are usually about 60 Tun, and carry about 30 Men.

SMACK, *Smaka* in *Latin*, is a small Vessel with but one Mast. Sometimes such are employed as Tenders on a Man of War, and they are also used for Fishing upon the Coasts.

SMOKE-*farthings*, the Pentecostals, or Customary Oblations offered by the Inhabitants within any Dioceſs, when they made their Processions to the Mother or Cathedral Church, and came by degrees into an annual standing Rent, called *Smoke-farthings*.

SOFITTO, is the *Italian* Term in Architecture, for the *Eaves* of the *Corona* of the Capital of a Column.

SOLIDS: there are usually placed on the Sector 2 Lines (one on each Leg) which are called by *Gunter* very properly, the *Lines of Solids*. These are graduated, either by finding 2 mean Proportionals between the whole side, and each 1000 part of the like side, all of them cutting the same 2 Right Lines; and then the former of the 2 Lines so cut, shall contain the Divisions required. Or the Lines of Solids may be made out of the Line of Lines, (or rather out of a Diagonal Scale, equal to it in length) by a Table of Cubick Roots, and this is the readiest way; for the Roots taken out of the Scale of equal Parts, shall give the Cubes in the Lines of Solids, *c. gr.* To inscribe the Place of 125 in the Line of Solids, affix 12 Cyphers to it, and then extract the Cubick Root, which will be 50000; and that taken out of the Line of Lines, will find the Point of 125 in the Line of Solids, *&c.*

*The Use of the Lines of Solids.*

1. *To find the Proportion between two or more Similar Solids.*

In the Sphere, in regular Parallels, and other like Bodies, whose Sides adjoining to the equal Angles are proportional; proceed thus: Take one of the Sides of the greater or greatest Solid, and open the Sector to it in the Points of 10 and 10, in the Line of Solids: And then taking the like Sides of the lesser Solids severally, and carrying them parallel to the former, till the Feet of the Compasses stay in like Points; the Numbers belonging to those Points, will express the Proportions to 1000; that is, the Solids will be to each other as these Numbers are to 1000.

2. *To Augment or Diminish a Solid in a given Ratio*; as suppose in that of 2 to 3.

Open the Sector to the side of the Solid given in the Points 2 of the Number given; and then keeping it at that Angle, the parallel Distance between 3 and 3, the Points of the Number required, shall give the like side of a Solid similar to the former, and in the *Ratio* required.

3. *To Add or Substract one Solid to, or from another.*

Find the Ratio between them (by Prob. 1.) and then Add or Substract those Proportions, and accordingly augment or diminish (by the precedent.) Thus, if *A* and *B* be the sides of 2 Cubes to be *added* or subtracted; I first find the Proportion of *A* to *B* to be, suppose, as 100 to 40, or as 5 to 2; then adding 5 to 2, it makes 7: wherefore I augment the side *A*, in the Ratio of 5 to 7, which will give a new side, as *C*, on which a Cube being made, will be equal to them both. Proceed *vice versa*, in Substraction.

4. *To find 2 Mean Proportionals between 2 given Lines; as suppose between* A *and* D.

First find (by the Line of Lines) the *Ratio* between the 2 given Lines, which are the Extreams, and let that be in Numbers as 27 to 8; and then open the Line of Solids on the Sector, so that the greater Extream A, may be applied in the Points 27 and 27. Then keeping the Sector at that Angle, take the Distance between 8 and 8, and that shall give you *B*, suppose the former of the 2 Means. Next, apply that Mean B over in the Line of Solids on the Points 27 and 27, and then the parallel Distance between 8 and 8 will give you *C*, the other Mean sought.

5. *To find 2 Mean Proportionals between 2 Numbers given*: Suppose between 27 and 8.

Reckon 27 and 8 on both sides in the Lines of Solids from the Centre. Then taking 27 from the Centre also in the Line of Lines, put it over in the Line of Solids in the Points 27 and 27. So shall the parallel Distance between 8 and 8 in that Line, reckoned in the Line of Lines from the Centre, give 18, the former of the 2 Means sought. Apply over then 18 between 27 and 27 in the Line of Solids, and keeping the Sector at that Angle; the Parallel between 8 and 8 in the same Line, will give a Length to be reckoned, as before on the Line of Lines from the Centre, which will be 12, the latter Mean Proportional required.

6. *To find the Cubick Root of a Number given, or the Cube of a Number assigned.*

In the Extraction of the Cube Root, you must point from the Right-hand towards the Left, the first, and then every third Place; and then there will be as many Places in the Root, as there are such Points over the Cube Number given. Wherefore if the Number be under 1000, the Root can consist but of one Figure. If less than 100000, it can consist but of 2 Places; and if less than 1000000000, it will have but 3 Places in the Root, *&c.* Wherefore the Line of Solids is divided first into 1000 unequal Parts: And therefore, if the Number given be greater than 1000, the first Division of the Line, which before signified but one, will now stand for 1000, *&c.* as in the Line of Numbers. By this means, if the last Point over a Cubick Number, fall on the last Fi-

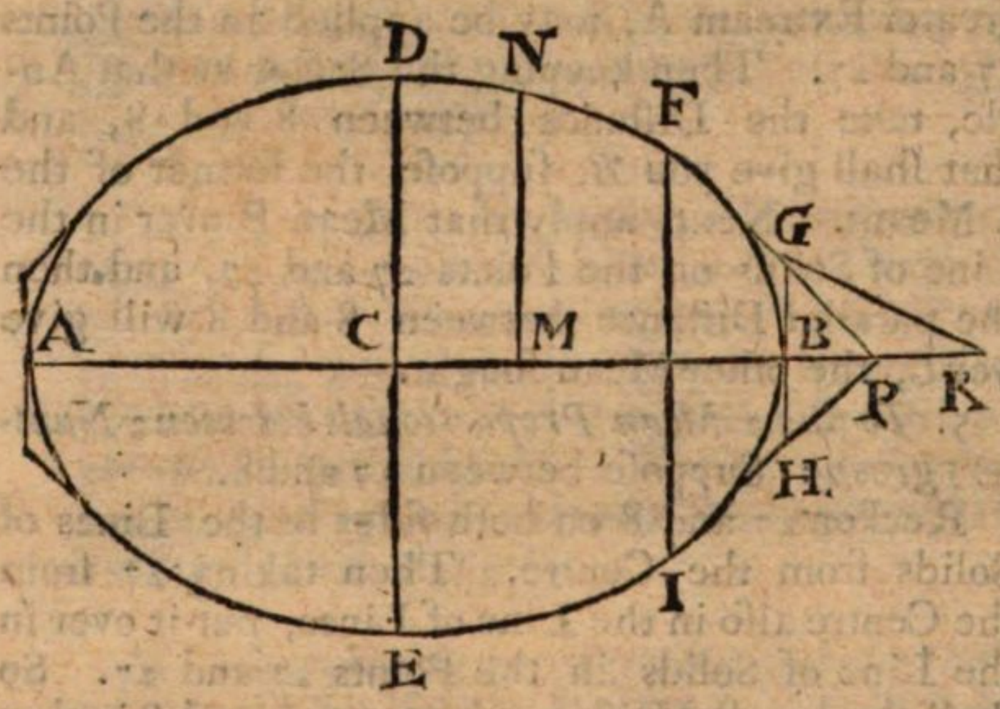
gure to the Left-hand, the Number given ſhall be reckoned on the Line of Solids, from 1 to 10, and the firſt Figure of the Root will be either 1 or 2. But if the Point fall on the laſt Figure but one, the Number given muſt be accounted in the middle of the Line of Solids, between 10 and 100, and the firſt Figure of the Root will be always either 2, 3, or 4. And if the laſt Point ſtand over the laſt Figure but two, then the Number given ſhall be accounted at the end of the Line of Solids, between 100 and 100.

This being premiſed, the Extraction of the Cube Root will be eaſy, without opening the Sector: Set one Foot in the Sector, and extend the other to the Point repreſenting the Numbers. That Diſtance will reach in the Line of Lines from the Center to the Root.

Thus the neareſt Root of 8490000 is about 204
of 84900000 — 439
of 849000000 — 947

And the Extent from the Centre of the Line of Lines to any Number for a Root, will reach in the Solids from the Centre to the Cube.

SOLID *of leaſt Reſiſtance*, Sir *Iſaac Newton*, in his *Principia*, p. 327. ſhews, that if

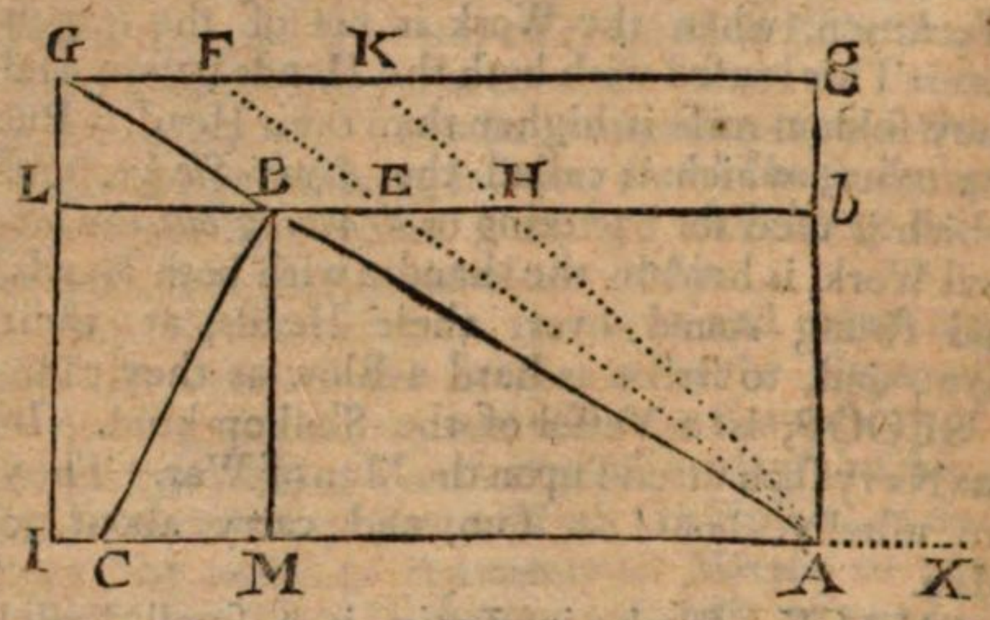



there be a Curve Figure, as DNFB, of ſuch a nature, as that from any Point, as *N*, taken in its Circumference, a Perpendicular be let fall to the Axis, as NM: And if from a given Point, as G, the Right Line GR, be drawn parallel to a Tangent to the Curve in that Point; and alſo if the Axis being produced till GR cut it, it then be, as MN. GR :: GR$^3$. $\frac{N}{4BR\times}$ GB$^2$. Then the Solid, which may be generated by the Revolution of this Curve round its Axis AB, when moved moſt ſwiftly in a rare and elaſtick Medium, ſhall meet with leſs Reſiſtance from the Medium, than any Circular Solid whatſoever, deſcribed after the ſame manner, and whoſe Length and Breadth are the ſame.

After this, in the Year 1699, *M. le Marquis de L'Hoſpital*, produced an eaſy Method of finding *a round Solid, which being placed in a Fluid, whoſe Parts are at reſt, ſhall, when moved in that Fluid parallel to its Axis, meet with leſs Reſiſtance from the Medium, than any Solid whatever, whoſe Length and Breadth are the ſame, and which ſhall be moved with the ſame Velocity.*

And this he doth by finding a Curve, which revolving round its Axis, ſhall generate the Surface of ſuch a Solid. See *Memoires de l'Academ. Royale des Sciences*, 1699. In the latter end of the Year 1700, Mr. *John Craig* ſent to the Publiſher of the *Philoſophical Tranſact.* a *Latin Letter*, in which there is a Solution of this Problem, of finding the *Solid of leaſt Reſiſtance.* (See *Philoſ. Tranſ.* N°. 268) and which is introduced by this *Lemma*.

*To find the Ratio between the Reſiſtance of the Right Angled Triangle AIG, and the Rectangle AIGB, circumſcribing it, when each is moved in a Fluid, according to the Direction of the Line IA, from I towards X.*




From any Point, as *B*, draw the right Line BG, perpendicular to the Diagonal GA, *Bb* parallel to *AI*, and alſo *BM* normal to AI; then take in Bb, bH = $\frac{CM^2}{BC}$ and bE = BC, and thro' the Points H, E, let the right Lines HA, EA, be produced till they cut Gg in k and in F.

Then I ſay, that the Reſiſtance of the △ AIG, is to the Reſiſtance of the Rectangle AIG, as the Area of the Triangle AIG, is to the Area of △ AFg, and the Reſiſtance in any part of the Line AG, is to the Reſiſtance in the correſponding part of the Line Ag (ſuppoſe in AB and Ah, *&c.*) :: as the Area AHB, to the Area AEB. The Demonſtration of this depends on a general Theorem, which I did very eaſily deduce from the 35 Prop. of Sir *Iſ. Newton's Princip.* p. 324.

Cor. 1. Let BG, and hg, be infinitely ſmall Parts of the Lines AG, and Ag, and produce bB to L; then I ſay, that the Reſiſtance in BG, (which let us call *e*) is to the Reſiſtance in *bg*, (which call *E*) as GL$^2$ is to GB$^2$

For e. E :: KHbg. FEbg; that is, e. E :: bg × bH. bg × bE (by the preceeding Lemma) wherefore e. E :: bH. bE. (that is) e. E :: $\frac{CM^2.}{BC}$ BC. (by the Conſtruction of that Lemma) wherefore e. E :: CM$^2$. BC$^2$. But CM$^2$. BC$^2$ :: GL$^2$. GB$^2$, (from the ſimilar Triangles BMC, GLB) wherefore e. E :: GL$^2$. GG$^2$. Q.E.D.

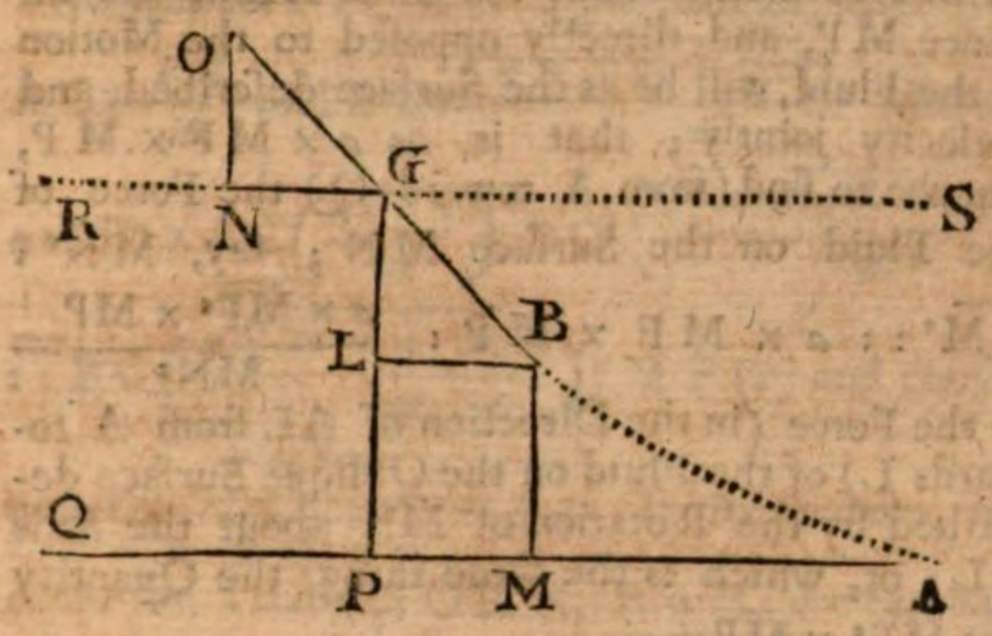
Cor. 2. *The Reſiſtance againſt the infinitely ſmall part GB, is equal to the Cube of the Line GL, divided by the Square of the Line GB.* For if all the infinitely ſmall Parts of the Line Ag, (as bg, *&c.*) be ſuppoſed equal; then the Reſiſtance in *bg* might be expreſſed by bg: that is, E = bg, and therefore E = GL. Wherefore, by Cor. 1. e. GL :: GL$^2$. GB$^2$. wherefore e = $\frac{GL^3.}{GB^2}$ Q.E.D.

Cor.

Cor. 3. Let $r$ be Radius, and $c$ the Circumference of any Circle; I say, the Resistance against the Conical Surface, generated by the Rotation of the *Lineola* G B, round about A I, is equal to the Product of $\frac{c \times BM}{r}$ into $\frac{GL^3}{GB^2}$: for the Resistance against that Conick Surface, is equal to all the Resistances against the *Lineola* G B; that is, to all the $e$. That is, 'tis equal to the Circumference of the Circle whose *Radius* is B M, multiplied by $e$. That is, the Resistance against that Conick Surface, is equal to $\frac{c \times BM}{r} \times e$. wherefore by Cor. 2. it is equal to $\frac{c \times BM}{r} \times \frac{GL^3}{BG^2}$ Q.E.D.

Then follows the Problem proposed, which is this:

*Problem*, To find the Curve, by whose Rotation round an Axis, a round Solid shall be produced, which, supposing to be moved in a Fluid, according to the Direction of the said Axis, shall suffer the least possible Resistance in that Medium.

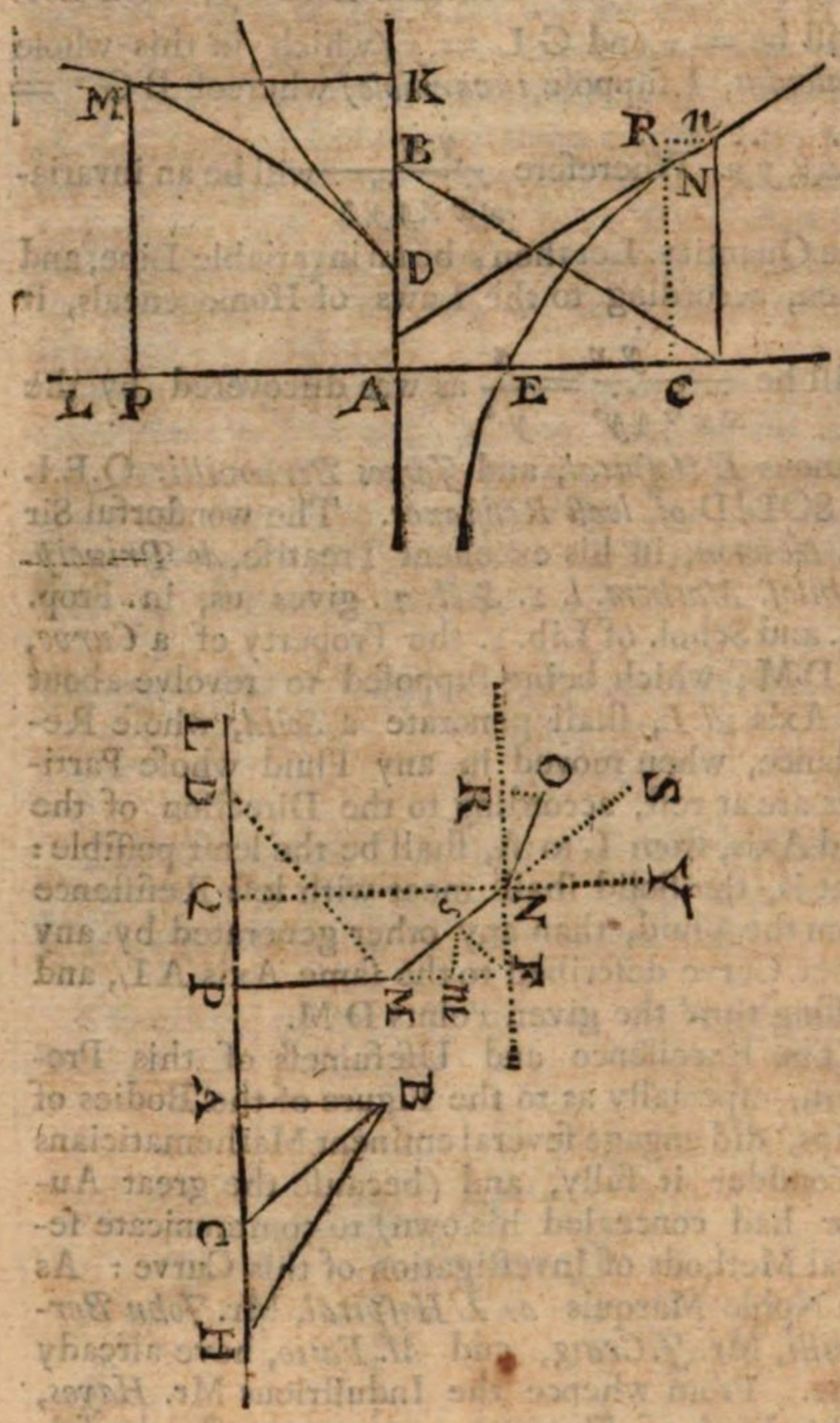



Suppose O G, G B, two infinitely small Parts in the Curve required, by whose Rotation round the Axis A Q, the Solid of least Resistance is generated. Let B M, G B be drawn at Right Angles to A Q, and draw B L parallel to A Q, and O N parallel to B M. 'Tis then plain, that $\frac{c \times BM \times GL^3}{r \times GB^2}$ is the Resistance against the Surface generated by the Rotation of the *Lineola* G B, about the Axis A Q; and that $\frac{c \times GP \times ON^3}{r \times OG^2}$ is the Resistance against that generated in like manner by O G, from Cor. 3. of the preceding Lemma. Now both these Resistances taken together, must be the least possible: Wherefore $\frac{c \times BM \times GL}{r \times GB^2} + \frac{c \times GP \times ON^3}{r \times OG^2}$ = a *Minimum*, or to the least possible Resistance. And consequently in the Line $R S$, (which must be drawn parallel to A Q; so that O N = G L) the Point G is to be Investigated, where this will happen. And supposing $O$ and $B$ fixed Points, this will easily be found by the Method *de Maximis & Minimis*. And producing the *Calculus*, it will come at last to stand thus; $\frac{BM \times BL}{BG^4} = \frac{GP \times NG}{OG^2}$.

Wherefore 'tis plain, that $\frac{BM \times BL}{BG^4}$ is an invariable Quantity. So that if the Abscissa $AM$, be called $x$, and the Ordinate B M = $y$, then B L will be = $\dot{x}$ and G L = $\dot{y}$ (which in this whole *Calculus*, I suppose *invariable*) whereof $BG^2 = \dot{x}\dot{x} \times \dot{y}\dot{y}$. Wherefore $\frac{\dot{y}x}{\dot{x}\dot{x} \times \dot{y}\dot{y}^2}$ will be an invariable Quantity. Let then $a$ be an invariable Line, and then, according to the Laws of Homogeneals, it will be $\frac{\dot{y}x}{\dot{x}\dot{x} \times \dot{y}\dot{y}^2} = \frac{a}{y^2}$ as was discovered by the famous *L'Hospital*, and *James Bernouilli*. Q.E.I.

SOLID *of least Resistance*. The wonderful Sir *Is. Newton*, in his excellent Treatise, *de Princip. Philos. Mathem. l.* 2. *Sect.* 7. gives us, in Prop. 35. and Schol. of Lib. 2. the Property of a *Curve*, as D M; which being supposed to revolve about its Axis $AL$, shall generate a *Solid*, whose Resistance, when moved in any Fluid whose Particles are at rest, according to the Direction of the said Axis, from L to A, shall be the least possible: that is, the Solid shall meet with less Resistance from the Fluid, than any other generated by any other Curve described to the same Axis A L, and passing thro' the given Points D M.

The Excellence and Usefulness of this Problem, especially as to the Figure of the Bodies of Ships, did engage several eminent Mathematicians to consider it fully, and (because the great Author had concealed his own) to communicate several Methods of Investigation of this Curve: As the Noble Marquis *de L'Hospital*, Mr. *John Bernouilli*, Mr. *J. Craig*, and *M. Fatio*, have already done. From whence the Industrious Mr. *Hayes*, in his Book of *Fluxions*, p. 147. extracts the following Solution.




*To inveſtigate the Nature of that Curve which ſhall generate the Solid of leaſt Reſiſtance.*

Imagine the little Lines MN, NO to be two Sides of the Infinito-lateral Polygon, which conſtitutes the Curve required: Draw MP, NQ Ordinates to the Axis AL, and draw RNF Parallel to the ſame Axis AL, and let OR, MF be perpendicular to RNF, and MD perpendicular to the Side MN.

Then 'tis evident, that if the Right Lines MN, NF move in the Direction of the Axis from L towards A, that the Force of Reſiſtance of the Fluid in ſuch a Caſe, is equal to the Action of the Fluid moving in the ſame Direction from A towards L (and with the ſame Velocity.) On the ſaid Lines MN, MF, being quieſcent, draw FS perpendicular to MN, and then the Triangles FSN, FMN, PMD are ſimilar; therefore if FN repreſent the Force of a Particle of the Fluid to move the Line FM, in the Direction of AL, from A towards L, then FS will repreſent the Force of the ſame Particle of the Fluid to move the Line MN in the Direction of MD, from M towards D; that is, the Force of the Particle to move M from FA towards L, is to the Force of the ſame Particle to move MN, from M toward D :: FN : FS :: MD : DP. Again, if MD repreſent the Force of the ſame Particle to move MN from M towards D, then DP will repreſent the Force of the ſame Particle to move MN in the Direction of DP, from P towards D; therefore the Force of the Particle of the Fluid to move MF, from A towards L, is to the Force of the ſame Particle to move MN from A towards L :: $\overline{DM}^2 : \overline{DP}^2 :: \overline{MN}^2 : \overline{FM}^2$. The Proportion between the Force of the Particle of the Fluid to move MF (or $Qv$) from A towards L, and the Force of the ſame Particle to move MN from A towards L may be found thus: If FN repreſent the Force of the Particle againſt $QNv$ in the Direction from A towards L, then FS will repreſent the Force of the ſame Particle againſt $MNs$ in the Direction of MD; and if FS repreſent the Force of the Particle againſt MN from M towards D, then $mS$ will repreſent the Force of the ſame Particle againſt MN in the Direction of AL from A towards L: therefore the Force of the Particle of the Fluid to move MF (or QN) from A towards L, is to the Force of the ſame Particle to move MN from A towards L, as EN is to $mS$, that is, as $FNq$ is to $FSq$, or as $MDq$ is to $DPq$.

Whence if the given right Line AB (*a*) repreſent the Velocity of the Particles of the Fluid ſtriking againſt the Right Lines MN, MF, then the Force of the ſame Fluid upon the Plane deſcribed by MF revolving about the Axis AL at the diſtance MP, and directly oppoſed to the Motion of the Fluid, will be as the Surface deſcribed, and Velocity jointly; that is, as $a \times MF \times MP$, whence to find (from A towards Q) the Force of the Fluid on the Surface MN; ſay, $\overline{MN}^2 : \overline{FM}^2 :: a \times MF \times MP : \frac{a \times \overline{MF}^2 \times MP}{\overline{MN}^2} =$ to the Force (in the Direction of AL from A towards L) of the Fluid on the Oblique Surface deſcribed by the Rotation of MN about the Axis AL; or, which is the ſame thing, the Quantity $\frac{a \times \overline{MF}^2 \times \overline{MP}}{\overline{MN}^2}$, expreſſing the Reſiſtance which the ſame Surface moving from L towards A, ſuffers from the Fluid at reſt. In like manner the Reſiſtance, which the Surface deſcribed by NO revolving about the Axis AL, meets with from the quieſcent Fluid, may be repreſented by $\frac{a \times \overline{OR}^2 \times \overline{NQ}}{\overline{NO}^2}$.

Now if we ſuppoſe the Points MO, and the right Line RF, to be given by Poſition, and that they are in the ſame Plane with the Axis AL; it remains only to determine the Point N in the Line RF, ſo that the Surface generated by the right Lines MN, NO revolving about the Axis AL ſhall ſuffer the leaſt Reſiſtance.

Let the invariable Quantities MF be $= m$, $MP = r$, $OR = n$, $NQ = q$; and the variable Quantities $FN = v$, and $NR = z$; then $\overline{MN}^2 = mm + vv$, and $\overline{NO}^2 = nn \times zz$; therefore the Reſiſtance which the Surface deſcribed by the Line MN meets with, *viz.* $\frac{a \times \overline{MF}^2}{\overline{MN}^2} \times MP$ is $= \frac{a + m^2 \times r}{mm + vv}$, and that which the Surface deſcribed by NO (revolving about the Axis AL) *viz.*

*viz.* $\frac{a \times \overline{OR^3} \times NQ}{\overline{NO^2}}$ is $= \frac{a \times n^3 \times q}{nn + zz}$, whence it is evident (from the Nature of the Queſtion) that the Quantity $\frac{a \times m^3 \times r}{mm + vv} + \frac{a \times n^3 \times q}{nn + zz}$ ought to be a *minimum*, and (*Art.* 198.) conſequently the Fluxions thereof muſt be $= o$. Whence $\frac{2m^3 r \times vv}{\overline{mm + vv}^2} = \frac{-2n^3 q \times zz}{\overline{nn + zz}^2}$. Now becauſe $vz +$ is $=$ R F an Invariable Quantity, therefore $\dot{v} = -\dot{z}$, and conſequently $\frac{m^3 \times r \times v}{\overline{mm + vv}^2} = \frac{n^3 \times q \times z}{\overline{nn + zz}^2}$. Whence if A B ($a$) be erected Perpendicular to the Axis A L, and if the right Lines B C, B H, be drawn Parallel to the Infinitely little Sides M N, N O, it will be $4\overline{AB} \times AC : \overline{BC^3} :: BC : MP$; and in like manner $4\overline{AB^2} \times AH : \overline{BH^3} :: BH : NQ$; for becauſe the Triangles M F N, B A C are Similar, therefore $AC = \frac{au}{m}$, and $BC = \frac{a \times \overline{mm + vv}^{\frac{1}{2}}}{m}$, whence

$$4AB^2 \times AC\left(\frac{4a^3 v}{m}\right) : \overline{BC^3}\left(\frac{a^3 \times \overline{mm + vv}^{\frac{3}{2}}}{m^3}\right) :: BC\left(\frac{a \times \overline{mm + vv}^{\frac{1}{2}}}{m}\right) : MP\ (r)$$

and conſequently $\frac{r m^3 v}{\overline{mm + vv}^2} = \frac{1}{4}a$. In like manner, becauſe the Triangles O R N, B A H, are Similar, $AH = \frac{az}{n}$, and $BH = \frac{a \times \overline{nn + zz}^{\frac{1}{2}}}{n}$. Whence

$$4AB^2 \times AH\left(\frac{4a^3 z}{n}\right) : BH^3\left(\frac{a^3 \times \overline{n^2 + z^2}^{\frac{3}{2}}}{n^3}\right) :: \overline{BH}\left(\frac{a \times \overline{nn + zz}^{\frac{1}{2}}}{n}\right) : NQ = q.$$

Whence $\frac{qn^3 z}{\overline{nn + zz}^2} = \frac{1}{4}a$; and conſequently, $\frac{m^3 \times r \times v}{\overline{mm + vv}^2} = \frac{n^3 \times q \times z}{\overline{nn + zz}^2}$. Which is the very ſame Equation that we firſt found.

Whence 'tis manifeſt; that the Nature of the Curve M D (which being revolved about its Axis A L, generates the Solid of leaſt Reſiſtance) is ſuch, that drawing A K Perpendicular to the Axis A L, and taking A B $= a$, and drawing B C parallel to any Tangent of the Curve, *v. g.* in the Point M, then it will always be $4\overline{AB^2} \times AC : \overline{BC^3} :: BC : MP$ the Ordinate paſſing thro' the Point M, which is the Property of the Curve that generates the Solid of leaſt Reſiſtance, diſcover'd by Sir *Iſaac Newton*.

*And having thus diſcovered the Property of the Curve* M D, *it may be Conſtructed by help of the Logarithmetical Line in this manner:*

In the Perpendicular A K aſſume A B $= a$, and in the Axis A L produc'd, take A E $= \sqrt{\frac{1}{8}aa}$, and through the Point E deſcribe the Logarithmetical Line E N, and let A K be the Aſſymptote, and $\frac{1}{4}a$ the Sub-tangent; then take A C at pleaſure, which ſuppoſe $= z$, and draw C N parallel to A K, until it meet the Logarithmetical Curve in N; then if A K be taken $= \frac{aa}{4z} + \frac{1}{2} + \frac{z^3}{4aa}$, and A P $= \frac{zz}{4a} + \frac{3z^4}{16a^3} - \frac{5a}{48} +$ C N (*viz.* $+$ C N when A C $>$ A E and $-$ C N when A C $<$ A E) and compleat the Parallelogram P K, I ſay, the Angle M, or the Point wherein K M interſects P M will be in the Curve requir'd.

For A C being $= z$, if A P $= x$, and P M $= y$, then by the Property of the Curve A K or P M $= y$ is $= \frac{a^4 + 2aazz + z^4}{4aaz}$, and conſequently, $\dot{y} = \frac{1}{2}\dot{z} + \frac{3zz\dot{z}}{4aa} - \frac{a\dot{a}\dot{z}}{4zz}$, and becauſe B C is parallel to the Tangent in M, therefore the Triangle A B C is Similar to the little Triangle at M, and conſequently $a : z :: \dot{y} : \frac{z\dot{y}}{a} = \dot{x} = \frac{z\dot{z}}{2a} - \frac{3z^3\dot{z}}{4a^3} - \frac{a\dot{z}}{4z}$, and the flowing Quantity or A P ($x$) is $= \frac{zz}{4a} + \frac{3z}{16a^3} - S\frac{a\dot{z}}{4z}$, but by the Property of the Logarithmetical Line $z : \frac{1}{4}a :: z\,(R\,n) : \frac{a\dot{z}}{4z} =$ R N, whence $S\frac{a\dot{z}}{4z} =$ C N, therefore A P ($x$) is $= \frac{zz}{4a} + \frac{3z4}{16a^3} -$ C N $\pm$ an Invariable Quantity $\frac{Sa}{48}$, and conſequently, when C N vaniſhes, then A P or $x$ will vaniſh alſo, therefore C M is the Curve requir'd.

SOLSTICE: how to find the exact Times of Solſtices, ſee under *Tropick* in Vol. 1.

SOUND, Mr. *Carre*, of the R. Academy of Sciences at *Paris*, hath publiſhed this Year a Book *Sur la Theorie General du Son*, &c. In which he ſhews that *Sound*, when conſidered with relation to Body, conſiſts only in the Motion of the Air; but in ſuch a Motion as is very different from the Wind. The firſt Motion from whence Sound comes, is produced (he thinks) by little Vibrations, or Shakings repeated, which the Parts of the Sonorous Body occaſions in the Air; whereas Wind conſiſts in a Local Motion of the Air, without Vibrations; and this he proves by ſeveral Experiments. The Motion of the Air in Winds, will act ſtrongly on Flame, but will not affect the Ear with Sound, but on the Interpoſition of ſome Body which may occaſion ſome Vibrations: Whereas the Agitation of the Air in Sounds affects not Flame; for a lighted Candle put near a Bell

Bell which hath been ſtruck, will not have its Flame agitated by the Sound.

He concludes alſo, that Sound is not produced by a total and ſenſible Vibration of the ſonorous Body; but by inſenſible Vibrations of the little Parts, always helped, and ſometimes occaſioned by total Vibrations. Thus, when a Chord hangs looſe, it will move forward and backward quick enough (when ſtruck) without making any Sound; becauſe thro' want of being ſtraitly extended, each little Part can't make its Vibrations by itſelf, and communicate them to the Air.

In ſonorous Bodies, in the ſame, or of different Matter, the difference of Sound, as to *Grave* or *Acute*, flows from the greater or leſſer Spring of each Part, and from the more or leſs quickneſs with which theſe Parts do bend and unbend. Two Strings or Wires, one of Gold and the other of Steel, of the ſame *Length*, *Thickneſs*, and *Tenſion*, yet will give a different Sound, *viz.* the Gold one more *Grave*, the Steel-wire one more *Acute*; becauſe the Parts of the Gold are more ſoft and flexible, and have leſs Spring than thoſe of the Iron, and therefore will have leſs ſpeedy, and weaker Vibrations. But yet Sound, be it *flat* or *ſharp*, is ſtill *ſtrong* or *weak*; and 'tis not the *Strength* or *Weakneſs* of Sound, that renders it *flat* or *ſharp*: *ſtrong Sound* ariſes from *great Vibrations* in the Air, and from a *great Quantity* of it, moved in the ſame time; and the weak Sound is occaſioned by the juſt contrary. So that the Strength or Weakneſs of Sound, is in proportion to the *Quantity of Air ſtruck*, and the *Strength* of the Vibrations: But *Grave* and *Acute* Sounds follow the Proportion of greater or leſſer *Number* of the Vibrations of the Air in the ſame time.

The Reverend Mr. *William Derham*, a very induſtrious and uſeful Member of the *Royal Society*, in *Philoſophical Tranſactions*, N° 313. hath obliged the World with ſome very curious and careful Obſervations and Experiments about the Motion of Sound; being furniſhed with very good Inſtruments, and many Advantages to make them, which others have not been.

He obſerves, firſt, that there hath been a conſiderable difference in the Accounts given by good Authors, about the Velocity of the Motion of Sound. Sir *Iſ. Newton*, in *Princip. Lib. 2. Prop.* 50. allows but 968 Feet for the Progreſs of Sound in a Second of Time.

The Hon. Mr. *Fr. Roberts*, *Phil. Tranſ.* N° 207. 1300 Feet.

Mr. *Boyle*, in his *Eſſay* on *Languid* and *Unheeded Motion*, 1200 Feet.

Dr. *Walker*, in *Phil. Tranſ.* N° 247. 1338 Feet.

*Merſennus* in *Baliſtic. Prop.* 39. 1474 Feet.

*Flamſtead* and *Halley*, 1142 Feet.

The *Florentine Academy*, 1148 Feet.

The *French Obſerv. Hiſt. Acad. Regiæ*, 1172 Feet.

The Reaſon of this Diverſity he judges to ariſe, (1.) From theſe Gentlemens uſing not good Pendulum Clocks ordinarily, but a String and Plummet only, of ſuch a length as to ſwing Seconds. But this latter way can't be ſo exact as that by a Movement; becauſe the Obſerver's Eye muſt firſt obſerve the Flaſh of the Gun, *&c.* fired; and then the Swing of the Pendulum, which takes up Time, and occaſions much Confuſion. (2.) From there not being *diſtance* enough between the Sound and the Place of Obſervation. And, (3.) From there being no regard had to the *Winds*, of which more below. And he judges, that the little difference there is between the three laſt Numbers of 1142, 1148, and 1172, ariſes from there being good Pendulum Clocks made uſe of in theſe Obſervations, and the Diſtances being conſiderable.

After this, he propoſes to anſwer the following Queſtions:

1. How far a Sound moves in a Second of Time, and conſequently in any Time aſſigned?

2. Whether the Report of a Gun, diſcharged with its Mouth *towards*, comes *ſooner*, than when its *Muzzle* is *from* the Obſerver?

3. Whether Sounds move in the ſame Time, the ſame Spaces, in all States of the Atmoſphere, and Heights of the Barometer?

4. Whether they move faſter by *Day*, or by *Night*?

5. Whether they move ſwifter with, or ſlower againſt the Wind? And how the Wind affects them?

6. Whether Sounds move faſter in calm or ſtill, then in windy and turbulent Weather?

7. Whether a ſtrong tranſverſe Wind accelerates or retards the Motion of Sound?

8. Whether Sounds have the ſame Degree of Velocity in Summer and in Winter.

9. Whether they have the ſame in ſnowy and clear Weather?

10. Whether a great Sound and a ſmall one have the ſame Velocity?

11. Whether the Sound of a Gun move equally ſwift at all the Elevations of the Gun?

12. Whether different Strengths of Gun-powder change the Motion of the Sound of the Report?

13. Whether the Velocity be the ſame in all Heights of the Atmoſphere above the Earth?

14. Whether the Report be in the ſame Time, if the Piece be diſcharged in an *Acclive* or *Declive* Poſition?

15. Whether all kinds of Sounds, as of Guns, Bells, Beetles, *&c.* have the ſame Velocity?

16. Whether Sounds be ſwifteſt in the beginning of their Motion, and ſloweſt in the end?

17. Or whether they be not rather *equable*, moving equal Spaces in equal Times?

18. Whether Sound move equally ſwift in all Regions? in *North*, *South*, *&c.* Climates?

19. Whether Sound move in a right Line the neareſt way, or whether along the Earth's Surface?

To ſolve theſe Problems, Mr. *Derham* was at the trouble of getting, and had the advantage of hearing and ſeeing from the Tower of his Pariſh-Church at *Upminſter* in *Eſſex*, many Muskets fired at the diſtance of 1, 2, 3, and ſo far as to 8 Miles; beyond which he could not hear in that woody Place, the Report of a Musket. But tho' the Firing of theſe ſmall Arms did him much Serivce in his Deſign, he was much better ſerved by the Ordnance, or great Guns, on *Black-Heath*; for he could from his Church aforeſaid, always by Night with his naked Eye, and by Day with a Teleſcope, ſee the Flaſhes of the *Sakers* (a ſort of Cannon) there fired, to exerciſe her Majeſty's young Engineers, and hear their Report very plainly. On theſe he made many repeated Obſervations; and at laſt, by favour of the Board of Ordnance, he got leave to have two *Sakers* (ſee that word in

Vol. 1.) to be placed one by another on the Heath, but with their Muzzles quite contrary ways; and on the 13th of *Feb.* 170$\frac{4}{5}$ to be discharged continually every half Hour, from 6 in the Evening, till 12 at Night: There was a small Gale of Wind blowing directly against the Sound.

The Interval between the Flash and the Report of each Gun, he always found to be about 120, or 122 half Seconds of Time. He mentions both these Numbers, because the Sound of the Report always came double; the first within 120 half Seconds; the second (which he takes to be an Echo from the Wind-Mill, or adjacent Houses on *Black-Heath*) within 122.

He observed no difference in the Time of the Sound's Progress, when the *Saker* was fired *towards* him, or from him, which answers his second Question.

Nor did he find that any *different Elevation* of the several Muskets made any alteration in the Motion of the Sound; which is an Answer to his 11th *Problem*. And to solve the 12th Query, he found that different *Quantities* or *Strengths* of Powder, made no alteration in the *Velocity* of the Sound's Motion; tho' it manifestly did so in the *Strength* of the Noise. Nor did he find that there was any Variety in the Time of the Motion of the Sound, either by Night or Day; whether it were clear or cloudy; whether it rained or snowed, whether the Barometer were high or low, and whether it were Summer or Winter; which solves his 3, 4, 6, 8, 9 Queries. He found also, in answer to his 15th Question, that all kinds of Sounds, as of Bells, Beetles, Muskets, *&c.* from the same Distance came to his Ear in the same Time.

And the same he found, as to intense or strong, and languid or weak Sounds; which answers his 10th Question.

By repeated and very accurate Observations, he also found the Motion and Time of the Progression of Sound to be in all respects *equable*; which solves the 17th Problem: that is, that *Sound* moves just an *English* Mile in 9$\frac{1}{4}$, or 9, 25 half Seconds; two Miles in 18$\frac{1}{2}$, three Miles in 27$\frac{3}{4}$, *&c.* and so on uniformly.

As to his last, or 19th Question, he is confirmed, that Sound moves the nearest way, and that it doth not creep along the Earth's curved Surface: And he believes (in answer to the 14th Query) that the Velocity of the Sound is the same in *Accli-vites* and *Declivites*; tho' he hath not had opportunity of making Experiments *enough* to determine it exactly.

From the Communications which his Friends in *Italy* have afforded him, he thinks the Difference of Regions or Climates, makes no difference in the Motion of Sounds; which is an Answer to his 18th Question.

He found that very thick cloudy and snowy Weather, did always lessen and dull the Noise made by the Discharge of Guns, *&c.* whereas in frosty and clear Weather, they were much more audible, clear, and distinct, than at any other times.

By many repeated and accurately made Experiments, he discovered, that contrary Winds do always retard the Motion of Sounds, and that in proportion to their Strength; which is what the *Florentine Virtuosi*, and many others have formerly been entirely mistaken in; asserting, that Contrariety of Winds occasion no Retardation of the Motion of Sound.

By Observations and Experiments, made with proper Instruments, about the Velocity of the Motion of Wind, he concludes, that in the greatest and most rapid Storms that ever blew, the Wind moves not above 60 Miles an Hour, and perhaps not above 50; whereas Sounds may go above 700 Miles in the same time: and consequently they cannot be the same Particles of the Air or Atmosphere, which carry both; at least they can't be moved after the same manner. He concludes, as aforesaid, that the Velocity of Sound is such, that it ordinarily moves 5280 Feet, or an *English* Mile, in 9$\frac{1}{4}$ half Seconds: And that it moves 571 in a half, and 1142 Feet in a whole Second of Time. But that the Winds may so affect it, by conspiring with its Motion, as to carry it 600 Feet in half a Second; or, by being contrary to it, to retard it so, that it may not move more than 560 Feet in a half Second of Time.

He concludes with shewing the Uses that may be made of this Knowledge of the Velocity of the Motion of Sound, in measuring the Distances of Ships at Sea from one another, or of a Ship from Shore; of Forts and Batteries one from another, or of any Places at Land within the hearing of the Report of a Gun; of the Distances of Thunder, Clouds, *&c.*

In *Philosophical Transactions*, N°. 156, you have an Account of the Doctrine of Sounds, by *Narcissus* Bishop of *Ferns* and *Leighlin*; and in N°. 247, of the Swiftness of Sounds, and their Reflections by Echoes.

In the History of the Royal *French* Academy for *A. D.* 1700, they say it hath been experienced, that a Sound moves 180 of their Toises in a Second, or 283 middle *French* Leagues in an Hour. (1.) Therefore they conclude, that the Air must be moved or struck at first with a very great Smartness or Swiftness. (2.) All Conjectures and Physical Reasons persuade us, that this Motion or Stroke on the Air, must be impressed by very brisk Vibrations of the small Parts of the sonorous Body, in order that they may exert their Spring or elastick Force (3.) In *Philosophical Transactions*, N°. 297, you have an account of some Experiments of Mr. *Hawksbee*'s, whereby it appears plainly, that as exhausting the common Air out of a Receiver, doth very much lessen the Noise made by the Bell there hung and struck, so crouding or conveying more Air into a Vessel, made on purpose for such Condensations of Air, did very sensibly augment the Sound of the included Bell.

SOVERAIGN, was a Piece of Gold Coin, Currrent at 22 Shillings and Sixpence, in 1 *H.* 8. when, by Indenture of the Mint, a Pound Weight of Gold of the old Standard was to be coined into 24 Soveraigns. In 34 *H.* 8. *Soveraigns* were coined at 20 Shillings, and half Soveraigns at 10 Shillings. In 4 *Ed.* 6. Soveraigns were coined at 24 Shillings a-piece, and in 6 *E.* 6. at 30 Shillings; and also in 2 *Eliz.*

SOWNE, is a Term of Art used in the *Exchequer*, and seems a Corruption from the *French Souvenu*, i. e. *remembred:* For the Stat. 4 *H.* 5. *c.* 7. in the Original *French*, hath *Des Estreats oriens Souvenu.* And such Estreats and Casualties as are not to be remembred, run not in Demand, *i. e.* are not leviable. So now in the *Exchequer* they say, such Estreats as the Sheriff by his Industry cannot get, are *Estreats that Sowne not*; and *Estreats that Sowne*, are such as he may gather.

SPHERE,

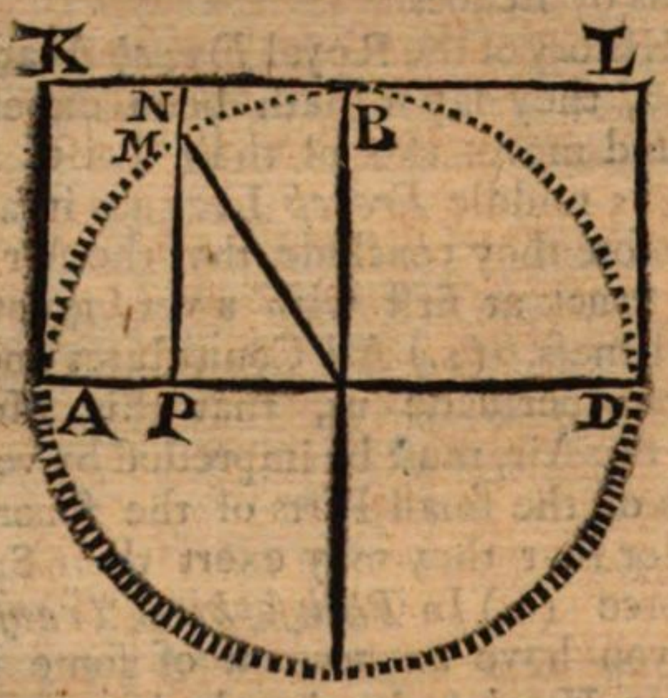
SPHERE: 1. The Surface of a Sphere is equal to the Periphery of a great Circle, multiplied by its Diameter; *Hayes*, p. 73.

2. The Area of any Segment of a Sphere cut off by a Plain, or by two Plains which are parallel, is to the whole Spherical Surface, as the intercepted Portion of the Diameter is to the whole Diameter. Wherefore putting $r$ = Radius, $c$ = Periph. and $x$ = the intercepted Diameter; the Area of any Segment may be found by this Proportion. $2r.x :: 2rc.cx.$

The Part of the Sphere's Surface contained between the Semi-circular Arks of any two (Great) Interfecting Circles, is to the whole Surface, as the Angle of Inclination of the Planes of thofe Circles is to 4 right Angles.

3. When the Diameter of any Sphere is equal to the Radius of any Circle, then the Area of that Circle will be equal to the Surface of the correfponding Sphere.

4. The Convex Area of a Cylinder Circumfcribing a Sphere of the fame Diameter with its own Altitude (which in this Notation will be $2rc$) is Quadruple of the Area of the Bafe; and confequently = to the Area of the Surface of the Sphere, and the Surface of an Hemifphere is = to twice the Area of one of its great Circles.




5. Suppofe the Square A L, together with the Semi-circle A B D, to revolve round A D as an Axis; then will the Line K L generate a Cylindrick Surface = to the Hemifpherical one generated by the Semi-circle (by 3.) Wherefore if any Point, as M, be affigned, and thro' it P N be drawn Normal to A D; I fay, the Surface or Ring defcribed by K N, will be equal to the Segment defcribed by the Ark A M. For the Ring defcribed by K N, will be to the whole Cylindrick Surface defcribed by K L, as K N, K L. And the Segment made by the Revolution of the Ark A M, is to the whole Spherick Surface, as A P, A D, that is, as K N, K L. Wherefore, &c.

About the Dimenfions of the Sphere and Cylinder; fee Dr. *Wallis* in *Philofophical Tranfact.* N°. 262. *p.* 547.

SPIGURNEL, was anciently (*Spigurnellus*) he that had the Office of the *Efpigurnantia*, or Sealing of the King's Writs. This Word *Spelman* and *Du Freine* recite, without interpreting it. But it feems to be taken from the *Saxon*, *Sparrau*, which fignifies to *fhut up*, *Seal* or Secure. *Kennet's Gloff. in Paroch. Antiquit.*

SPIRITUALITIES of a Bifhop, are fuch Profits as arife to him from the Benefit of his Jurifdiction in his Dioceffs, and not as a Baron of the Parliament; fuch as thofe of his Vifitations, Inftitutions, Ordinations, &c.

SPIRAL *Line*. See on this Subject further, *Stephano de Angelis de Infinitis Spiralibus inverfis*, &c. *Petavii*.

*Il. Bullialdi Demonftrationes Novæ de Spiralibus.*

SPLEEN. The Veffel which in Beafts they call the *Milt*, is fituated in the left *Hypochondrium*, under the *Diaphragm*, between the Ribs and the Stomach, above the left Kidney; it is tied to the *Peritonæum*, to the Diaphragm, and to the *Omentum*. 'Tis of a blueifh or leaden Colour, of an oblong Figure, thick at the edges, and not thin as the *Liver*: It hath two Membranes, the External comes from the *Peritonæum*; the Internal Membrane is finer and thicker than the External: for if you blow into the Splenick Artery, the Air will pafs thro' the one, but not the other. Its Fibres are not regularly woven, as thofe of other Membranes feem to be, but they come from innumerable Points, as *Radii* from fo many Centres; and the Fibres of one Point are regularly woven with the Fibres of the Points furrounding it. It receives Veins, Nerves and Arteries from thofe that enter the Spleen.

The Subftance of the Spleen is not only kept together by its two Membranes, but alfo by innumerable Fibres which come from the Points of the Internal Membrane, and are inferted in the Points of the oppofite fide of the fame Membrane; and Expanfion of the Extremity of thefe Fibres feem to compofe the Internal Membrane.

The Spleen is compofed of an infinite Number of Membranes, which form little Cells and Cavities of different Figures and Bignefles, which communicate with one another, and are always full of Blood.

At the Extremities of the Blood Veffels in the Spleen of Sheep, we find feveral white foft Specks, which *Malpighius* calls *Glands*.

The Spleen hath Arteries from the *Cœliaca*, whofe Capillary Branches make frequent Inofculations upon the Membranes of the Cells. Its Veins, whofe Extremities communicate with the Cavities of the Cells, as they come out of the Spleen, unite and make the *Ramus Splenicus* of the *Porta*, which carries the Blood from the Spleen to the Liver. Thefe, with its Nerves, which are confiderable, from the *Plexus Splenicus*, are equally diftributed thro' the whole Subftance of the Spleen, being all included in a *common Capfula*. There are likewife a few Lymphatick Veffels which arife from the Spleen, and difcharge themfelves into the *Lumbary Glands*.

The true Ufe of the Spleen is yet uncertain; the Antients thought it to be the Receptacle for the melancholick Humour: fome fince confidering that in the Spleen there are a great Number of Membranes and Fibres, and alfo many Nerves, have thought that the Blood is attenuated, and becomes more fpirituous in the Spleen: And confidering that the moft of the Blood in the Liver comes immediately from the Spleen and *Omentum*, they think that one furnifhes the Oleaginous, the other the Spirituous part of the Bile.

SPOTS *in the Sun*: Beſides what may be concluded about theſe Solar Spots, being no Planets revolving round the Sun's Body, as ſome have thought; Dr. *Hooke*, in his *Opera Poſt.* draws theſe further Concluſions: (1.) That theſe Bodies are either opake, and ſo hinder the Sun's Light from paſſing thro' them; or elſe are incombuſtible and dark Bodies, which will afford no Light at all for a certain time, and do, as it were, quench and deaden that part of the Sun where they riſe. (2.) There appear in ſome Parts of the Sun's Face, alſo *Nebulæ* or Clouds; in ſome others *Faculæ* or Blazes, which give a clearer Light than the other Parts of his Body. The Spots are ſubject to increaſe and decreaſe, having ſometimes covered a part of the Sun bigger than all *Europe*, and ſometimes bigger than the whole Surface of the Earth. (3.) The Motion of theſe Spots is always from *Eaſt* to *Weſt*, according to the Order of a Line of Sines, beginning from the Center, of which the Semi-diameter of the Sun is Radius. And this Motion appears to be in a ſtraight Line in the beginning of *June* and *December*; when the Earth is in that part of the Plain of the Ecliptick, which cuts the Plain of the Equinoctial of the Sun's turbinated Motion. At other times the Line of their Motion is incurvated and bent into an Ellipſis; which is greateſt when the Earth happens to be in thoſe Parts of the Ecliptick, which are the extreme Limits of it, compared to the Plain of the Sun's Equinoctial: And this alſo is twice a Year, *viz.* in the middle between the Nodes, both Plains paſſing thro' the Centre of the Sun, that is, about the beginning of *March* and *September*. Whence he deduces, by undeniable Demonſtration, that the Sun is of a Globular Figure, and that it moves on its own Axis from *Eaſt* to *Weſt*: As alſo, that the Axis of his turbinated Motion remains fixed, and is always directed towards the ſame Point in the Heavens, as the Earth's Axis is found to do; as alſo the Axis of *Jupiter* and *Saturn* is, as far as can yet be diſcovered by the Spots, Satellites, and Ring of theſe Planets. (4.) He obſerves alſo, that there is a kind of Torrid Zone, or certain Space or Breadth on each ſide the Sun's Equator towards the Poles, in which theſe *Maculæ*, *Nebulæ* and *Faculæ*, do appear moſt. Whereas, without theſe Limits, or in the temperate Zones (as with regard to our Earth they may be called) they appear but ſeldom, and never towards the Polar parts.

SQUADRON *of Ships*, is a Diviſion, or part of a Fleet, commanded by a Vice or Rear Admiral, or ſome other Commander or *Commadore*, as they call it; but the Number of Ships in it is uncertain.

SQUADRON, is a Body of Horſe, whoſe Number is not fixed; but uſually is from 100 to 200 Men, according to the General's pleaſure, the ſtrength of the Army, and as occaſion ſerves. Uſually a Squadron conſiſts of 3 Troops, each of 50 Men, and it never exceeds 200 Men; becauſe a greater Number than that can't be advantageouſly poſted, nor have room to act in *narrow Ground*, *Woods*, *Marſhes*, *Defiles*, &c. The Eldeſt Troop takes the *Right* of the Squadron, and the Second the *Left*, and the youngeſt the Center. A Squadron is always drawn up 3 deep, or in 3 Ranks, with the length of a Horſe between each Rank. The Standard is always in the Center of the firſt Rank.

SQUARE *Battel*, or *Battalion* of Men, is one that hath an equal Number of Men in Rank and File.

To form any Number of Men into a Square Battle, as ſuppoſe 500, extract the neareſt Square Root of 500, which is in Integers 22; and that will give the Number of Men for Rank and File. There will be a Remainder of 16 Men, who may be diſpoſed of as the Commander thinks beſt.

SQUARE *Battalion of Ground*, is when the Ground of the Flanks is of the ſame extent as the Ground of the Front and Rear. To make a ſquare Battalion of Ground; as ſuppoſe the Number were 60, multiply 60 by 3, the Number of Feet which every Man takes up in Front, the Product will be 180; divide that by 7, which is the Number of Feet each Man takes up in depth, or which is the diſtance of the Ranks, the Quotient without a Fraction will be 25, whoſe ſquare Root is 5; which will give the Number of Men in File. And if you divide the firſt given Number 60 by this Root 5, you will quote 12, which is the Number of Men in each Rank.

SQUARE *Hollow*, or *hollow Square*, in the Art Military, is a Body of Foot drawn up with an empty ſpace in the middle, for the Colours, Drums and Baggage, facing and covered by the Pikes every way to keep off Horſe.

STABLE-STAND, is the Term for one of the four Evidences or Preſumptions whereby a Man is convicted, to intend the ſtealing the King's Deer in the Foreſts. The other three are *Dog-draw*, *Back-bear*, and *Bloody-hand*. This *Stable-ſtand* is, when a Man is in *Stabili Statione*, at his *Standing* in the Foreſt with a *Croſs-bow*, or *Long-bow*, ready to ſhoot at a *Deer*; or elſe when he is *ſtanding* cloſe up by a Tree, &c. with Grey-hounds in a Leaſh ready to ſlip.

STAKE, is the Name of a ſmall *Anvil* uſed by Smiths; ſometimes it ſtands on a broad Iron-foot, on the Work-Bench, to be moved up and down occaſionally; and ſometimes it hath a ſtrong Iron Spike at the bottom, by which 'tis fixed to ſome place on the Work-Bench. Its uſe is to ſet ſmall and cold Work *Strait*, by hammering it on the Stake, or to cut or punch upon with the *cold Chiſſel*, or *cold Punch*.

STALLAGE, was a cuſtomary Rent paid in Fairs or Markets, for the Liberty of a *Stall* or *Standing*, by the *Stallangers* or the *Creamers*, i.e. thoſe Traders who expoſed their Goods to Sale on the ſaid Stalls. In *Scotland* they call it *Stallenge*; the *Romans* called it *Siliquaticum* from *Siliqua*, which was their firſt and leaſt Weight, a kind of *Caract* of 4 Grains.

STAMPING-MILL, called alſo a *Knocking-Mill*, is a Mill uſed in the Tin-works to bruiſe the *Ore* ſmall. See the Deſcription of it under *Tin*.

STANDARD for *Gold-Coin* in *England*, is 22 Caracts of fine Gold, and 2 Caracts of Copper; and the *French* and *Spaniſh* Gold are nearly of the ſame Standard. See *Caract*.

For *Silver-Coin*, 11 Ounces and 2 Penny Weight of fine Silver, and 18 Penny Weight of Copper, being melted together is the true Standard, and ſuch Silver is called *Sterling*. When either Gold or Silver is finer than Standard, they call it *better*; if coarſer, *worſe*: and they reckon the exceſs or defect by Caracts, and Grains of a Caract in Gold, and by Penny-weights in Silver. And it is thus diſcovered: They take a ſmall Quantity and *aſſay* it; that is, weigh it very exactly, and then melt it in a Crucible with a ſtrong Fire, ſo long

till the Copper, or other *Allay* mixed with it, be burnt away. When cold, they weigh it again accurately; and if it hath loſt nothing of the firſt Weight, they call it *fine Gold*; if it hath loſt $\frac{1}{24}$ part of its Weight, they call it Gold of 24 Caracts, or one Caract better than Standard; if it have loſt $\frac{2}{24}$ parts, then 'tis 22 Caracts fine, or Standard; if it hath loſt $\frac{3}{24}$ parts, 'tis called 21 Caracts fine, or 1 Caract *worſe* than Standard, *&c.* And ſo they aſſay Silver, only they compute its loſs by Penny-weights, *&c.*

STANNARIES; are the Mines and Works where *(Stannum)* Tin is dug and ſmelted; as in *Corn-wall*, and other Places. There are ſeveral Laws about, and Liberties granted to the *Stannary Courts* in ſeveral Acts of Parliament; as in the time of *Edw.* 1. and afterwards, as abridg'd by *Edw.* 3. and in 17 *Car.* 1. *c.* 15.

STAPLE, ſignifies this or that Town, City or Place where the Merchants of *England* were, by Act of Parliament, to carry their Wool, Cloth, Lead and Tin, *&c.* and ſuch like *Staple* or *Standing* Commodities of this Land, in order to their being ſold by the Great. Theſe Places you will find in ſeveral Statutes, appointed and altered by the Kings of *England*, from the ſecond Year of *Edw.* 3. to the fifth of *Edw.* 6. and what Officers theſe *Staples* had belonging to them, you may ſee in *Anno* 27 *E.* 3. *Stat.* 3. *c.* 21. The Staple Commodities of this Land, are Wool, Leather, Woolfells, Lead, Tin, Butter, Cheeſe and Cloth; as appears by 14 *Rich.* 2. *c.* 1. tho' ſome will allow only the firſt five.

STAR. All Deeds, Obligations, Contracts, Releaſes, *&c.* of the *Jews*, were antiently called *Stars*, from the *Hebrew Shetar*, a Deed or Contract. Theſe were ſometimes written in *Hebrew* and *Latin*, but uſually in *Hebrew* alone.

STAR-CHAMBER; was a Chamber at *Weſtminſter*, formerly ſo called, from its Roof being painted with Stars. *Henry* the Seventh and Eighth, ordered by ſeveral Statutes, that the Chancellor, aſſiſted by others there named, (*vid.* 3 *H.* 7. *c.* 1. and 21 *H.* 8. *c.* 2.) ſhould have Power to puniſh *Routs*, *Riots*, *Forgeries*, *Embraceries*, *Perjuries*, and ſuch other Miſdemeanors, as were not ſufficiently provided for by the Common-Law; and for which the inferior Judges are not ſo proper to give Correction. But this Court, by 17 *Car.* 1. *c.* 10. was entirely diſſolved and determined, and ſo continues to this day.

STATIONARY; how to an Eye placed at the Earth, a Planet appears to ſtand ſtill or be Stationary, ſee under the word *Direct* in this Vol. 2.

STELLIONATE, in the Civil Law, is all kind of Cozenage, and Knaviſh Practice in Bargaining; and all ſorts of Frauds that have no peculiar Names in the Law. And 'tis ſo called from *Stellio*, a Lizard with great variety of Spots, and very prejudicial to Mankind.

STERLING Money; this Word ſeems to come, as Mr. *Somner* hath derived it, from the *Saxon* Word *Steore*, that is, a *Rule* or *Standard*; and therefore it ſignifies that Coin or Money, which for Metal and Value, was to be a common Standard of all Current Money. And this is the more probable, becauſe ſuch Money, at the coming in of the *Normans*, was called *Sterilenſis*. As *Orderic. Vital. ſub Anno* 1082. *Porrigam quindecem Sterilenſium*, Dr. *Kennet's Gloſſary*. *Eſterling* in *Stow* is uſed for a Penny-weight, ſignifying a Penny of fine Silver, ſuch as we now call *Standard*. But the word *Sterling*, as being a Piece of Money, generally, if not always, ſignifies a *Penny*. And as for a good while together there was no other Coin but Pennys; and that *Denarius* ſignifies, in many Authors, the ſame as *Nummus*; all good *Standard* Silver came to be called *Sterling Silver*, and good Money, *Sterling Money*, as it is to this day.

STILES; the upright Pieces which go from the bottom to the top in any Wainſcot, are by the Workmen called *Stiles*.

STILOBATUM, is, in Architecture, the Body of the Pedeſtal of any Column.

STIPULATION, in the Civil Law, is a Contract made by Words, and not in Writing, by asking a Queſtion, and receiving preſently a proper Anſwer: And in this Contract the Obligation is only upon one ſide, *i. e.* on the ſide of the *Promiſer*, who was called *Reus Debendi*, or *Promittendi*; as the *Stipulator*, or *Creditor*, to whom the Promiſe is made, was called *Reus Credendi*, or *Stipulandi*. This was the old Senſe, but now with us the Word *Stipulation* is commonly uſed for the Act of the Perſon obliged; and ſome ſay that the Word *Stipulator* is common both to Debtor and Creditor.

STOMACH, ſee *Ventriculus*. Monſieur *Chirac*, Profeſſor of Medicine at *Montpellier*, hath by an eaſy Experiment ſhewn, that the Force of the Stomach alone (in Vomiting) without taking into conſideration the Muſcles of the *Diaphragm* and *Abdomen* (whoſe force *together* is more than that of 248000 Pound weight) is equal to that of 12000 Pound weight.

STRAIKS, in Gunnery, are Plates of Iron of the length and breadth of one of the ſix *Felloes*, which ſerve for the Round of the Wheel of a Gun-carriage, and fixed on the Circumference of the Wheel with ſtrong Nails, which are called the *Straik-nails*; theſe *Straiks* cover the Joints of the *Felloes*, and defend the Wheel.

STRIÆ, are the Liſts or Rays which run between the *Flutes*, *Channels* or *Striges*, in Fluted Pillars. Theſe are 20 in the Dorick, and 24 in the Ionick Order.

STRIGES, in Architecture, are the hollow Channels in the Shaft of a Column, called by our Workmen *Flutings* and *Grooves*. They more properly belong to the Ionick Order, tho' they are found ſometimes in the Dorick, and often in the Corinthian and Compoſite. They are generally at right Angles with the Plane of the Baſe, but are ſometimes found winding about the Pillar. Sometimes the *Striges* are filled up with a ſwelling a third part from the Baſe, lying in the hollow like a Stick ſhot of a round form: Theſe Mr. *Evelyn* thinks we ſhould call *Staved* or *Cabled Columns*.

STUCCO: Painting in *Stucco* was revived from the Antients by *Giovanni d'Udine*, a Scholar of *Raphael's*; he found the true Matter which the Antients made uſe of, which was a Compoſition of Lime and Marble powder'd very fine.

STRUT, is a Term uſed by ſome Builders for that *Brace*, which is framed into the *King-Piece* and the *principal Rafters*.

STUDDING-SAILS, in a Ship, are Bolts of Canvas, or any Cloth that will hold Wind, extended in a fair Gale of Wind along the ſide of the Main-ſail, and boomed out with a Boom; they are ſometimes alſo uſed to the Clew of the Main-ſail, Fore-ſail and Sprit-ſail, when the Ship goes either before the Wind, or Quartering.

STYLO-

STYLO-*Chondrohyoidæus*, vel *Stylo-Hyoides alter*, is a Muſcle of the *Os Hyoides*, which ariſes fleſhy and tendinous from the *Styloid Proceſs*, near the Origin of the *Stylo Pharyngæus*, and runs under the *Cerato-Gloſſus*. It is inſerted into the Cartilaginous Appendix of the *Os Hyoides*; and its Uſe is to aſſiſt the *Stylo-Hyoidæus*, in putting the *Os Hyoides* upwards and laterally. Dr. *Douglaſs*.

STYLO-*Hyoidæus*, is a Muſcle of the *Os Hyoides*, ariſing by a round Tendon from near the middle of the *Proceſſus Styliformis*, and is inſerted tendinous into the Baſis of the *Os Hyoides*, near its *Cornu*; to which alſo it often adheres fleſhy. Its Uſe is to put the Bone of the Tongue on one ſide, and a little upwards, when both act in Concert.

SUBNORMAL; is a Line, determining in any Curve, the Interſection of the Perpendicular to the Tangent in the Point of Contact, with the Axis. And this Subnormal, in the common or *Apollonian* Parabola, is a determinate invariable Quantity; for 'tis always equal to half the *Parameter* of the *Axis*.

SUBROGATION, in the Civil Law, is putting another Perſon into the Place and Right of him, that, in any Caſe, is the proper *Creditor*. This is alſo called *Ceſſion*.

SUBSTITUTION, is, in Algebra or Fluxions, the putting in the room of any Quantity in an Equation, ſome other Quantity which is really *equal* to it, but expreſs'd after another manner; and this is done, in order to find, at leaſt, ſuch a proper Expreſſion in the Equation, as ſhall ſolve the Problem, or Queſtion propoſed. And in the Knack of doing this readily, conſiſts the chiefeſt Buſineſs of the Operations in Fluxions.

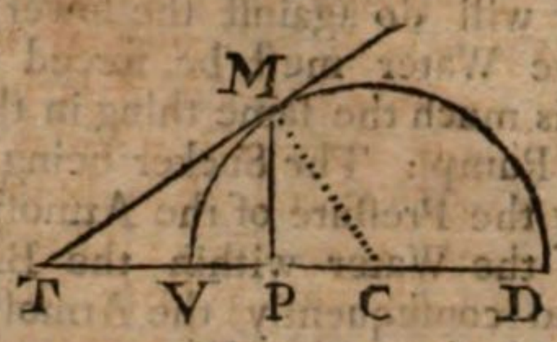
SUB-TANGENT, in any Curve, is the Line which determines the Interſection of the Tangent in the Axis. And in any Equation if the value of the Sub-tangent come out *Poſitive*, 'tis a ſign that the Point of Interſection of the Tangent and Axis, falls on that ſide of the Ordinate where the Vertex of the Curve lies; as in the *Parabola and Paraboloids*. But if it come out *Negative*, the Point of Interſection will fall on the contrary ſide of the Ordinate, in reſpect to the Vertex or beginning of the Abſciſſa; as in the *Hyperbola*, and *Hyperboliform Figures*.

And univerſally, in all *Paraboliform* and *Hyperboliform Figures*, the *Sub-tangent is equal to the Exponent of the Power of the Ordinate multiplied into the Abſciſſa*.

Thus, in the common Parabola, whoſe Property is $px = yy$, the Sub-tangent is in length equal to $x$ the Abſciſſa multiplied by 2, the Exponent of the Power of $yy$, the Square of the Ordinate; that is, 'tis equal to twice the Abſciſſa: and by the former Rule for Paraboliform Figures, it muſt be taken above the Ordinate in the Axis produced. Thus alſo in one of the cubical Paraboloids, where $p\,x\,x = y\,y\,y$, the length of the Sub-tangent will be $\frac{1}{3}$ of the Abſciſſa.

Thus, in the Figure annexed, you will ſee that the

SUB-TANGENT, in any Curve, is a Line which determines the Interſection of the Tangent




in the Axis. Thus, if T M be a Tangent in the Point M, and P M an Ordinate to the Axis, the T P is the Sub-tangent, becauſe it determines the Point T, where the Tangent cuts the Axis produced beyond the Vertex of the Curve V. And the Line P C, which determines the Interſection of the Perpendicular *M C* (to the Tangent in the Point of Contact M) in the Axis V D, is called the *Subnormal*.

SUBURBICARIÆ *Regiones*, called alſo *Suburbanæ*, *Urbicariæ vicinæ*; were ſuch Regions or Cities of the Roman Empire, as lay within an hundred Miles of *Rome*, and were under the Juriſdiction of the Præfect of that City: Wherefore they are ſometimes called *Regiones Solitæ*, becauſe in theſe the Governour of *Rome* was wont to exerciſe his ſolemn Juriſdiction. This alſo was the antient Extent of the Power and Charge of the Biſhops of *Rome*, before the Papal Uſurpation.

SUCTION; there are many Effects vulgarly attributed to *Suction*, which, in reality, have very different Cauſes. As when any one *ſucks* Water, or any other Liquor up thro' a Pipe, 'tis commonly thought, that by that Action the Perſon *draws* the Air up into his Mouth, and that the Water, which is contiguous to it, follows it by a kind of *Attraction*, as if the Air and Water hung together: And others fancy that the Air moves into the Mouth of the *Sucker*, and the Water moves up after the Air, to prevent a *Vacuum*, which they ſay, *Nature abhors*. Whereas the true Cauſe of this Phænomenon, is only that the Air and Atmoſphere preſſes with its whole weight, uniformly on the Surface of the Liquor in the Veſſel, and conſequently prevents any one part of the Water to riſe higher than the other there: And if a Pipe be put in of any tolerable large Bore, and be open at both ends, the Water will riſe within the Pipe to the ſame height as without, and indeed a little higher, becauſe the Preſſure of the Air within the Pipe is a little taken off by bearing againſt the ſides of the Pipe. Now when any one applies his Mouth to the upper end of the Pipe and ſucks, his Lips ſo ſtrongly encloſe the Pipe, that no Air can get between them and it; and by the voluntary Motion of the Spirits in the Muſcles, the Cavity of his *Thorax*, or Breaſt, is opened and enlarged; by which means the Air included there, hath now a much larger Space to dilate itſelf in, and conſequently cannot preſs ſo ſtrongly againſt the upper end of the Pipe, as it did before the Cavity of the *Thorax* was ſo enlarged, and when the Weight of the whole Atmoſphere kept its Spring bent. And that Weight or Preſſure being now taken off by the Lips of the Man that ſucks, the Æquilibrium is deſtroyed, the Air gravitates on the Surface of the Water, but cannot do ſo on the upper Orifice of the Pipe, becauſe the Juncture of the Lips takes it off; and the Spring of the Air included in the Thorax, being weakened

by the Dilatation of its Cavity, it cannot preſs ſo hard againſt the upper Orifice of the Pipe, as the Water will do againſt the lower, and conſequently the Water muſt be forced up into the Pipe. 'Tis much the ſame thing in the Suction of a common Pump: The Sucker being tight, takes off entirely the Preſſure of the Atmoſphere on the Surface of the Water within the Barrel of the Pump; and conſequently the Atmoſphere by its weight muſt force the Water up to make the Æquilibrium. See *Hydroſtaticks*.

SUFFRAGAN; is a titular Biſhop appointed to aid and aſſiſt the Biſhop of the Dioceſs, and by 36 *H.* 8. *c.* 14. every Biſhop is empowered to elect two honeſt and diſcreet Spiritual Paſtors, which ſhall be called *Biſhops Suffragans*.

SULPHUR: Sir *Iſ. Newton*, on very good grounds, concludes, that the common Sulphur is compoſed of volatile and fixed Parts, ſtrictly adhering to one another by mutual *Attraction*, ſo that they will both ſublime together; for by diſſolving Flowers of Sulphur in Oil of Turpentine, and then diſtilling the Diſſolution, 'tis found, that Sulphur conſiſts of a thick, volatile and inflammable Oil, or of a *fat Bitumen*, an *acid Salt*, and a very fixed Earth, with a little Metal. The three firſt of which are found there in nearly an equal Quantity; but there is only a very ſmall Proportion of the laſt. The *acid Salt* being diſſolved in Water, is the ſame with the *Oleum Sulphuris per Campanam*.

SUMMATORY *Calculus*, according to ſome, is the ſame with the *Calculus Differentialis* of *Leibnitz*: but more properly *Summatory Arithmetick*, is the Art of finding the flowing Quantity, from the Fluxion; and ſo it is the ſame with the *Calculus Integralis*. See *Hayes*'s Fluxions.

SUMMONER, or *Summonitor*, an Apparitor, who is to cite in Offenders, to appear at a certain Time and Place, to anſwer to the Charge exhibited againſt them.

SUMMUM *Bonum*, or the chiefeſt Good of human Nature, is that, which, by its enjoyment, renders truly and compleatly happy. The Schools diſtinguiſh this chief Good of Man, into that which is ſimply and adequately ſo, and beyond which there can be no other; and into a leſſer and ſubordinate one, which is in ſome meaſure attainable in this imperfect State; and this laſt they call *Fœlicitas Viatorum*, and the former *Fœlicitas Comprehenſorum*.

SUN: Dr. *Hooke*, in *Opera Poſt. p.* 89. from all his, and others Obſervations, thinks it reaſonable to conclude, That the Superficies of the Sun is covered with an Air, or Atmoſphere, or ſome other Fluid Body: And that this Atmoſphere, tho' poſſibly 80 times thicker and higher than that about our Earth; yet in compariſon of the vaſt Diameter of the Solar Body, becomes wholly inviſible to us, tho' aſſiſted by the beſt Teleſcopes: He ſuppoſes it alſo to look as bright as the Body of the Sun it ſelf, and that it is really the Shell of this Atmoſphere, and not the very Body of the Sun that ſhines. And from hence he ſaith, that all the Phænomena of the *Maculæ* and *Faculæ* of the Sun will be ſolved; and that they are only Clouds or Smoaks in this Atmoſphere.

The Sun it ſelf, within this Atmoſphere, he concludes to be a Solid and Opacous Body, (*p.* 91.) from theſe Reaſons. (1.) The Conſtancy of its Rotation. (2.) The Fixedneſs of its Axis. (3.) The Power of its Gravitation or Attraction towards its Centre. Theſe prove its Solidity; and its Opacity, he concludes, from the diſappearing of the Solar Spots in the Limb, and their not returning backwards, as they would ſeem to do if the Body were tranſparent as the Atmoſphere is, or the Flame of a Candle, or the Radiation or hazy Light about the *Nucleus* of a Comet, thro' which, as well as thro' its Beard, the ſmall fixed Stars may be ſeen.

He thinks the ſuperficial Parts of the Sun, to conſiſt of Bodies ſimilar to our Nitre and Sulphur, and that theſe are ſet on fire; and conſequently, that the Phyſical Cauſe of its Light, is the actual burning or fire of its ſuperficial Parts. Nor can there be any Objection of Moment brought againſt this Hypotheſis, from the danger of the Sun's Fire being burnt quite out in ſo many thouſand Years as it hath been in being; for, (*ſaith he*) ſuppoſing it to have grown ſome Minutes leſs ſince it began to give Light, none can contradict it by any Obſervations we have on Record: For, ſuppoſing we had Obſervations Aſtronomical of 4000 Years ſtanding, as we have none above 2000 of that kind; and allowing that the Sun's Diameter had been then obſerved to be as many Minutes as it is now; yet could it not be thence concluded, that the Sun did not loſe a Mile in Diameter every Year, and conſequently be now 4000 Miles leſs in Diameter than it was then. For ſince his Diameter is near 87 times greater than that of the Earth; which latter he ſuppoſes 8000 Miles, then the Sun's muſt be 696000 Miles. Now 4000 is but a 174th part of that Diameter, and conſequently would have diminiſhed it but $\frac{1}{2}$ of a Minute; which is a much leſs Quantity than the Antients pretended to obſerve to.

But, ſuppoſing they could have obſerved even to Seconds, yet that could not have contradicted it; becauſe 'tis poſſible the Sun may have approached as much nearer us as that Diminution amounts to; and for which, *he ſaith*, he could ſhew a Reaſon.

Sir *Iſ. Newton* alſo, in his Opticks, gives good Reaſons, to ſuppoſe the Sun and fixed Stars to be great Earths, vehemently hot; whoſe Heat is conſerved by the Greatneſs of their Bodies, and the mutual Action and Re-action between them and the Light which they emit; and whoſe Parts are kept from fuming away, not only by their *Fixity*, but alſo by the vaſt Weight and Denſity of the Atmoſpheres incumbent on them, and every way ſtrongly compreſſing them, and condenſing the Vapours and Exhalations which ariſe from them. The Light ſeems to be emitted from the *Sun* and fixed Stars (which probably are Suns to other Syſtems) much after the manner as Iron, when heated to ſuch a degree as to be juſt going into Fuſion by the vibrating Motion of its Parts, emits with Force and Violence, copious Streams of Liquid Fire all around: Great Bodies muſt preſerve their Heat longeſt; and that, perhaps, in the Proportion of their Diameters.

Sir *Iſ. Newton* hath made it probable, that the great Comet in the Year 1680, in its *Peribelion*, went ſo near the Sun, as that it acquired a Heat which would not entirely go off in 50000 Years. Whence we may gueſs, that if the Sun and fixed Stars be only Collections of denſe and ſolid Matter, like the Planets, but heated to a very intenſe degree, they may be many Millions of Years without loſing any conſiderable part of their Heat.

Accord

According to *Caſſini*, the Sun's diſtance from the Earth is 172,800,000 Miles *Engliſh*.

The Phænomena of the Sun's apparent Motion round the Earth, on which the Theory of this vaſt Body is eſtabliſhed, are by Aſtronomers obſerved to be theſe:

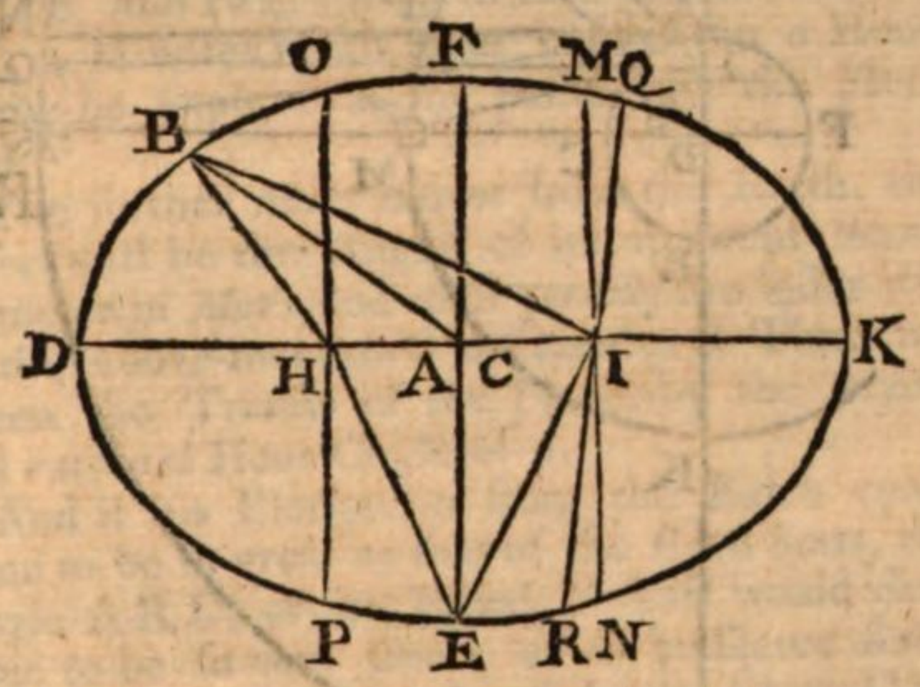
1. *That the Centre of the Sun's Body moves annually in the ſame Plane of the Ecliptick, and never deviates from the Line ſo called.*

Which apparent Motion of the Sun doth in reality belong to the Earth; which being at firſt put into ſuch a Motion, and with ſuch a Direction by the Great Creator, will always continue to move after the ſame manner; ſince here none of thoſe *diſturbing Forces* have any Place, which render the Motion of the Moon ſo irregular. Of which in its proper Place.

2. *But the apparent Motion of the Sun in the Ecliptick is very unequal; for a little after the Vernal, and a little before the Autumnal Equinox, he is in the Mean between the Extremes of his Motion; but his Motion is moſt ſwift a little after the Winter Solſtice, as 'tis always moſt ſlow* a little after *the Summer one every Year.*

All which ariſes from the Earth's revolving not in a Circle, but an Ellipſis, in one of whoſe *Foci* or *Umbelici* the Sun is placed. And with this Law alſo, that the Areas deſcribed by Lines drawn from the Earth to the Sun, ſhall always be equal, in equal and proportional times.

In the Figure annexed, let the Sun be in the Point I, and let the Curve FDEK be an Ellipſis, or the annual Orbit of the Earth's Centre revolving round the Sun, and repreſented by B.




Let the Point H be the other *Focus*, and C the Centre of the Ellipſis; KD its great Axis, or the *Linea Apſidum*; and D the Aphelion; and K the Perihelion of the Earth. FE is the leſſer Axis, IC, or CH is the *Eccentricity*, or the diſtance between the Centre and the *Foci*. Let MN, or OP, be the *Latus Rectum* of the Ellipſis, and let the right Line AB biſect the Angle HBI: Now ſince by Lines drawn from its Centre to the Sun, the Earth deſcribes always Areas proportional to the Times of its Motion in the Orbit, it will deſcribe equal Areas in equal Times. But ſeeing the Line BI grows *longer* towards and at the Aphelion, and *ſhorter* at and about the Perihelion, the Earth muſt move ſlower in the former, and ſwifter in the latter Caſe. And indeed the Velocity of the Earth's Courſe in her Orbit, will always be in a reciprocal Ratio of her diſtance from the Sun; ſo that if the diſtance between D and I be double to that between K and I, ſhe will move twice as faſt in the Perihelion as in the Aphelion.

3. And from this Figure 'twill be apparent, that the Sun's Diameter will appear *greater* when the Earth is in her Perihelion, which is a little after the Winter Solſtice, and *leſs* when ſhe is in her Aphelion, which is a little after the Summer Solſtice, as is found by Obſervation. And this difference in his apparent Diameter, ſhews alſo that the Earth moves not in a Circle, but an Ellipſis round the Sun.

4. Thoſe Places in the Ecliptick, in which theſe greateſt Differences of the apparent Motions and Diameters of the Sun happen, in proceſs of time are *changeable*, and do move forward (or *in conſequentia*) equally. For tho' the *Aphelia* and *Nodes* of the Planets are really at reſt and immoveable; yet becauſe of the annual Ceſſion of the Equinoxes *in antecedentia*, they appear to be moved forward juſt the ſame Quantity.

5. If you ſuppoſe the Ecliptick to be biſected in the Equinoxial Points, the Sun appears to ſtay about 8 Days longer in the *Northern* than in the *Southern* half of that Circle.

For the Elliptick Orbit of the Earth will be cut unequally by a Line paſſing thro' the 2 Equinoctial Points: The Perihelion not being far from the Winter Solſtitial Point, the Equinoctial Points will not be coincident with the longer Axis, but almoſt with the *Latus Rectum*; for in the Figure above the Line of the Equinoxes, QR is not much different from NM the *Latus Rectum*.

But this Inequality of the Sun's apparent Motion, is not now the ſame as it was in *Ptolemy*'s Time, and is continually changing, and in proceſs of Time the Equinoctial Points will come to be in K and D; and then there will be no difference in the time of the Sun's ſtay in either Segment of the Ecliptick: But after this it will encreaſe again, and then again decreaſe as now, if the Earth's annual Motion be continued.

6. And yet the Spaces or Times of the Earth's entire Revolution in her Orbit, are all equal one to another, and are what we call *Years*, containing each 365 Days, 5 Hours, and 49 Minutes nearly.

7. The Angle of the Inclination of the Planes of the Ecliptick and Equator, or the Sun's greateſt Declination hath been always invariably the ſame, *viz.* 23, 30.

8. The Sun's Diurnal Parallax is almoſt inſenſible, and his Menſtrual Parallax is ſcarce 15 Minutes of a Degree.

And this is of the greateſt uſe in Aſtronomy throughly to underſtand; nay, of ſuch an abſolute neceſſity, that, without its Knowledge, neither the Diſtances nor Magnitudes of the Sun or Planets, can be obtained to any tolerable Certainty.

There have been three Ways made uſe of by Aſtronomers, to find the Sun's Horizontal Parallax.

1. That of the famous *Hipparchus*, which proceeds on the Theorem which our Mr. *Horrox* hath accurately deſcribed and explained, and which is exactly and geometrically certain, and would do if the Parallax of the Sun were any conſiderable quantity: but all that we can accurately conclude from it, is, that it is not ſo; and conſequently that the Diſtance of the Sun is vaſtly great. See Mr.

Mr. *Whiſton*'s *Prælect. Aſtron.* p. 61. where there is a ſhort account of this Method.

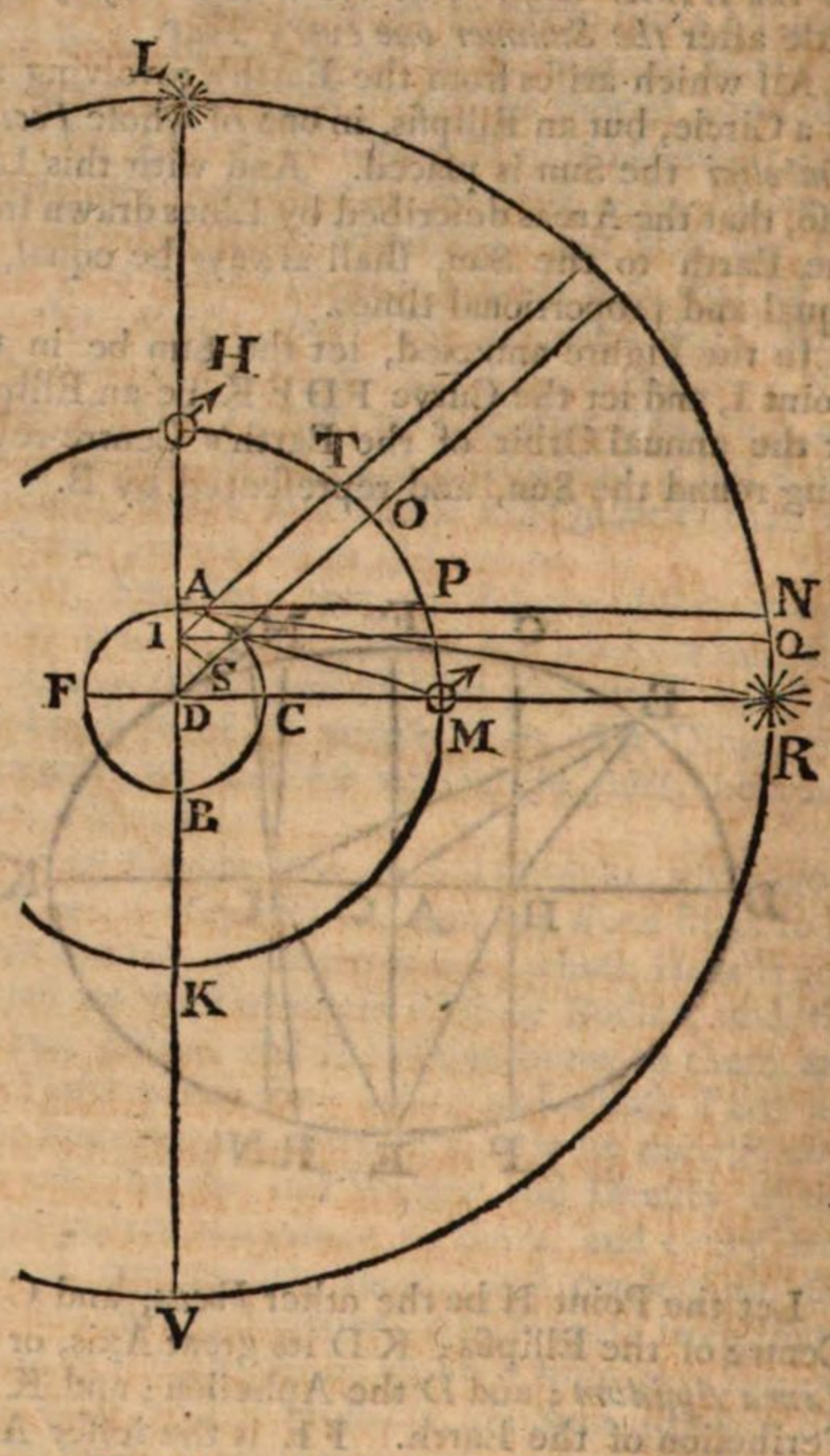
2. The ſecond way of finding the Sun's Horizontal Parallax, is that which 'tis ſaid *Ariſtarchus Samius* firſt uſed, and hath been followed by *Kepler*, *Vendeline*, and more eſpecially by *Ricciolus*. This ſuppoſes that you have the exact Moment of the Time of the *Half-Moon*, or the *Dichotomization*, or *Biſection* of her Disk, by the Light and Shadow; and ſome other things, as difficult to obtain as what you ſeek for: And therefore I ſhall ſay no more of it, than only to refer you to Mr. *Whiſton*'s Book, p. 66. where you have a good account of this Method; becauſe I muſt give you an account of

3. A third way of finding this Horizontal Parallax of the Sun; which tho' it be not ſo direct, is yet more accurate and exact than either of the former.

And this depends on a Method of determining firſt the Parallax of *Venus* or *Mars*.

The annual Parallax of the fixed Stars, being by late Obſervation eſtabliſhed, the *Copernican* Syſtem is ſo too, and the *Proportions* of the Diſtances of all the Planets from the Sun are given. And ſince 'tis clear in that Syſtem, that not only *Mars* and *Venus*, but even *Mercury*, do ſometimes come nearer to the Earth than the Sun ever doth, and conſequently muſt have all of them a greater Parallax than the Sun at ſuch times; from hence it is manifeſt, that if we can get the Parallax of *Mars*, when in oppoſition to the Sun, or that of *Venus* and *Mercury*, when in conjunction with him; the Sun's Parallax will be diſcovered. Indeed, as to *Mercury*, he is uſually ſo hid in the Sun, and his Motion is yet ſo indetermined, that nothing certain can be eſtabliſhed about his Parallax. And the Conjunctions of *Venus* and the Sun are ſo rare (and that time only is proper for it) that its Parallax is as yet not accurately enough determined.

There remains then *Mars* only, who being ſometimes diſtant from the Earth, but half as far as the Sun; and being at ſuch times, when he is in oppoſition to the Sun, very conſpicuous and fit for Obſervation, is much the moſt fit Planet for our preſent Purpoſe. *Caſſini* ſeems to have been the firſt that thought of, and practiſed this Way; but our Mr. *Townley*'s Invention of the *Micrometer* hath been very ſerviceable to him in it, as well as of the greateſt uſe in other Aſtronomical Obſervations. Before we deſcribe the Method of *Caſſini* for finding the Sun's Parallax, I muſt remind you, that the Parallax of *Mars*, for inſtance, is only the difference between the apparent Place of that Planet, with reſpect to the Earth's Centre, and to a Point on its Surface, when the Planet is exactly in the Obſerver's Horizon; that is, you muſt ſuppoſe two Obſervers, one with his Eye at the Earth's Centre, and the other Eye at the Earth's Horizon, at the other Extremity of a Semidiameter of the Earth, whoſe Poſition is normal to that Line which connects the Earth's Centre, and that of *Mars*, the latter being accurately in the Horizon of that Obſerver, who is ſuppoſed at the Surface. And thus, for inſtance, the Moon's Parallax may be obtained by the Obſervations of two Aſtronomers at the ſame Minute of Time, if ſhe be *Vertical* to one of them, and *Horizontal* to the other; becauſe the Moon's Place to the Vertical Obſerver will be the ſame as if he had ſeen her from the Centre of the Earth. And this Method, with good Inſtruments, will do for any other Planet or fixed Star. But the Method of *Caſſini* for finding the Parallax of *Mars* (v. gr.) hath this great Advantage in it, That it may be performed by the Obſervation of but one Aſtronomer furniſhed with a good Teleſcope and Micrometer; ſince the Part of the other may be ſupplied by means of the fixed Stars: Of which now take *Blanchinus*'s Account, in the *Leipſick Acts of* October, 1685, with ſome few Explications and Corollaries. Let the Circle A F B C repreſent the Earth's Equator, H K M the Diurnal Ark of *Mars*, when he moves in the Equator; L V R, as the Equinoctial in the Heavens, extended infinitely in the Region of the fixed Stars. Let *Mars* be in A, in the Plane of the Equator; then his Diurnal Revolution will be truly repreſented by the Motion of the Line D H, round D as a Centre, in the Plane of the Equinoctial, ſo as to form the Circle H M K,




which the Planet is ſuppoſed to deſcribe in 24 Hours round the Earth, without any regard now to any other Motion. Then if you ſuppoſe this Circle to be divided into 24 equal Parts, thro' each of which a Plane ſhall paſs at right Angles to the Equator, and alſo thro' the Centre D; theſe Planes will be the Planes of the Hour Circles, and will alſo be *Meridians*, with reſpect to Places on the Earth. Let the right Line L H A V be one of theſe Planes, or the Meridian of the Place A in the Earth's Equator, where an Obſerver ſees the Planet *Mars*, and the fixed Star L in one and the ſame right Line. Now if the Star and the Planet had only the ſame Diurnal Motion, they would be both together again at the ſame Place, or in the ſame right Line, at the end of 24 Hours;

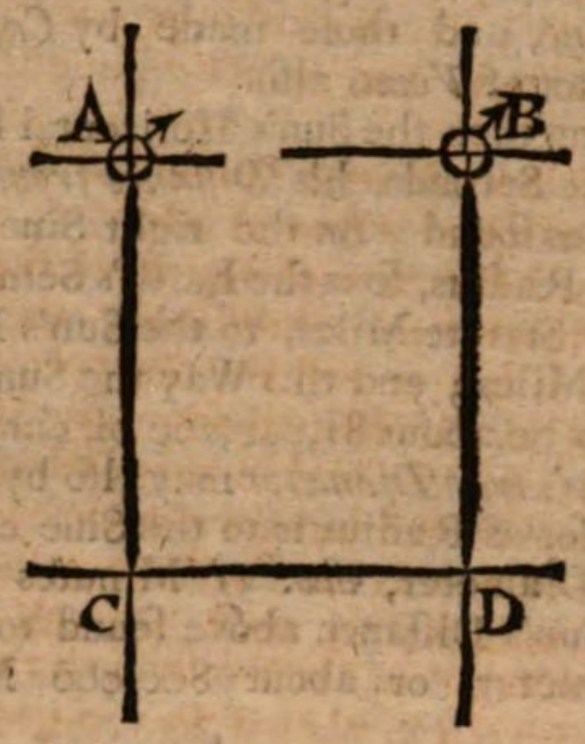
Hours; and if the Diurnal Motion be ſuppoſed equable, in ſix Hours the Planet and Star would be in the right Line FDMR, at right Angles with the Meridian LHD, or in the Aſtronomical Hour-Circle of 6. Wherefore an Eye placed at the Earth's Centre, would always ſee the Planet and the Star in one and the ſame right Line, or in conjunction together, whether in the Meridian, or any other Hour-Circle. But it can't be ſo to an Eye at the Earth's Surface, as ſuppoſe at A; for tho' under his proper Meridian, both the fixed Star and the Planet will appear to him in the ſame right Line AHL, yet in any other Meridian, as ſuppoſe that of DR, (which, in reſpect of the Place at A, may be conſidered as the Hour-Circle of 6) *Mars* will appear to him in the Plane AM, but the fixed Star in the Plane AR. To him therefore *Mars* will either appear *Retrograde*, or to move *in Antecedentia*, or the Star to move *in Conſequentia*; altho' in reality both are ſuppoſed to have the ſame Diurnal Motion. And tho' he knows that they are both at the 6 Aſtronomical Hour-Circle, yet *Mars* will appear to be paſt it, before the 6 Hours are expired: Becauſe the *ſenſible* 6th Hour, with regard to the Place A, is not the Plane FDR, but APN. And the difference of Time intervening between *Mars* coming to the *ſenſible* Hour-Circle of 6, and the *rational* or *real* one, which may be called the Planet's *Horary Parallax*, is meaſured by the Ark of the Equator PM, which *Mars* by his Motion deſcribes. And the Quantity of this Ark is equal to that of the Angle PAM, or its Alternate AMD; that is, equal to the Angle of the Earth's Semi-Diameter, when ſeen in *Mars*, and this is that *Parallax* of *Mars* which we have been ſeeking. Wherefore if the Ark PM be juſt one Degree, *Mars* will appear to have paſſed the Plane AP, 4 Minutes of an Hour before the 6 Hours would be expired in his paſſing by the Meridian.

The further *Mars* moves from the Earth, the leſſer will be the Angle of its apparent Semi-diameter in *Mars*, and conſequently the leſſer will be the above-mention'd difference of Time between the Tranſit of the Planet by the *ſenſible* and *rational* Hour-Circle of 6.

And if his Elongation from the Earth could come to be ſo great as that of the fixed Stars, the Angle ARD, or its Equal NAR would then come to be ſo very ſmall, as to be ſcarce ſenſible; ſo that when the Star is in the Plane DR, it would appear in that of AN.

And by this means a fixed Star, or rather a good Pendulum Clock, made to move with the Star's Hour, will ſupply the Want of another *Obſerver*, in the Place repreſented by C; for all that an Aſtronomer there could do, is only to aſſure us, that he had ſeen *Mars* in the ſame Plane of *his* Meridian, or of *our* 6th Hour Circle, when he appears to us in another Poſition. But this our Clock can inform us of, by ſhewing us that Time after *Mars* hath tranſited our Meridian. For ſince 'tis plain that the Star L, in 6 Hours after it hath paſſed our Meridian, will be in the Plane of the Hour Circle DR, we ſhall know the Star is actually in that Plane, by our Clock's ſhewing us, that the Time is elapſed. And becauſe, with regard to the fixed Stars (whoſe diſtance is ſo immenſe) the Plane of the *ſenſible* Hour Circle of 6 is coincident with that of the *real* one; if, when 6 Hours are paſt from the Star's tranſiting our Meridian, a Plane be imagined to paſs thro' our Eye, and the Star parallel to the Earth's Axis; that Plane muſt be that of the ſenſible Hour-Circle of 6, and in which the Star muſt neceſſarily be. But *Mars* will appear to differ from this, by ſo many Minutes of his Parallel, as are the Number of his Parallax. Counting therefore by the Pendulum, the Seconds of Time, which intervene between the Tranſit of *Mars*, and of the fixed Star, and allowing four ſuch Seconds for every Minute of a Degree, you will have the Quantity of the Angle MAN, or AMD, which is the Parallax of the Plane ſought.

But how this difference of Time is obſerved, I muſt next ſhew you. In the common Focus of the *Object* and *Eye-glaſſes* of the Teleſcope you obſerve with, there muſt be placed at leaſt 4 fine Threads,




or Hairs, interſecting one another at right Angles; and the Teleſcope furniſhed with its *Micrometer*, muſt be ſo moved up and down, till that fixed Star which is then neareſt the Planet *Mars* ſhall appear to paſs along one of the Hairs, as the Image of the Planet moves in the Teleſcope, as it muſt do, parallel to the Equator; for then the Hairs will, in that Poſition, be alſo parallel to the Equator; and the other Hairs which croſs them at right Angles, will anſwer to the Circles of right Aſcenſion. As in the Figure annexed, where the two parallel Threads AB and CD, have 2 others, AC and BD, placed at right Angles to them, juſt as the Equator and all its Parallels do interſect the *Meridians*, or Circles of right Aſcenſion always at right Angles; the Obſerver then muſt wait a while with his Teleſcope and Micrometer adjuſted, till the Planet and fixed Star, being both carried together by the ſame apparent diurnal Motion, come to one and the ſame Meridian: and then the exact Time of the Appearance muſt be noted. After 6 Aſtronomical Hours, the fixed Star will be come into the Plane of the 6th Hour Circle, but *Mars* will be got thither a little before the Star. About the Hour of 6 therefore the Teleſcope muſt be uſed again, and the Hairs retaining their former Poſition, muſt be brought into the Plane of the Hour Circle of 6, and there fixed. Then the exact Moment of Time muſt be noted when *Mars* appears by his diurnal Motion to move along by the tranſverſe Hair AC; and the exact Difference in Time alſo between the Planets and the Star's coming thither afterwards, muſt be nicely counted, as being the Time of the Horary Parallax of *Mars*: which being turned into Parts of a Degree, as above ſhewed, is the

Hori-

Horizontal Parallax of the Planet required.

By this Method, our *Flamstead*, and *Cassini* at *Paris*, found the Parallax of *Mars* to be about 25 Seconds, and certainly not more, but probably a little less.

Having thus gain'd the Parallax of *Mars*, let us next endeavour to obtain by it the thing at first proposed, that is, the Sun's Horizontal Parallax; which will be easily had from that of the Planet *Mars*. For since at this time of Observation of the *Martial* Parallax, *i. e.* when *Mars* is in opposition to the Sun, the Sun must be more than twice as far distant from the Earth as the Planet *Mars* is, the Sun's Parallax can't be quite half so much as that of *Mars*, and therefore may be accounted not to be above 10 or 12 Seconds at the most. And this agrees with the Observations of *Vendeline*, and those made by *Cassini* about the Parallax of *Venus* also.

Supposing then the Sun's Horizontal Parallax to be about 10 Seconds, his *Distance from the Earth* will be thus found: As the right Sine of 10 Seconds is to Radius, so is the Earth's Semi-diameter in *English* Statute Miles, to the Sun's Distance in the same Miles; and this Way the Sun's Distance is found to be about 81,000,000 of our Miles.

The *Sun's true Diameter* may also by this means be had; for as Radius is to the Sine of the Sun's apparent Diameter, *viz.* 31 Minutes and a half, so is the Sun's Distance above found to his real or true Diameter, or about 800,000 Miles *English*.

Indeed the true Magnitude of the Sun's Body cannot be determined from hence, because that depends also on his Density, which cannot be found this way.

From this usual way of finding the Sun's Horizontal Parallax, the Astronomers draw these and such like Consequences:

1. *That it is easier to determine the annual Parallax of the fixed Stars, than the Sun's diurnal one.* For since the annual Parallax of the fixed Stars is at least quadruple of the Sun's diurnal one, as the Parallax of *Mars*, by whose Knowledge the solar one was found, is almost double of it; it must be better subject to Astronomical Observation, and be capable of a Determination twice as accurate.

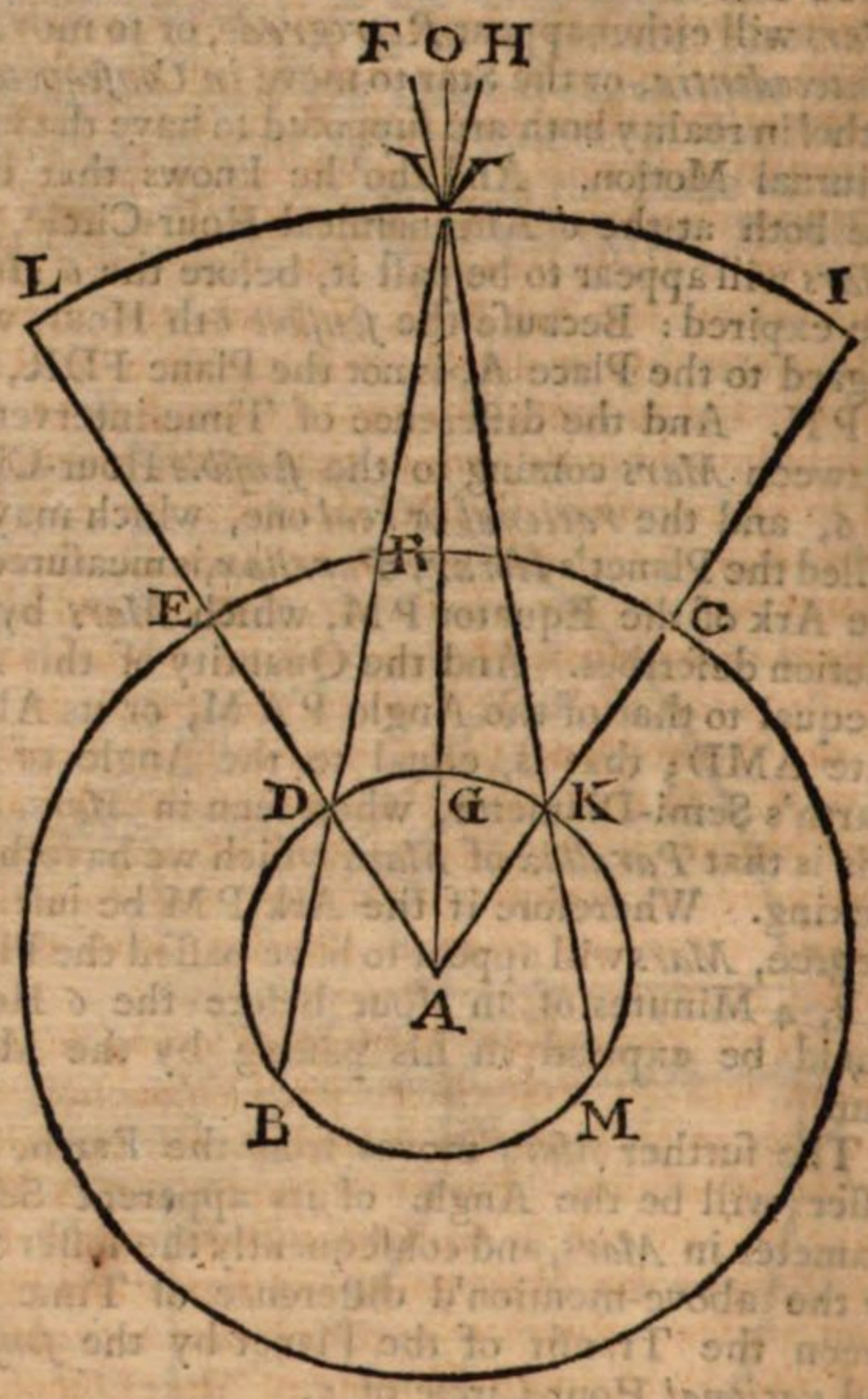
2. *In Astronomical Calculations by the Tables, this Parallax of the Sun may generally and safely be neglected.* For since it doth not arise to above a sixth part of a Minute of Time, it will be scarcely considerable; our present Astronomical Tables not being capable of bringing us to a greater Accuracy and Exactness.

3. *The Earth's Distance from the Sun being given, the Distances of the other Planets, both from the Sun and the Earth, are also given*; and in the following Table you have their Distances from the Sun, their Diameters, and the Times of their Periodical Revolution.

| | | |
|---|---|---|
| The Diameter in *English* Miles of | *Mercury* | 4240 |
| | *Venus* | 7906 |
| | *Earth* | 7935 |
| | *Mars* | 4444 |
| | *Jupiter* | 81155 |
| | *Saturn* | 67870 |
| | *Sun* | 763460 |

| | | Days. | Hours. |
|---|---|---|---|
| The Time of the Periodick Revolution of | *Mercury* | 87 | 23 |
| | *Venus* | 224 | 17 |
| | *Earth* | 365 | 6 |
| | *Mars* | 686 | 23 |
| | *Jupiter* | 4332 | 12 |
| | *Saturn* | 10759 | 7 |

| | | |
|---|---|---|
| *Mercury* | | 32,000,000 |
| *Venus* | | 59,000,000 |
| The Earth | is distant from the | 81,000,000 |
| *Mars* | Sun, of *English* Miles | 123,000,000 |
| *Jupiter* | | 424,000,000 |
| *Saturn* | | 777,000,000 |




SUPERIOR *Planets*, are *Mars*, *Jupiter*, and *Saturn*: They are so called, because they move in Orbits round the Sun, which are larger than that of our Earth, and so are above us with regard to the Sun, and never can come between the Earth and him. The Theory of the Motions of these superior Planets, to an Eye placed on the Earth, are these:

1. That, besides their apparent Motion from *East* to *West*, which the diurnal Rotation of the Earth occasions, they appear usually to move also slowly from *West* to *East*, and to make entire Revolutions this way; as in reality they do in their Orbits round the Sun: But *Mars* moves faster than *Jupiter*, and *Jupiter* than *Saturn*, in proportion to their several Distances from the Sun.

2. But sometimes they will also to an Eye at our Earth, appear to move the contrary way from *East* to *West*, which was a great difficulty in the old Astronomy, but may easily be solved by the consideration of the following Diagram; in which let A be the Sun, M G B the Orbit of the Earth, in which it moves annually from M by G, towards B,

B from *West* to *East*; let the Circle Q R S be the Orbit of any Superior Planet moving the same way as the Earth. Let the Circle T V X represent the Sphere of the fixed Stars supposed at an immense distance, and with respect to which, the Retrogradation and Stations, &c. of the Planet are accounted. For tho' to an Eye placed in the Sun at A, the Planets would appear to move always uniformly and equally forward in their Orbs, as in reality they do; yet to an Eye placed on the Surface of our Earth, the Phænomena will be very different, and the Planets will appear sometimes to be *Retrograde* and *Stationary* in their Motions, as well as at other times *Direct*. For, suppose the Earth at M, and *Jupiter* in C, while *Jupiter* moves from C to R, and describes the Ark *C R*, a part of its Orbit round the Sun in A: The Earth, because its Angular Motion is much more swift, will describe the Ark *M G*; so also while *Jupiter* describes the Ark R E, the Earth will move from G to B. Now while the Earth is describing the Ark M K, *Jupiter* will appear to be moving *a little* forward; but whilst the Earth moves thro' the Ark K G, *Jupiter*, tho' in reality still progressive or direct, will appear to be Retrograde, and to move backward from *F* to *O*. Nor can it be otherwise, while the Earth moves from G to D, and while *Jupiter* describes the Ark R E. But when the Earth comes towards *B*, then the Planet will appear a little *direct* again, and his apparent Progressive Motion will for a while continually encrease. And when the Earth is near *K* or *D*, the Planet will appear to be Stationary in F or H. So that 'tis obvious to see that the apparent Motion of the Planets will be very irregular and unequal, sometimes swifter, and sometimes slower, according to their Position, with respect to the Earth.

3. The Progressive Motion of every Superior Planet will be swiftest in his Conjunction with the Sun, as his Retrograde Motion will be swiftest in his Opposition. For the apparent direct Motion of the Planet in his Conjunction, arises from the *Sum* of the Motions of the Earth and Planet then moving directly contrary one to another; and the Retrograde Motion in the Opposition arises from the greatest *Excess* of all the Terrestrial Motions above the Planetary, both from there being then the least Distance between the Earth and the Planet, and from the Parallelism of their Motions at that time, as is clear from the Consideration of the Figure.

SUPERFICIES; they are frequently placed upon a Sector, 2 Lines (one on each Leg) which Mr. *Gunter* calls very properly *Lines of Superficies*. They are made by finding mean Proportionals between the two Homologous Sides, and the hundredth part of such a Side, or by a Table of Square Roots; which Roots may be taken out of the Divisions of the Lines of Lines, and they will give the proper Distances from the Centre, where the 10 (or 100) unequal Divisions must be placed.

*The Uses of the Line of Superficies.*

1. *To find the Proportion between two or more Similar Superficies.*

Take one of the Sides of the greater Surface, and put it over from 10 to 100, at the end of the Line of Superficies. Then take the corresponding Sides of the Similar Surfaces severally, and carrying the Points of the Compasses so that they fall on the same Number on each Leg, they will there shew the Proportion which they bear to 100.

2. *To augment a Surface, or to diminish it in a given Ratio*, as suppose in the Ratio of 2 to 5.

Take the Side of the Surface, and to it open the Sector in the Points 2 and 2, in the Line of Surfaces; and, letting the Sector lie, the Distance between 5 and 5, will give you the Side of a Similar Figure, whose Area shall exceed that of the given one in the Proportion required. And proceed *vice versa*, for *diminishing*.

3. *To Add together, or to Substract one from another, Similar Surfaces.*

Find first the Ratio between the Surfaces by *Prop.* 1. and then Add or Substract the Numbers, expressing those Proportions by *Prob.* 2. and then augment or diminish by the precedent Problem.

4. *To find the Ratio between Unlike or Non-Similar Surfaces.*

First find *Squares* equal to those Surfaces, and then those being Similar Figures, you may easily find the Ratio they bear by *Prob.* 1.

SUPREMACY of the Queen within her Dominions, is declared by the 37th Article of the Church of *England*, by *Can.* 1. and 2. by Stat. 25 *H.* 8. *c.* 19, 20, 21. and by Stat. 1 *Eliz.* 1. to be Power of Sovereignty and Rule over all Persons born within her Majesty's Dominions and Realms, of what Estate soever they be, whether Ecclesiastical or Civil (or Temporal) so as no Foreign, nor other Power, shall, or ought to bear any Superiority over them. This Supremacy chiefly consists in the following Instances.

1. That the Archbishops of either Province cannot summon their Bishops and Clergy to Convocation, nor enact any Canons, without the Queen's express Consent, by 25 *H.* 8. *c.* 19. Whereas before that Act the Convocation was often called, and Laws were made by it for Governing the Church, without any Authority from the Crown.

2. In that there lies now an Appeal from the Archbishop to the Queen in *Chancery*; and on such an Appeal, a Commission under the Great Seal is to be directed to certain Persons, whereof commonly half are Lay-men, and half Clergymen; which is called the Court of *Delegates*; and which finally determines all Ecclesiastical Causes, by 25 *H.* 8. *c.* 19. tho' sometimes a Review is granted. Before this Statute, the Appeal from the Archbishop's Court lay to the People only.

3. The Queen can grant Commissions for visiting such Places as are exempt from the Jurisdiction of the Bishops and Archbishops, and Appeal lies from thence to the Queen in *Chancery:* Whereas before 25 *H.* 8. the Pope could only visit them, and receive Appeals from those Courts.

4. Persons in Holy Orders are not, as formerly, exempt from the Queen's Temporal Laws, any more than Laymen. And,

5. Now the Bishops and Clergy neither Swear, nor pay any Obedience to the Pope, but must take the Oaths of Allegiance and Supremacy to the Queen, *&c.*

SURFACE *Line*, or Line of *Superficies*, is a Line placed by Mr. *Gunter* on each Leg of his Sector; 'tis divided into 100 unequal Parts, and numbred with 1, 2, 3, 4, *&c.* to 10. See *Superficies.*

SWALLET, in the Lead-Mines in *Mendip*, is their Term for a Quantity of Water which breaks in upon them in their Work; when they meet with it, they drive an Adit on a level till it is dry. See *Lead.*

SYMPATHY, is an Agreement of Affections between two or more Persons; some have thought that there is also a Sympathy between some Natural Bodies, or their Particles. But this ought rather to be called a *Congruity.* See that Word.

SYNDICK, in the Civil Law, is sometimes the Title of a single Person, deputed to act for any Corporation or Community.

SYNODALS, or *Synodies*, were a pecuniary Rent (commonly two Shillings) paid to the Bishop at the Time of the annual Synod, by every Parochial Priest. For the Bishops used to hold their Diocesan Synods, and to visit all at once; from whence these Synodals are accounted amongst the Bishop's Procurations at this Time.

SYNODALES *Testes*, the Urban and Rural Deans were at first so called, from informing against, and attesting the Disorders of the Clergy and People in the Episcopal Synod. But when they sunk in their Authority, the *Synodical Witnesses* were a sort of impanelled Jury, consisting of a Priest and two or three Laymen for every Parish. And, at last, two for every Diocess were annually chosen, till, at last, this Office came to be devolved upon the Church-wardens. Some think our Questmen, who are assistant to the Church-wardens, were called *Sides-men*, from hence *quasi Synod-men.*

SYNODALE *Instrumentum*, was the Solemn Oath that these *Synodical Witnesses* took, as now our Church-wardens are Sworn to make their just Presentments.

SYZIGIES; how to calculate the exact Time of the *True* and *Mean* Syzigies of the Sun and Moon, in order to the determination of Eclipses, *vid. Whiston*, p. 145.



TABERDERS, or *Tabiters*, for so, by Corruption, 'tis now pronounced, are the Batchelor Scholars of the Foundation of *Queen's* in *Oxon*: They were so called from a short Gown, called *Taberd*, or *Tabert*, in those Days, reaching no lower than their Middle-leg; which these Batchelor Scholars were then obliged to wear.

TACTICKS, is the Art of disposing any Number of Men into a proper form of Battle: The *Greeks* were very skilful in this part of the Art Military; having Publick Professors of it, who were called *Tactici*, who were to teach and instruct their Youth in this Matter. *Ælian* hath a particular Book on this Subject; and there is a great deal of it in *Arrian*, in his History of *Alex. M.* and in *Mauritius* and *Leo Imperator.*

TAILLE *Douce*, a Term in Painting, signifying, as Mr. *Evelyn* in Chalcography tells us, the Art of Sculpture or Chalcography it self. In *French* it signifies *sweetly or tenderly cut*; and this, whether done with the *Burin* (or Graver) or with *Aquafortis*, which we call *Etching.* He saith, the *Italians* call it *Intaglia* or *Stamp*, without any Epithet or Adjunct; and also *Bolino*, which he takes to be the more antient and unwarrantable, as implying the use of the *Point* and *Needle*, and of *Etching* with *Aquafortis*; which is sometimes so happily performed, as scarce to be discerned from the finest Stroaks of the *Bolio*, or *Graver* it self.

TALLAGE, was formerly a certain Rate or Proportion, according to which Barons and Knights were tax'd by the King, and inferior Tenants by their Lords. And this latter *Tallage* of the Customary Tenants was sometimes fixed and certain, and sometimes at the arbitrary Pleasure of the Lord; and it was also sometimes compounded for.

TALUS *Superior*, in Fortification, is the Slope on the top of the Parapet; for the top of the Parapet is made sloping, that the Soldiers may defend the Covert-way with small Shot, which they could not do if it were level.

TANGENT; a Plane is said to be a Tangent to a Cone, when 'tis coincident with two Lines, one of which is drawn on the Surface of the Cone, and thro' its Vertex, and the other a Tangent to the Circle of the Base, meeting the former Line in the Point of Contact.

TANGENT *Line*, how the Line of Tangents and half Tangents are made, you'll find under *Scales*; and their Uses in *Projecting* and *Measuring* the Parts of *Right Circles* in Spherical Projection, you have under Spherick Projection. And the Use of the Line of artificial Tangents, in concert with the Line of Sines and Numbers, you have in Plain Trigonometry, *&c.* But there are some other Uses of the Lines of Tangents and half Tangents in *Dialling*, &c. Sometimes on the edge of *Gunter's* Sector you have a *Tangent Line*, in whose end a Pin or Gnomon, equal to Radius, is normally placed; and by that means the Sun's Altitude may be had, by holding the Sector erect, and the Pin parallel to the Horizon; for then the Shadow of the Gnomon, when turned to the Sun, will, in the Divisions of the

the Tangent ſhew the Degree of the Sun's height.

This Tangent-Line is uſed alſo to draw the Hour-Lines on the Planes of Dials; and is commonly known and ſhewn in almoſt all Books of Dialling.

On the Croſs-ſtaff there are alſo Lines of Tangents drawn; one uſually of 36 deg. 3 min. and another of 49 deg. 6 min. which, becauſe their middle Points are at 20 and 30, are, by Mr. *Gunter*, called the Tangents of 20 and 30. Theſe Tangents are uſed in taking of Angles, the Altitude of the Sun or Stars, *&c.* as you will find under *Croſs-ſtaff*.

Dr. *Wallis* gives an Abſtract of his two Methods of drawing Tangents to Curves, in *Philoſophical Tranſactions*, N° 81. which are taken from his *Conick Sections*, and other Parts of his Mathematical Works. And Dr. *Barrow*, in his fourth Geometrical Lection, *p.* 40. gives a general Method of determining the Tangents to all *Cycloids*, and all other Curves deſcribed, or generated after the manner of a *Cycloid*. In Lect. 9, 10. he ſhews how to determine Tangents to all manner of *Spiral Curves*, and to many Curves of other kinds. In *Philoſophical Tranſactions*, N° 284. you have a Method of Tangents, by Mr. *H. Ditton*, taken from the Theory of *Maxima* and *Minima*, which is very ſimple and univerſal.

TARTANE; is a ſmall Veſſel, much uſed in the *Mediterranean*, with but one Maſt, and the three-cornered Sail, like a Galley; they fiſh with them on the Coaſts of *Spain*.

TASSELS, in a Building, are thoſe Pieces of Boards that lie under the Ends of the Mantle-trees.

TAXERS; are two Officers choſen in *Cambridge*, to look after the true Gage of all Weights and Meaſures.

TEETH: Mr. *de la Hire* obſerves, that the *Bone* of the Tooth doth not grow in Adult Perſons, but only the *Perioſtium*; which is a Subſtance very different from the Bone every way. 'Tis compoſed, *he ſaith*, of an infinite Number of ſmall Threads, which are faſtened to the Bone by their Roots, much like the *Horns* and *Nails* of Animals; theſe little Threads grow as the Nails. When a part of the *Perioſtium* is broke, and the Bone is laid bare, the Tooth uſually periſhes.

TELESCOPES: (1.) Sir *Iſaac Newton*, in his admirable Treatiſe of Opticks, *p.* 59. demonſtrates, *That the Perfection of Teleſcopes is impeded by the different Refrangibility of the Rays of Light*; and not, as hath been vulgarly ſuppoſed, by the *Spherical Figures* of Glaſſes: and conſequently, they will not be perfected by Glaſſes of the Figures of the *Conick Section*, i. e. by *Parabolick*, *Hyperbolick* Glaſſes, *&c.* For having ſhewed the Ratio between the leſs and greater Refractions of the different Rays to be very nearly as 27 to 28, *he ſaith*, thoſe that are skilled in Opticks, will eaſily underſtand, that the leaſt circular Space, into which the Object Glaſſes of Teleſcopes can collect all ſorts of parallel Rays, is about the $27\frac{1}{2}$ part of half the Aperture of the Glaſs; or the 55th part of the whole Aperture; and that the *Focus* of the moſt refrangible Rays, is nearer to the Object Glaſs than the *Focus* of the leſs refrangible ones, by about $27\frac{1}{2}$ part of the Diſtance between the Object Glaſs, and the *Focus* of the mean refrangible ones.

And if Rays of all ſorts, flowing from any one lucid Point in the Axis of any Convex *Lens*, be made by the Refraction of the *Lens* to converge to Points not too remote from the *Lens*, the *Focus* of the moſt infrangible Rays ſhall be nearer to the *Lens* than the *Focus* of the leaſt refrangible Rays, by a Diſtance which is to the $27\frac{1}{2}$ part of the Diſtance of the *Focus* of the mean refrangible Rays from the *Lens*, as the Diſtance between that *Focus* and the lucid Point from whence the Rays flow, is to the Diſtance between the lucid Point and the *Lens* very nearly.

After this, he ſhews, by Experiments, made with very great accuracy, that the Rays of Light, which differ in Refrangibility, do not all converge to the ſame *Focus*; but if they flow from a lucid Point as far from the *Lens* on the one ſide, as their *Foci* are on the other, the *Focus* of the moſt refrangible Rays ſhall be nearer to the *Lens*, than that of the leaſt refrangible, by above the 14th part of the whole Diſtance: And if they flow from a lucid Point ſo very remote from the Glaſs, that, before their Incidence, they may be accounted parallel; the *Focus* of the moſt refrangible Rays, ſhall be nearer to the *Lens*, than the *Focus* of the leaſt refrangible, by a 27th or 28th part of their whole Diſtance from it. And the Diameter of the Circle in the middle Space between theſe two *Foci*, which they illuminate when they fall there on any Plane, perpendicular to the Axis (which Circle is the leaſt into which they can all be gathered) is about the 55th part of the Diameter of the Aperture of the Glaſs. So that 'tis a wonder that Teleſcopes do repreſent Objects ſo diſtinctly. But were all the Rays of Light equally refrangible, the Error ariſing only from the Sphericity of the Figures of Glaſſes, would be many hundred times leſs. And expreſly by Calculation, *p.* 70. he proves, that the Error ariſing from the ſpherical Figure of Glaſſes, to that ariſing from the different Refrangibility of the Rays, is as 1 to 8151; and conſequently is ſo little, as deſerves not to be conſidered.

There is another Argument, (ſaith our excellent Author, *p.* 73.) which proves, that the different Refrangibility of the Rays, is the true Cauſe of the Imperfection of Teleſcopes. For the Errors of the Rays ariſing from the ſpherical Figures of the Object-Glaſſes, are as the Cubes of the Apertures of ſuch Object-Glaſſes: And thence to make Teleſcopes, of various Lengths, magnify with equal Diſtinctneſs, the Apertures of the Object-Glaſſes, and the *Charges*, or magnifying Powers, ought to be as the Cubes of the ſquare Roots of their Lengths; which doth not anſwer to Experience. But the Errors of the Rays ariſing from the different Refrangibility, are as the Apertures of the Object-Glaſſes: And thence to make Teleſcopes of various Lengths magnify with equal Diſtinctneſs, their *Apertures and Charges ought to be as the Square Roots of their Lengths*: And this anſwers to Experience, as is well known. For inſtance; a Teleſcope of 64 Feet in Length, with an Aperture of $2\frac{2}{3}$ Inches, magnifies about 120 times with as much Diſtinctneſs, as one of a Foot in Length, with $\frac{1}{2}$ of an Inch Aperture, magnifies 15 times.

By reaſon of this different Refrangibility, he concludes that there can ſcarce be any other means of improving Teleſcopes by Refractions alone, beſides that of *increaſing their Lengths*; for which end the late Contrivance of *Hugenius* ſeems well accommodated. (See *Philoſophical Tranſactions*, N°. 161.) For in his *Aerial* Teleſcope, the Glaſſes are readily manageable, and the Object-Glaſs being upon a ſtrong upright Pole, becomes more ſteady.

Sir *Iſ. Newton*, in his *Opticks*, p. 76, acquaints us how he poliſhed his reflecting Metal, which he uſed in his reflecting Teleſcope; and which, becauſe it appears to be a much better way than in any common Uſe, I here give the Reader.

I had two round Copper-plates, each of ſix Inches in Diameter, the one Convex, and the other Concave, and ground very true one to another; on the Concave I ground the Object Metal or Concave, which was to be poliſhed, till it had taken the Figure of the Convex, and was ready for a Poliſh; then I pitch'd it over thinly, by dropping melted Pitch upon it, and warming it, to keep the Pitch ſoft, whilſt I ground it with the Concave Copper, wetted to make it ſpread evenly all over the Convex. Thus, by working it well, I made it as thin as a Groat, and after the Convex was cold, I ground it again, to give it as true a Figure as I could. Then I took Putty, which I had made very fine, by waſhing it from all its groſs Particles, and laying a little of this on the Pitch, with the Concave Copper, I ground it upon the Pitch, till it had done making a noiſe; and then on the Pitch I ground the Object Metal with a brisk Motion, for about two or three Minutes, leaning hard upon it. Then I put freſh Putty upon the Pitch, and ground it again, till it had done making a noiſe, and afterwards ground the Object-Metal upon it, as before; and this Work I repeated, till the Metal was poliſhed, grinding the laſt time with all my Strength for a good while together, and frequently breathing upon the Pitch, to keep it moiſt, without laying on any more freſh Putty.

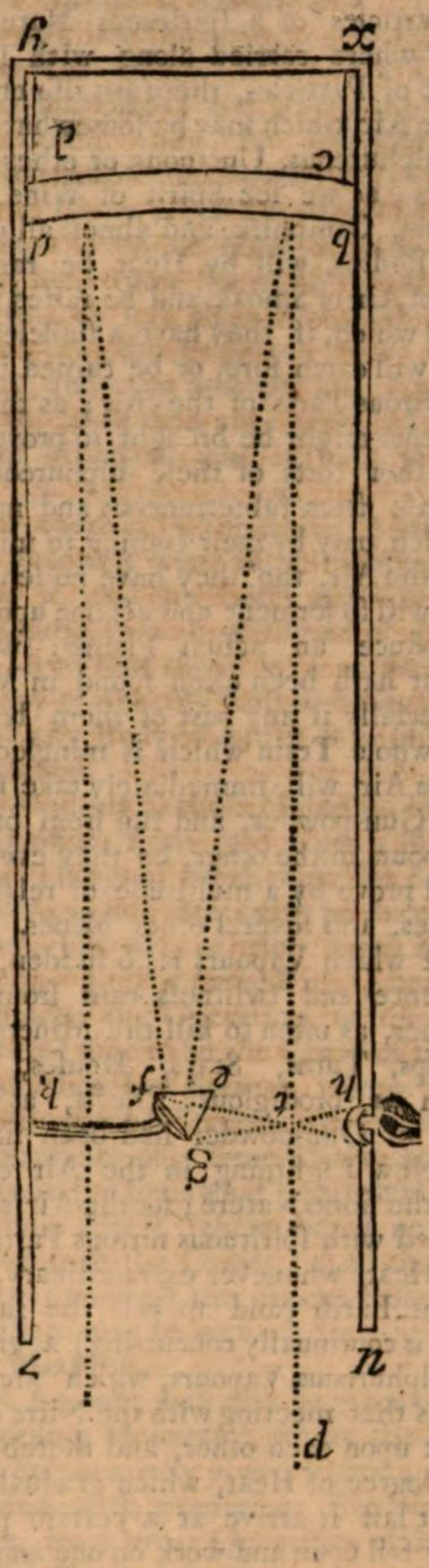
But becauſe Metal is more difficult to poliſh than Glaſs, and is afterwards very apt to be ſpoiled by tarniſhing, and beſides reflects not ſo much Light as Glaſs, Quickſilver'd over, does; I propound, inſtead of Metal, to uſe a Glaſs, ground Concave on the fore-ſide, and as much Convex on the back-ſide, and on the back-ſide well Quickſilver'd over; the Glaſs alſo muſt be exactly all over of the ſame thickneſs, otherwiſe the Object will look coloured and indiſtinct.

With ſuch a Glaſs I tried, about five or ſix Years ago, to make a Reflecting-Teleſcope of four Feet in length, to magnify about 150 times: And I ſatisfy'd myſelf, that there wants nothing but a good Artiſt to bring this Deſign to Perfection: For the Glaſs being only after the common manner of grinding Glaſſes for Teleſcopes, tho' it ſeem'd as good as Object-Glaſſes uſed to be, yet when it was Quickſilver'd, the Reflection diſcover'd innumerable Inequalities all over the Glaſs: And by reaſon of theſe Inequalities, Objects appear'd indiſtinct in this Inſtrument. For the Errors of *Reflected Rays*, cauſed by any Inequality of the Glaſs, are about ſix times greater than the Errors of *Refracted Rays*, cauſed by the like Inequalities. But I however found by this Tryal, that the Reflexion on the concave ſide of the Glaſs, which I fear'd would diſturb the Viſion, did really no ſenſible prejudice to it; and conſequently, that nothing is wanting to perfect theſe Teleſcopes but good Workmen, who can grind and poliſh Glaſſes truly ſpherical. I once mended a common fourteen Foot Object-Glaſs conſiderably, by grinding it with Pitch or Putty, and leaning very eaſily on it in the grinding it, leſt the Putty ſhould ſcratch it: beſides, leaning too hard on the Glaſs in grinding it, is apt to bend it; and then the Figure cannot be truly ſpherical.

Sir *Iſaac Newton*'s Method of ſhortning Teleſcopes, *vid.* his *Opticks*, p. 29.

Let *abde* repreſent a Glaſs ſpherically concave on the Fore-ſide *ab*, and as much convex on the Back-ſide *cd*, ſo that it be every where of an equal thickneſs; for it muſt not be thicker on one ſide than the other, leſt it make Objects appear coloured and indiſtinct: it muſt alſo be very well wrought and quickſilver'd over on the Back-ſide: Place this Glaſs in the Tube *vxyz*, which muſt be made very black within. Let *efg* repreſent a Priſm of Glaſs or Chryſtal, placed near the other end of the Tube, in the middle of it, by means of an Handle of Braſs or Iron *fgk*, to whoſe end, made flat, it is cemented. Let this Priſm be Right-Angled at *e*, and the other two Angles exactly equal, and conſequently each 45 Degrees. Let the Sides *ef* and *ge* be exactly plane and Squares, and by conſequence the third Side *fg*, a rectangled Parallelogram, whoſe Length is to its Breadth in a ſubduplicate Proportion of 2 to 1.

Let




Let this Prism be so placed in the Tube, that the Axis of the Concave Speculum may pass thro' the middle of the square side *e f* perpendicularly, and consequently thro' the middle of the side *f g*, at an Angle of 45 deg. And let the side *e f* be turned towards the Speculum, and the Distance of this Prism from the Speculum be such, that the Rays of the Light *p q*, *r s*, &c. which are incident upon the Speculum in Lines parallel to the Axis thereof, may enter the Prism at the side *e f*, and be reflected by the side *f g*, and thence go out of it thro' the side *g e* to the Point *t*, which must be the common *Focus* of the Speculum *a b d c*, and of a Plane Convex Eye-glass *h*, thro' which those Rays must pass to the Eye. And let the Rays at their coming out of the Glass pass thro' a small round Hole, or Aperture, made in a little Plate, Lead, Brass, or Silver, wherewith the Glass is to be covered; which Hole must be no bigger than is necessary for Light enough to pass thro': for so it will render the Object distinct; the Plate in which it is made, intercepting all the erroneous Part of the Light which comes from the Verges of the Speculum *a b*.

Such an Instrument well made, if it be 6 Foot long (reckoning the Length from the *Speculum* to the Prism, and thence to the Focus *t*,) will bear an Aperture of 6 Inches at the *Speculum*, and magnify between 2 and 300 times. But the Hole *h*, here limits the Aperture with more advantage, than if the Aperture were placed at the *Speculum*.

If this Instrument be made longer or shorter, the Aperture must be in proportion, as the Cube of the square Root of the length, and the magnifying as the Aperture. But it's convenient, that the Speculum be, at least, an Inch or two broader than the Aperture; and that the Glass of the Speculum be thick, that it bend not in the working. The Prism *e f g*, must be no bigger than is necessary, and its backside *f g* must not be Quicksilver'd over; for without Quicksilver it will reflect all the Light incident on it from the *Speculum*.

In this Instrument the Object will be Inverted, but may be erected by making the sides *e f*, and *e g* of the Prism *e f g*, not plain but spherically Convex, that the Rays may cross as well before they come at it, as afterwards between it and the Eye-Glass.

If it be desired that the Instrument bear a larger Aperture, that may be also done, by composing the Speculum of two Glasses, with Water between them.

The reason why four Glasses in a Telescope represent the Object erect, Mr. *Molyneux* shews plainly in *Philosophical Transactions*, N° 183.

Mr. *Auzout* saith, in *Philosophical Transactions*, N° 4. That the Apertures of Telescopes ought to be in a Sub-duplicate Ratio of their Lengths; but this must be taken, so as to allow for the Quantity of Light which comes into the Tube; for the more Light comes in, the greater the Aperture must be, saith Dr. *Hook*. *ibid*. And Dr. *Hook* also doth there shew a way to make a Plane Convex-Glass of a small Sphere collect the Rays at a great Distance; but I don't find that he ever made any considerable Use of it afterwards.

Mr. *De la Hire* saith, in the *Memoirs de l'Academie Royal des Sciences*, for *May* 1699. That to prevent the Dew falling on the Object-Glass of a Telescope in a nocturnal Observation, 'tis a very good way to make a Tube of coarse brown Paper.

TELLER; is an Officer in the *Exchequer* (of which there are four) who receive all Moneys due to the Queen, and gives the *Clerk of the Pell* a Bill to discharge him therewith. They pay also all Money payable to the Queen, by Warrant from the *Auditor of the Receipt*, and make weekly and yearly Books of all Receipts and Payments, which they deliver to the Lord Treasurer.

TEMPORALTIES of Bishops; are such Revenues, Lands, Tenements, or Lay-Fees, which have been laid or annexed to Bishops Sees by our Kings, or other Persons of high Rank in the Kingdom.

TENAILE *of the Foss* or Ditch; is a low Work raised before the Curtain, in the middle of the Foss: It is of three sorts; the first is composed of a Curtain, two Flanks and two Faces: The *Rampart*

*part* of the *Curtain*, including the *Parapet* and *Talus*, is but five Fathom thick, but the Rampart of the *Flanks* and *Faces* is seven. The Second, which *Vauban* saith he found to be of very good Defence, is compoſed only of two Faces made on the Lines of Defence, whoſe *Rampart* and *Faces* are parallel. The Third ſort differs from the Second, only that its Rampart is parallel to the Curtain of the Place. All three ſorts are good Defences for the Ditch, and lie ſo low, that they cannot be hurt by the Beſiegers Cannon, till they are Maſters of the Covert-way, and have planted their Cannon there.

TENON, in Architecture, is the ſquare end of a piece of Timber fitted into a Mortiſe.

TERRER, or *Terrier*, is a Book or Roll wherein the ſeveral Lands, either of a private Perſon, or of a Town, College, Church, *&c.* are deſcribed; and this ſhould contain the Number of Acres, the Site, Boundaries, Tenants Names, *&c.*

TERRÆ *Teſtamentales*; Lands that were held free from *Feodal Services*, in *Allodio*, in Soccage, deſcendable to all the Sons, and therefore called *Gavel-kind*, were deviſeable by Will, and therefore called by this Name, *Terræ Teſtamentales.*

TESSELATA *Pavimenta*; were the Pavements in the Tents of the Roman Generals, a rich *Moſaick Work*, made of curious ſmall ſquare Marbles, Bricks, or *Tiles*, called *Teſſellæ*, from the Form of *Dice.*

TESTONS, or, as we commonly call them, *Teſtors*, from their having an Head (*Teſta*) upon them, were in 34 *H.* 8. coined either *here*, or in *France*; and *Spelman* ſaith, their value in *France* was 18 *d.* and he doth not know but that they might go for as much here. He ſaith it was Braſs, and cover'd over with Silver, (which perhaps gave riſe to the Iniquity of *Plating* Money.) They went with us in *H.* 8th's time for 12 *d.* but in *Edw.* 6th's they ſunk down to 9 *d.* and then to 6 *d.* (which ſtill retains the Name of a *Teſtor.*) In *Anno Dom.* 1559, they fell to 4 *d. ob.* and *Stow* ſaith, there was a ſecond ſort of *Teſtons*, which in that Year were *Cried down* to 2 *d. q.* and that there was a third ſort, which were made *unpaſſable* at any rate. *vid. Chron. Precioſ.* p. 41.

TETRACTYS *Pythagorick*, was a Point, Line, Surface and Body.

TETRAGONISTICK *Calculus*, is the ſame with the ſummatory or differential Calculus of *Leibnitz*; which ſee.

THANE, anciently in the *Saxons* time, was a military Servant; the King's Thane was a *Saxon* Lord or Nobleman: but after the Conqueſt the Word came to be uſed ſometimes to denote all Perſons of Superior Degree.

THORUS. See *Tore.*

THRAVE of Corn, in moſt parts of *England*, conſiſts of four Shocks; and each Shock contains ſix Sheaves; but in ſome Places they reckon but twelve Sheaves to a *Thrave.*

THRIMSA, was an old piece of Money of the value of a Groat, or the third part of a Shilling; being ſeemingly a Corruption from *Tremiſſis*, which was a *German* Coin, of the value of Four-pence. Some will have it to be a Three Shilling Piece, but it ſeems a Miſtake.

THUNDER *and Lightning.* The *Phænomena* of this very common, but oftentimes dreadful Meteor, are thus accounted for, and ſolved by Dr. *Hooke*, *Opera Poſth.* p. 169.

The Atmoſphere about the Earth abounds with nitrous Particles of a ſpirituous Nature, which are every where carried along with it; beſides which ſort of Particles, there are alſo others raiſed up into the Air, which may be ſomewhat of the Nature of Sulphureous, Unctuous, or other combuſtible Bodies; as we ſee Spirit of Wine, Spirit of Turpentine, Camphire, and almoſt all other combuſtible Bodies, will by Heat be rarefied into the form of Air or Smoak, and be raiſed up into the Air. All which, if they have a ſufficient Degree of Heat, will catch Fire, or be turned into Flame by the nitrous Parts of the Air; as thouſands of Experiments might be brought to prove. There are alſo other ſorts of theſe ſulphureous Steams, which ariſe from ſubterraneous and mineral Bodies; which, only by their coming to mix with the Nitre of the Air, tho' they have no ſenſible Heat in them, will ſo ferment and act one upon another, as to produce an actual Flame: which is a thing that hath been often found in Mines, and more eſpecially if any part of them be kindled, then the whole Train which is mingled with the contiguous Air, will immediately take fire, like a Train of Gun-powder, and run from one end of thoſe Vapours to the other, be they ever ſo long; as I could prove by a multitude of relations from Coal-Mines, and ſeveral other Mines. The Accenſion of which Vapours is ſo ſudden, and with ſuch violence and ſwiftneſs runs from one end to the other, as often to kill the Miners, blow up their Props, Turns, Stays, Houſes, *&c.* and produceth as prodigious Effects, as if a vaſt Quantity of Gun-powder had been fired in the Mine. Now Lightning in the Air ſeems to be much of the ſame Nature; for the Air is continually furniſhed with ſpirituous nitrous Parts; and the Summer Heat, whenever extraordinary, raiſes up out of the Earth (and to this the ſubterraneal Heat alſo is continually concurring) a great Quantity of ſulphureous Vapours, which are of ſuch a nature, as that meeting with the Nitre of the Air, they work upon each other, and thereby begins a further Degree of Heat, which gradually encreaſes, till at laſt it arrive at a certain pitch; and then they fall upon and work on one another, producing an actual Fire and Flame, which with wonderful ſwiftneſs fires the whole Train, and ſo produces the Flaſh and Noiſe.

Dr. *Wallis* in *Philoſ. Tranſ.* N° 231. *p.* 655. ſaith, That Thunder and Lightning are ſo very like the Effects of fired Gun-powder, that we may reaſonably judge they proceed from the like Cauſes. Now the principal Ingredients in Gun-powder, are Nitre and Sulphur, (the admiſtion of Charcoal being chiefly to keep the Parts ſeparate, for the better kindling of it.) So that if we ſuppoſe in the Air a convenient mixture of *Nitrous* and *Sulphurous* Vapours, and thoſe by accident to take fire, ſuch *Exploſion* may well follow with ſuch Noiſe and Light, as in the firing of Gun-powder; and being once kindled, it will run from Place to Place, as the Vapour leads it, like as in a Train of Gun-powder, with the like Effects.

This *Exploſion*, if high in the Air, and far from us, will do no miſchief, or not conſiderable; like a parcel of Gun-powder fired in the open Air, where nothing is near enough to be hurt by it. But if the Exploſion be near to us, or amongſt us, it may

may kill Men or Cattle, tear Trees, fire Gun-powder, break Houſes, or the like; as Gun-powder would do in all like Circumſtances. This *Nearneſs*, or *Farneſs*, may be eſtimated by the *Diſtance* of Time between ſeeing the Flaſh of Lightning, and hearing the Clap of the Thunder; for tho' in their Generation they be *Simultaneous*, yet Light moving faſter than Sound, they come to us ſucceſſively. I have obſerved, that commonly the Noiſe is about ſeven or eight Seconds after the Flaſh; but ſometimes 'tis much ſooner, in a Second or two, or leſs than that, juſt after the Flaſh; and then the Exploſion muſt needs be very near us, and even amongſt us. And in ſuch Caſes I have more than once preſaged the Expectation of Miſchief, and it hath proved accordingly.

Now that there is in Lightning a ſulphureous Vapour, is manifeſt from the ſulphureous Smell that attends it, and the ſultry Heat in the Air, which is commonly a Fore-runner of Lightning ſoon after. And that there is a *nitrous* Vapour in it, we may reaſonably judge, becauſe we do not know of any Body ſo liable to a ſudden and violent Exploſion.

As to the kindling of theſe Materials, in order to ſuch an Exploſion, I am told that a Mixture of Sulphur, and Filings of Steel, with the Admiſtion of a little Water, will not only produce a great Effervеſcence, but will of itſelf break forth into an actual Fire. I ſay *a little Water*, becauſe too much will hinder the Operation, or quench the Fire: And this I take to be the Cauſe of the *Bath-Waters*, and other hot Springs, where Steel and Sulphur cauſe a great Effervеſcence, but no Flame. So that there wants only ſome *Chalybeate*, or *Vitriolick* Vapour (or ſomewhat equivalent) to produce the whole Effect, (there being no want of Aqueous Matter in the Clouds.) And there is no doubt, but that amongſt the various Effluvia from the Earth, there may be copious Supplies of Matter for ſuch Mixtures.

The ſame Account may alſo be given of *Ætna*, and other burning Mountains, where the Mixture of Iron and Sulphur may give a Flame; which is often attended with prodigious Exploſions and Earthquakes, from great Quantities of Nitre, as in Springing a Mine.

THYREO-STAPHILINUS, is a Muſcle of the *Uvula*, ariſing fleſhy from the edge of the upper part of the *Cartilago Thyreoides*, between the *Thyreo-pharingæus*, and the *Membrana Faucium*; from thence it aſcends ſtraight upwards, being much dilated as it approaches the *Uvula*, on the upper ſide of which it is ſpread very broad. In Swallowing, when this Pair of Muſcles act, the *Foramina Narium* are in a great meaſure ſhut, to hinder the paſſing of any thing thro' into the Noſe, that is taken in at the Mouth. *Douglas Miogr. Comp. Specim.*

TICHONIAN *Hypoth.* See *Tychonian.*

TIDES: The Tides of the great Ocean being cauſed (as you may ſee in Vol. I.) by the Action or Attraction of the Moon upon it (chiefly) and becauſe that part of the Ocean, which is directly under the Moon, will be more attracted by it than the reſt; there the Ocean muſt ſwell or riſe, and the Water will run from other Parts thither.

But from hence only it will not follow, that there ſhould be Tides produced in Rivers and in Land, Seas, Lakes, *&c.* of little or no breadth; becauſe they are ſo narrow, that the Moon can't act ſtronger on one Part than on another: and ſo there being no difference of Attraction, there is no reaſon why one part ſhould ſwell or riſe more than another; for, the Attraction being equal, the Water cannot *ſhift* or move from one Place to another.

TIGE, in Architecture, is the Shaft of a Column from the Aſtragal to the Capital.

TIN-KILN, is uſed for the burning of the *Mundick* from the Tin-Ore. See its Deſcription under Tin.

TIN: In *Philoſophical Tranſactions*, N° 69. and N° 138. you have the following Account of the manner of *Finding*, *Digging for*, *Preſſing* and *Blowing* of Tin.

The Miners imagine, that, before the Deluge, the uppermoſt Surface of the *Mineral Veins*, or *Loads*, lay parallel to the upper Surface of the Earth; but that, in the Flood, they were moved, looſed, and torn off; and that by the deſcending of the Waters into the Valleys, both the Earth or *Grewt*, and thoſe Mineral Stones or Fragments ſo torn off from the *Loads*, (and which they call *Shoad*) were, together with, and by the Force of the Waters, carried beneath their proper Place, and from ſome Hills, even to the bottoms of the neighbouring Valleys, and from thence by Land-Floods down into the Rivers.

On theſe Suppoſitions, they proceed thus in *Trayning* or purſuing of a *Load*: Where they ſuſpect any Mine to be, they diligently ſearch that Hill and *Country* (as they call the Place where the *Mine* lies) that they may the better know the *Grewt* and the Stones, when they meet them at a diſtance in the bottom of a neighbouring Valley. They take notice alſo of the *Frets*, or Openings which are made in the Banks of Rivers, newly made by great Land-Floods, which uſually are then very clean, to ſee whether there be any Metalline Stones in the Sides, or Bottoms; together with the *Caſt* of the *Country*, as they call it, *i. e.* any Earth of a different Colour from the reſt of the Bank. And this is a great help to them, to diſcover which Hill, or which ſide of it to ſearch. The Mineral Stones are diſcovered, either by their Weight, or their Poroſity; for moſt Tin-Stones are Porous, not unlike great Bones, almoſt throughly Calcined. Yet Tin ſometimes lies in very firm Stones; and Dr. *Chr. Merret* ſaith, that they are uſually found betwixt two Walls of Rocks, which are commonly of an Iron Colour, of little or no Affinity with the Tin. *Vid. Phil. Tranſ.* N° 138.

Another Way they have to diſcover whether the Stones contain any Ore, is, what they call *Vauning*, which is, to powder the Stone, Clay, *&c.* or whatever is ſuſpected to contain any Metal, and then placing it on a *Vauning Shovel*, then will the Gravel remain in the hinder part, and the Metal at the Point of the Shovel; whereby the Nature, Kind, and Quantity of the Ore is very nearly gueſs'd at.

If there be no *Shoad* found in theſe *Frets*, they truſt not to any found in the River, it being uncertain from whence the Water may have brought them. But then they go to the ſides of the Hills moſt ſuſpected, where there is a convenience of bringing a little Stream of Water (the bigger the better) and then they cut a *Leat* or *Gurt*, as they call

call it, that is, a Trench about two Foot over, and as deep as the *Shelf*; and by this means turn the Water, running two or three Days, that by waſhing away the Earth from the Stones, it may diſcover the *Shoad*. If they find any, they conclude there is a *Load* in the upper part of the Hill, or at leaſt a *Squat*. Then at the foot, or bottom of the Hill, they ſink what they call an *Eſſay-hatch*, *i.e.* a Hole about ſix Foot long, and four broad, and always as deep as the *Shelf*; and if they find no *Shoad* there, when they come to the Shelf, there is none to be expected: Tho' ſometimes the Shoad is waſhed clean away, when you come within two or three Foot of the *Load*, which then lies ſo much further up in the Hill. But if they find *Shoad*, they are almoſt at a Certainty; and this is held as an infallible Rule, that the nigher the *Shoad* lies to the *Shelf*, the nigher the *Load* is at hand, and *vice verſa*.

If they find no *Shoad* in the firſt Hatch, they aſcend uſually about twelve Fathom, and then ſink another, as before; and if no *Shoad* appear here, then they go as far on each hand ſide-ways, and ſink there, as before. And ſo they aſcend proportionably with three or more Hatches (if the Space of Ground require it) as it were in Breaſt, till they come to the top of the Hill. And if they find no *Shoad* in any of theſe *Hatches*, farewel to that Hill.

But if they find any *Shoad* in any *Hatch*, then they keep their aſcending *Hatches* from thence in a right Line; and as they draw nearer the *Load*, they leſſen the firſt Proportion of twelve Fathom to ſix, or yet leſs, as Conjecture directs them. If they find *Shoad* lying near the Shelf in one *Hatch*, and none in the next aſcending, they conclude they have over-ſhot the Load, and then they ſink nigher that *Hatch*, in which they laſt found the *Shoad*. Sometimes they find two different *Shoads* in the ſame *Hatch*, at different Depths, and then they have a Certainty of another *Load* above the former; and it may be in *Training* up to the ſecond, they meet with the *Shoad* of a third. Some Tinners affirm, that the ſeven *Loads* may lie parallel one to another in the ſame Hill, but yet only one *Maſter-Load*; the other ſix, three on each ſide, being the leſſer Concomitants; and ſo may five lie, three are common.

Every Load hath a peculiar coloured Earth or *Grewt* about it, which is found alſo with the *Shoad* in a greater quantity, the nearer the *Shoad* lies to the *Load*; and ſo leſſens by degrees to near a quarter of a Mile's diſtance; but further than that, the *peculiar Grewt* is never found with the *Shoad*.

A Valley may lie ſo, at the Feet of three ſeveral Hills, that they may find three ſeveral *Deads*, *i.e.* common looſe Earth, in which the *Shoad* lay, and which is not only contiguous to the *Load*: This they call the *Run* or *Caſt* of the *Country*, or of each Hill; and the Knowledge of this is very neceſſary, in order to ſurer *Training* of them one after another, as they lie in order, according to the foregoing Rules of *Eſſay-Hatches*; for the uppermoſt will direct you which Hill to begin firſt.

It may be, after they have *trained* up the Hill, they find nothing but a *Bonny* or *Squat*, which likewiſe have their *Shoad*. Their Form is about two or three Fathom long, and half as broad, few larger, and moſt leſs: Theſe communicate with no other *Load* or Vein, neither doth it ſend forth any of its own, but is entire of itſelf, and perhaps will go down into the *Shelf*, five or ſix Fathom deep, and there terminate.

The Manner of their Digging the Ore, is thus:

When they have found the *Load*, and laſt *Eſſay-hatch*, 'tis then called a *Tin-ſhaft*, or *Tin-hatch*, which is ſunk down about a Fathom, and then is left a little long ſquare Place, called a *Shamble*; and ſo they continue ſinking from *Caſt* to *Caſt*, (that is, as high as a Man can conveniently throw, or *caſt* up the Ore with a Shovel) till they either find the *Load* to grow ſmall, or degenerate into ſome ſort of *Weed*, which are divers; as *Mundick*, or *Maxy*, corrupted from Marchaſite; and this is white, yellow, and green. *Daze*, which is a kind of glittering Stone, enduring the Fire, of different Colours; as white, black, and yellow: *Iremould*, black and ruſty; *Caul*, which is *red*, differing both from Mundick and *Daze*, or *Spar*, (enduring the Fire) which *Marchaſite* will not; *Gliſter*, which is Blood-red and Black.

Then they begin to make a Drift three Foot wide, and ſeven Foot high; and if the *Load* be not broad enough of itſelf, as ſome are ſcarce half a Foot, then they uſually break down the *Deads*, or that part of the *Shelf* which contains no Metal, but encloſeth the *Load*, as a Wall between two Rocks, and then they begin to rip the *Load* itſelf.

The Inſtruments they uſe, are, 1. A *Beele*, or *Corniſh Tubber*, *i.e.* double Points of eight or ten Pounds, ſharp'ned at both ends, ſteeled and holed in the middle. This, in a hard Country, will laſt about half a Year, but muſt be new pointed every fourteen Days.

2. A *Sledge*, flat-headed, from ten to twenty Pound, will laſt about ſeven Years, new ordered once a Quarter. 3. Gadds, or Wedges, of two Pounds, well ſteeled at the Points, and four-ſquare; theſe will laſt three or four Days, or a Week; and then muſt be new ſharpened. 4. Ladders. 5. Wheelbarrows to carry the *Deads* and Ore out of the *Drifts* or *Adits*, to the *Shambles*. There are two Shovel-men, and three Beele-men, which are as many as one *Drift* can contain, without hindering one another. The *Beele-men* rip the *Deads* and Ore, the *Shovel-men* carry it off, and land it, by caſting it up with Shovels from one *Shamble* to another; unleſs where there is a *Winder* with two *Kecbles* or Buckets, one of which comes up as the other goes down.

It is uſually obſerved, that the *Tin Loads* run *Eaſt* and *Weſt*, and then they conſtantly *dip* towards the *North*, and ſometimes as much as three Foot in eight perpendicular. But in the higher Mountains of *Dartmoor*, there are ſome conſiderable *Loads* that run *North* and *South*, and theſe dip to the *Eaſt*.

Four or five *Loads* may a while run parallel to one another in the ſame Hill, as hath been known in *Hingſton* in *Cornwall*, and then turn in and meet altogether in one *Hatch*, and after ſeparate again, and run parallel, as before.

The Breadth of *Maſter-Loads* is generally from three to ſeven Feet, ſeldom larger, unleſs where ſeveral *Loads* unite, and make a Knot, or ſend forth Springs and Veins: But they do'nt retain the ſame Breadth in all Places.

The

The *Load* is uſually in a hard rocky *Country*, made up of *Metal*, *Spars*, and other *Weeds*; as it were all along in a continued Rock; but it hath many Veins and Joints.

In moſt Places they meet with Water at ſome *Feet* deep from the *Load*, at others not at many *Fathoms*; it runs continually thro' the Heart of the *Load*.

When it begins to trouble us, we begin at the Foot of the Hill, a *Drift* ſcarce half ſo big as that of the *Load*, and work it on a Level, till we come up to the *Load*. But where they have not this Convenience, or if they paſs that Level, then they are forced to draw it up with Winders and Keebles, or force it up with Pumps. Some, but very few Pumps may be dry. They obſerve, that when they have Water, they never want Air ſufficient for Reſpiration, and for their Candles to burn in; yet ſometimes in a ſoft clayey Country, the Air is ſo condenſed, as to become in a manner a *Damp*, and to require an *Air-Shaft* for a *Vent*: which Damps are ſometimes enlarged by working of the *Mundick* with the Ore.

If the *Country* be not ſtrong enough, they underprop their *Drifts* with *Stemples* and *Wall-plates*, placed much like a Carpenter's Square, on the one ſide, and over-head.

To know which way the *Load* inclines, to bring an *Adit*, or to ſink an *Air-ſhaft* in the deſired Place, the Uſe of the *Dial* is needful; which they call *Plumming* and *Dialling*, and is thus performed. A skilful Perſon firſt faſtens the end of a long Line at a known Place, and then exactly obſerves the Point at which the Needle of his *Dial* or *Compaſs* reſts; and at the next Flexure, or Winding, he makes a Mark on the Line, and again notes the *Point* at which the Needle ſtands at this ſecond Station; and ſo he proceeds from turning to turning, ſtill marking the Points and his Line, till he comes to the intended Place. Then he repeats above ground what he had done below, and his Dial and Line leads him, till he come exactly over the Place where he ended the *Mine*.

The Manner of *Dreſſing the Tin*, is thus:

When the Ore is landed, and the greater Stone broken at the top of the *Mine* by the *Shovel-men*, 'tis brought on Horſes to the *Stamping-mill*, whence the Ore is landed at the head of the *Paſs*, (*i.e.* two or three Bottom-boards, with two Side-ones, ſet ſlopewiſe) in which the Ore ſlides down into the *Coffer*; but that it may not tumble down all at once, there is placed a *Hatch* nigh the lower end of the *Paſs*, (that it is a Thwart-board to keep up the Ore.) Beneath that, comes in the *Cock-water* in a Trough, cut in a long Pole, which, with the Ore, falls down into the *Coffer*, (*i.e.* a long Square of the firmeſt Timber, three Foot-long, and one Foot and half over) wherein are the three uſual *Lifters*, placed between two ſtrong broad *Lones*, having two *Braces*, or Thwart-pieces on each ſide, to keep them ſteady as a Frame, with *Stamper-heads*, weighing about thirty or forty Pound each of Iron, which ſerve to break the Ore in the ſaid *Coffer*. Theſe *Lifters*, being about eight Foot long, and half a Foot ſquare, of Heart of Oak, and having as many *Timbers* or *Guiders* between them, are lifted up, in order, by double the number of *Tappels* (faſtened to as many *Arms*, paſſing diametrically to a great Beam, turned by an *Over-ſhot Water-wheel* on two *Boulſters*) which exactly, but eaſily meet with the *Tongues* ſo placed in the *Lifters*, as that they quickly ſlide from each other, ſuffering the Lifters to fall with great force on the *Ore*, thereby breaking it into ſmall Sand, which is waſhed out by the Cock-water, thro' a Braſs Grate, holed very thick, and placed within two Bars of Iron at one end of the Coffer, into the *Launder*, *i.e.* a Trench cut out in the Floor, eight Foot long, and ten over, and ſtopped at the other end with a Turf: ſo that the Water runs away, and the Ore ſinks to the bottom; which, when full, is taken up and emptied with a Shovel.

The *Stamping-Mill* is thus contrived to go two Hours, or more, after they give over attending it. There is a *Tiller*, or long Pole, faſtened without at one end to the *Slew* or *Ponder*, *i.e.* that looſe and laſt part of the Trough, that conveys the Stream to the Overſhot Wheel. Then, at the other end, there is tied a ſhort Rope, with a tranſverſe Stick at the end of it, curiouſly, but Trap-ways, hitched at both ends, under two little Pins, faſtened in the *Lones* for that Purpoſe: There is another Pin ſet in one of the *Lifters*, at ſuch an exact height, as that if there be no *Ore* in the Coffer, to keep that *Lifter* high enough, the purpoſed Pin, in deſcending, knocks out the Water, carrying it quite over the Mill-wheel; ſo that when the *Coffer* is emptied, the Mill reſts of courſe. The Launder is divided into three parts, the Fore-head, the Middle, and the Tail. That *Ore* which lies in the *Fore-head*, or within one Foot and a half of the Grate, is the beſt Tin, and is taken up in a Heap apart; the Middle and Tail is another Heap, which is accounted the worſt. This latter Heap is thrown up by the *Trambling Buddle*, that is, a long ſquare *Tye* of Boards, or *Slate*, about four Foot deep, ſix long, and three over; wherein ſtands a Man with a *Trambling-ſhovel* in his Hand, to caſt up the *Ore*, about an Inch thick, on a long ſquare Board, juſt before him, and as high as his Middle, which is called the *Buddle-head*; and with the Edge of his Shovel, he dexterouſly cuts and divides it long-ways, in reſpect of himſelf, about half an Inch aſunder; in which little Cuts, the Water coming gently from the edge of an upper plain Board, carries away the Filth, and lighter part of the prepared Ore firſt, and then the Tin immediately after, all falling down into the *Buddle*; where, with his bare Foot, he ſmooths it tranſverſely, to make the Surface the plainer, that the Water, and other Heterogeneous Matter, may, without lett, paſs away the quicker.

When this Buddle grows full, they take it up; here diſtinguiſhing again the Fore-head from the Middle and Tails, which are *trambled* over again: But the Fore-head of *this*, with the Fore-head of the *Launder*, are trambled in a ſecond Buddle, but not different from the firſt. In like manner, the Fore-head of this being likewiſe ſeparated from the two other Parts, is carried to a *third*, or the *drawing Buddle*, ; whoſe difference from the reſt is only this, that it hath no *Tye*, but only a plain ſloping Board, whereon 'tis once waſhed with the *Trambling-ſhovel*, and ſo it new names the Ore *Black Tin*, *i.e.* ſuch as is compleatly ready for the *Blowing-houſe*.

There is alſo another more curious way, called *Sizing*; that is, inſtead of a *Drawing Buddle*, they uſe a Hair-ſieve, thro' which they ſift the Ore, caſting back the remainder into the Tails, and new *trambling it*.

After the ſecond trambling it, they take that Fore-head in the ſecond *Buddle*, and *dilve* it, (*i.e.* putting it into a Canvas-ſieve, in a large Tub of Water, and ſhaking it luſtily) ſo that the Filth gets over the Rim of the Sieve, leaving the black Tin behind, which is put into Hogſheads, covered and locked, till the next Blowing.

The Tails of both *Buddles*, after two or three Tramblings, are caſt out into the firſt *Strake* or *Tye* (which is a Pit made purpoſely to receive them) and what over-ſmall Tin elſe may waſh away in *Trambling*.

There are commonly three or four of them ſucceſſively, which contain two ſorts of Tin, the one which is too ſmall, the other too great. The latter is new ground in a *Craze-mill* (which is juſt like a Griſt-mill, with two Stones, an upper and an under) and after that, trambled in order. The former, by reaſon of its exceeding Smallneſs, is dreſſed on a *Reck*, or Frame of Boards, about three Foot and a half broad, and ſix long, and which turns upon two Iron-Pins, faſtened in both ends, and the whole placed between two Poſts; ſo that it hangs in an Æquilibrium, and may, like a Cradle, be moved eaſily either way with the Shovel and Water.

### *Blowing of Tin.*

When they perceive much *Mundick* in their Tin, which makes it brittle and hard, they are neceſſitated to burn away the *Weed* in a *Tin Kiln*. This Kiln is four-ſquare, and at the top hath a large Moor-ſtone about ſix Foot long, and four broad; in the middle of which is a ſquare Hole of about half a Foot in Diameter: About a Foot beneath this Stone, is placed another, which is not ſo long by half a Foot; becauſe it muſt not reach the innermoſt, or back part of the Wall, which is the open Place, thro' which the Flame aſcends from a leſſer Place below that, where a very ſtrong Fire of Furze is conſtantly made. The Fore-part is like a common Oven; but near the back, on one ſide, there is another little ſquare Hole. When the Kiln is throughly heated, the *black Tin* that is to be burnt, is laid on the Top-ſtone, and as much of it is caſt down by the ſquare Hole, on the ſecond, or Bottom-ſtone, as will cover it all over, about three or four Inches thick. Then the Hole at the top is immediately covered with green Turfs, that the Flame may reverberate the ſtronger; and a Rake-man, with an Iron Coal-Rake, conſtantly ſpreads and moves the Tin, that all Parts of the *Mundick* may get uppermoſt of the Tin, and ſo be *burned* away; which we certainly know by this, that then the Flame will become *yellow* (as uſual) and the *Stench* leſſen'd: for whilſt the *Mundick* behind burns, the Flame is exceeding blue. Then with the Rake he thruſts it down at the open Place into the open Fire, and receives a new Supply of Tin from above. Now when the Place beneath, where the Fire is made, grows full of Tin, Coals, and Aſhes, with the Rake he draws it forth with the Coals at the little ſquare Hole, on the one ſide, near the back; where the Ore, fiery hot and red, lies in the open Air to cool; which it will ſcarce be in three Days, becauſe of the Coals, that lie hid in it; but when they cannot ſtay ſo long, they quench it with Water, and it is like Mortar. And whether it cool of itſelf, or be quenched, they muſt new *tramble* it, or waſh it, before 'tis put into the Furnace; which is no other than an *Alman-Furnace*.

*Moor-Tin*, or ſuch as is digged up in the *Moors*, runs or melts beſt with Moor-coal charked; but other Tin which lies in the Country, runs beſt with an equal Proportion of Charcoal and Peat (or Moor-coals) for the firſt Running: but when they re-melt their Slugs, then they uſe Charcoal. When all is melted down, and re-melted, there ſometimes remains a different Slug in the bottom of the Float, which they call *Mount-egg*; and this is moſtly an Iron Body, tho' of a Tin Colour; as was tried, by applying one of the Poles of a Load-ſtone to it, which it quickly attracted, tho' not ſo ſtrongly as Iron.

Tho' Tin, for the moſt part, be made from the Stones, in which it is incorporated, yet 'tis ſometimes mixed with a gravelly Earth, ſometimes white, but uſually red; from whence 'tis eaſily ſeparated by bare *Waſhing*. This gravelly Tin is called *Pryan Tin*, and has ſcarce half the Goodneſs of the other.

The *Mundick Ore* is uſually diſcovered by its Glittering, yet ſad-coloured Brownneſs, wherewith it will ſoon diſcolour their Fingers. This is ſaid to nouriſh the Tin; and yet they ſay, where much *Mundick* is found, there is little or no Tin. Certain it is, that if there be any *Mundick* left in melting the Tin, it makes it thick and curdy; that is, not ſo ductile as otherwiſe. The *Mundick* ſeems to be a kind of *Sulphur*; for Fire only ſeparates it from the Tin, and evaporates it into Smoke.

The *Corniſh Diamonds* lie intermixed with the *Tin-Ore*, and ſometimes on heaps; they are hard enough to cut Glaſs; and ſome of them are of a tranſparent red, and have the Luſtre of a deep Ruby. They ſeem to be only a fine hard Spar.

The beſt *Tin Ore* is that which is in Sparks, and next to this, that which hath bright Spar in it. The Furnace where they melt, and from whence they caſt their Tin, they call a *Blowing-houſe*. See alſo Mr. *Ray*'s Collection of *Engliſh* Words.

TIP-STAVES, are the Warden of the Fleet's Officers, attending the Queen's Courts with a painted Staff, for taking into Cuſtody ſuch Perſons as are committed by the Court; and to attend ſuch Priſoners as go at large by Licence. By this Name alſo are the Judges Officers called, who carry a Rod, or Staff, tipped with Silver, and take charge of ſuch Priſoners, as are either committed, or turned over at the Judges Chambers.

TOD *of Wool*, is a Weight mentioned in 12 *Car. cap.* 23. containing 28 Pound, or 2 Stone Weight.

TOFT, *Toftum* in the Law ſignifies a Meſſuage, or rather perhaps a Place where a Meſſuage ſtood: 'Tis a Word much uſed in Fines.

TOMICE, the Art of Carving in Wood, or Ivory. The Artiſt in this Work was called *Deſector*.

TOMPION, is the Stopple of a great Gun or Mortar, being made of Wood, and put into the Mouth, to keep out Rain; alſo in loading of a Mortar, there is a Tompion of Wood, which is fitted exactly to the Bore of the Piece at the Mouth of

of the Chamber, and this is drove in hard after the Powder, and the Bomb is placed upon it.

TONGUE *Grafting*, is a way of Grafting in Roots, thus: The Root is cut ſloping about an Inch in length, and the Graft as much, both very ſmooth; then each is cleft an Inch in length alſo, and then they are made to enter into one another, ſo that the Sap of the Graft may join to that of the Root as much as can be. Lap the jointed part about with a little Hemp, or Flax Hurds, and ſet the Root ſo grafted into the Ground, about ten or twelve Inches deep, ſo as the Joint may be about four Inches at leaſt covered under the Earth, that it may not be bared at any time, but kept moiſt by the Earth. The Root you graft on, may be a piece of the Root of an Apple or Pear-tree, about ſix Inches in length; it ſhould not be leſs than the Graft, but it may be bigger; but 'tis beſt when they are both of the ſame ſize. *vid. Phil. Tranſ.* Numb. 95.

About twenty-nine Years ago, ſaith Mr. *Lewis*, who communicated the Method above, I ſowed a Bed of Apple-kernels in *March*, the Spring following I plucked up forty of theſe Seedlings, grown to the thickneſs of a fair Graft; I grafted them in this manner of *Tongue Grafting*, and planted them again: they all grew, and four of them bare Fruit to perfection that Year; ſo that in a Year and a half, from an Apple-kernel I had ripe Fruit. Some of theſe Trees will now bear two Quarters of Apples upon a Tree, and are bigger than moſt of thoſe Trees among which they ſtand, which coſt twelve Pence a Tree, when theſe were Kernels. I conceive, ſaith he, that Plumbs, Cherries, Apricocks, Peaches, and all ſorts of Fruit-Trees, may be thus raiſed.

TORNADO, is the Name given by the Seamen for a violent Storm of Wind, and ſometimes followed by Rain; it uſually ſwifts or *turns* about to almoſt all Points of the Compaſs, whence I ſuppoſe its Name.

TORT, is a *French* Word, ſignifying *Wrong or Injury*, and is often uſed in our Law; as, *de ſon Tort*, is *in his own Wrong*.

TRAINING a *Load*, in the Miner's Language, is ſearching for, and purſuing a Vein of *Ore*.

TRAMBLING, is the Term uſed in dreſſing of *Tin-Ore*, for waſhing it very clean in Water, which is done with a Shovel, that they call a *Trambling-ſhovel*, and in a Frame of Boards, which they call a *Buddle*; ſee *Buddle* and *Tin*.

TRANSFORMATION of Curves.

The Abbot *Galloys* of *France*, having in the Year 1693, maintained, that Mr. *James Gregory*, and our excellent Dr. *Barrow*, had borrowed their general Propoſitions about the Transformation of Curves from Mr. *Roberval*; Dr. *David Gregory*, Aſtronomy Profeſſor in *Oxon*, doth in *Philoſophical Tranſactions*, N° 214. *p.* 233. fully refute that Aſſertion, by ſhewing that Mr. *James Gregory*'s Book was publiſhed at *Padua*, 1668; and Dr. *Barrow*'s *Lectiones Geometr.* 1674. And therefore 'tis more than probable, that Mr. *Roberval* had ſeen thoſe Books, ſince he did not die till *Oct.* 1675; and yet we find not that he makes any ſuch Complaint.

TRANSCENDENTAL *Quantities*, Mr. *Leibnitz*, in the *Act. Erud. Lipſiæ*, for *June* 1686, hath a Diſſertation, in which he propoſes to ſhew the Origin and Riſe of ſuch kind of Quantities, *viz.* Why ſome Problems are neither *Plain*, *Solid*, nor *Sur-ſolid*, nor of any certain Degree, but do tranſcend all Algebraical Equations: As alſo to ſhew how it may be demonſtrated without a *Calculus*, that an *Algebraical Quadratrix* for the *Circle* or *Hyperbola* is impoſſible. For if ſuch a *Quadratrix* could be found, it would follow, that by the help thereof, any *Angle*, *Ratio*, or *Logarithm*, might be divided in the *given* Proportion of one right Line to another; and this by one *univerſal Conſtruction*. And conſequently, the Problem of the *Section of an Angle*, or the *Invention* of any number of mean Proportionals, would be of a *certain Degree*. Whereas the different Numbers of Parts of an Angle, or of mean Proportionals, do neceſſarily require *different Degrees* of *Algebraical Equations*. And therefore the Problem, underſtood in general of any Number of Parts of an Angle, or mean Proportionals, is of an *indefinite Degree*, and *tranſcends* all *Algebraical Equations*.

However, ſince ſuch Problems as theſe may really be propoſed in Geometry (nay, and ought to be reckoned amongſt the moſt principal) and beſides are *determinate*; therefore 'tis neceſſary that ſuch Lines ſhould alſo be received into Geometry, as are alone ſufficient for the Conſtruction of theſe Problems.

And further, ſince they may be deſcribed exactly by a *continual Motion* (as is apparent in the *Cycloid*, &c.) they ought not to be accounted *Mechanical*, but *Geometrical Curves*; eſpecially too, ſince they are of much greater uſe than all the Lines of the common Geometry (except the right Line and Circle) and have alſo ſome very important Properties, which are altogether capable of Geometrical Demonſtration.

*Des Cartes* therefore was no leſs out in excluding *theſe* from Geometry, than the Ancients were, who neglected the *Loca Solida & Linearia*, as not Geometrical.

Now, becauſe the Method of diſcovering *indefinite Quadratures*, or their *Impoſſibilities*, is with me but a particular Caſe (and indeed an entire one) of a much ſublimer Problem, which I call the *Inverſe Method of Tangents*, in which the greateſt part of the whole Tranſcendental Geometry is contained; and which, if it could be always Algebraically ſolved, all that is wiſhed for would be done; ſince alſo I find nothing ſatisfactory, as yet, extant about it: I will now ſhew you how this may be done, as well as the *Indefinite Quadrature itſelf*.

Whereas then Algebriſts uſed before to aſſume ſome *general Letters*, or Numbers for the Quantities ſought, I (in theſe Tranſcendental Problems) aſſume *General or Indefinite Equations*, for the Lines ſought. *Ex. gr.* putting $x$ and $y$ for the *Abſciſſa* and *Ordinate*, the Equation I uſe for a Line ſought, is, $a+bx+cy+exy+fxx+gyy$, &c. $=o$. By the help of which indefinite Equation (which in reality is *finite*; for it may always be determined, how far ſoever 'tis neceſſary to raiſe it) I enquire the Tangent, and that which reſults comparing with the given Property of Tangents, I find the Value of the aſſumed Letters, $a, b, c$, &c. And thus I define the Equation of the Line ſought.

In which Equation, ſometimes there are ſome things which remain *arbitrary*, and in that Caſe innumerable Lines may be found that will ſatisfy the Problem.

And this was the Reaſon that a great many, obſerving the Reſult, believed the Problem not to be *ſufficiently determined*, nor indeed *poſſible*. The ſame things are alſo done by *Series*; but with reſpect to the *Abridgment* of the *Calculus*, I have ſeveral helps; of which, more in ſome other place.

Now, laſtly, if the *Compariſon* above-mentioned doth not proceed, I pronounce the Line ſought, not to be an *Algebraical*, but a *Tranſcendental one*.

This ſuppoſed, the next Work is to find the *Species of the Tranſcendency*; for *ſome Tranſcendentals* depend on the general Diviſion or Section of a *Ratio*, or upon the Logarithms; *others* upon the Arks of a Circle; and *others* on more *indefinite* and *compounded Enquiries*.

Here therefore, beſides the Symbols $x$ and $y$, I aſſume a third, as $v$, which denotes the Tranſcendental Quantity; and then of theſe three, I form a general Equation for the Line ſought, from which I find the Tangent, (according to my Method, which proceeds even in Tranſcendental Quantities;) then what I find, I compare with the given Properties of the Tangents, and ſo diſcover not only the Values of $a, b, c,$ &c. but alſo the particular Nature of the Tranſcendental Quantity.

And tho' it may ſometimes happen, that the ſeveral *Tranſcendents* are ſo to be made uſe of, and thoſe of different Natures too from one another; alſo, tho' there be *Tranſcendents* of *Tranſcendents*, and a Progreſſion of theſe *in infinitum*, yet we may be ſatisfied with the moſt eaſy and uſeful one, and, for the moſt part, may have recourſe to ſome peculiar Artifices for ſhortning the *Calculus*, and reducing the Problem to as ſimple Terms as may be.

Now this Method, applied to the Buſineſs of *Quadratures*, or to the Invention of *Quadratrices*, (in which the Property of the Tangent is always given) 'tis manifeſt, not only how it may be diſcovered, whether the indefinite Quadrature be *algebraically* impoſſible, but alſo how (when this Impoſſibility is diſcovered) a *Tranſcendental Quadratrix* may be found, which is a thing which has not yet been ſhewn. So that it ſeems, I may without vanity aſſert, that Geometry is by this Method carried infinitely beyond the Bounds, to which *Vieta* and *Des Cartes* brought it: Since, by this means, a certain and general Analyſis is eſtabliſhed, which extends to all theſe Problems, which are of no certain Degree, and conſequently are not comprehended within *Algebraical Equations*.

Again, in order to manage Tranſcendental Problems (wherever the Buſineſs of Tangents or Quadratures occurs) by a *Calculus*, there is hardly any that can be imagined ſhorter, more advantageous or univerſal, than my *Differential Calculus*, or *Analyſis of Indiviſibles and Infinites* (a very ſmall Specimen of which, is contained in my *Method of Tangents*, formerly publiſhed.) From this Calculus may be derived all thoſe Theorems and Problems that have been ſo much admired; and this with ſo much eaſe too, that there is now no more need of their being learned and kept in memory, than for a Man that underſtands Algebra to learn a great many of the Propoſitions of the common Geometry.

Thus, for example, in that Theorem of Dr. *Barrow*'s, *That the Sum of the Intervals between the Ordinates and Perpendiculars to the Curve, taken in*, and *applied to* the *Axis*, is *equal to the Semi-Quadrate of the laſt Ordinate*:

Let the Ordinate be $x$, the Abſciſſa $y$, the Interval between the Ordinate and Perpendicular $p$; it appears preſently, by my Method, that $p\,dy = x\,dx$, which *Differential Equation*, turned into a *Summatory* one, makes $S\,p\,dy = S\,x\,dx$. But, from what I have ſhewn in the Method of Tangents, $d\frac{1}{2}xx = x\,dx$, therefore contrarily, $\frac{1}{2}xx = S\,dx\,x$, (for as in the vulgar Calculus, Powers and Roots are reciprocal; ſo in this, Sums and Differences, *viz.* $S$ and $d$ are reciprocal.) It follows therefore, that $S\,p\,dy = \frac{1}{2}xx$. Q.E.D.

In the Notation I had rather make uſe of $dx$, and ſuch like Symbols, to denote the differential Quantities, than other Letters, becauſe that Expreſſion $dx$, is a certain Modification of $x$: And ſo by this means it comes to paſs, that the Letter $x$ alone (when 'tis neceſſary) together with its Powers and Differentials, enters the *Calculus*, and the Tranſcendental Relations between $x$ and any other are expreſſed.

By the ſame Method we may alſo explain the Nature of Tranſcendental Lines by an Equation; ex. gr. Let $a$ be the Ark of a Circle, and $x$ the Verſed Sine; then will $a = \frac{S\,dx}{\sqrt{2x - xx}}$, and if the Ordinate of the Cycloid be $y$, then will $y = \sqrt{2x - xx} + \frac{S\,dx}{\sqrt{2x - xx}}$, which Equation perfectly expreſſes the Relation between the Ordinate $y$, and the Abſciſſa $x$; and from it all the Properties of the Cycloid may be demonſtrated.

And thus is the Analytical *Calculus* extended to thoſe Lines which have hitherto been excluded, for no other Cauſe, but that they were thought incapable of it.

Alſo Dr. *Wallis*'s Interpolations, and innumerable other things are derived from hence.

As to what remains, that I may not ſeem to aſcribe too much to myſelf, or to detract too much from others, I will briefly ſhew what ſeems to me to be due to the chief Mathematicians of our Age, with reſpect to this kind of Geometry.

Firſt of all, *Galilæus* and *Cavallerius* began to explain the moſt involved Methods of *Conon* and *Archimedes*; but *Cavallerius*'s *Geometry* of Indiviſibles was no more than the Infancy of the Science: Greater Improvements were made yet by thoſe three famous Perſons; Mr. *Fermat*, in his Method *de Maximis & Minimis*; *Des Cartes*, by ſhewing how to expreſs the Lines of vulgar Geometry (for he excluded the Tranſcendental ones) by Equations; and *Gregory* St. *Vincent*, by ſeveral noble Diſcoveries: to which I add *Guldinus*'s admirable Rule about the Centre of Gravity. But all theſe ſtopped within certain (comparatively) narrow Bounds, which the famous Geometers, Mr. *Hugens* and Dr. *Wallis*, went beyond, opening new Ways. For 'tis probable enough, that *Hugens*'s Inventions gave riſe to that of *Heuraet*; as thoſe of *Wallis* might to thoſe of *Neil* and *Wren*, who were

were the first that rectified Curve Lines, and this without any Detraction from the just Praise of these noble Discoverers. These were follow'd by Mr. *James Gregory*, and Dr. *Is. Barrow*, who wonderfully increased the Science with admirable Theorems of this kind. In the mean time, Mr. *Nicholas Mercator*, a *Holsatian*, and most excellent Mathematician, was the first that I know of, who exhibited any Quadrature by an infinite Series. Which Invention that profound Geometer, Sir *Is. Newton*, did not only reach by himself, but also compleat, by an universal way; and would he make publick the Thoughts he has yet further on this Subject, he would certainly open new ways to us, to the great increase, and yet abridgment, of the Science. As for myself, it happened when I was yet but a *Tyro* in these Studies, that the sight of a certain Demonstration concerning the Magnitude of a spherical Substance, suddenly gave me some Light; for I saw in general, that the Figure made, by applying the Perpendicular to the Curve, as *Ordinates* to the *Axis* (which Perpendiculars in the Circle are the Radii) was proportional to the Surface of the Solid, generated by the Rotation of the Figure about the Axis. With which first Theorem being wonderfully delighted, and not knowing that the same was known to any one else, I presently invented a Triangle, which in every Curve I called the *Characteristick Triangle*, the Sides of which should be *indivisible* (or speaking more properly) *infinitely small* or *differential Quantities*; from whence I presently, and with ease, derived a vast *Copia* of Theorems, part of which I found afterwards in *Barrow*, and the *Gregories*. And as yet I made no use of an *Algebraical Calculus*, which when I did apply, I soon after found my Arithmetical Quadrature and several other things. But, I know not how, an Algebraical Calculus did not satisfy me in this Business, and I was forced to do a great many things (that I had a mind to in the Analytick way) by long *Ambages* of Figures, till at last I found out the true *Supplement of Algebra* for *Transcendental Quantities*, viz. my *Calculus Infinitus parvorum*, which I also call the *Differential*, *Summatory*, or *Tetragonistick Calculus*: And, if I am not mistaken, aptly enough, the *Analysis of Indivisibles* and Infinites. Which Method, once discovered, all those things which I formerly had so much admired in this kind, seem'd meer Play and Sport to me. For from hence I was able, not only to find out admirable *Compendiums*, but also to attain that most universal Method above explained; by the help of which, either *Quadratrices*, or any other Lines sought, whether *Algebraical* or *Transcendental*, are determined as far as is possible.

Before I conclude, I would yet add this one Caution, that in managing *Differential Equations*, such as this before mentioned, $a = \frac{S\,dx}{\sqrt{2x - xx}}$, a Man should not rashly neglect the $dx$ on this account, that it may be neglected when the $x$ are taken as increasing uniformly: For by this means a great many have gone wrong, and precluded the Way to themselves, in not allowing the Differentials, as $dx$, their own Universality: So that the Progression of the $x$ might be assumed at liberty. Whereas from this one thing alone arise innumerable Transfigurations and Equipollencies of Figures.

TRANSCRIPT, *An.* 34 and 35 *H.* 8. *c.* 14. is the Copy of any Original, written again, or exemplified; as the Transcript of a Fine.

TRANSIRE, 14 *Car.* 2. *c.* 11. is the Term given in the Custom-house to a Warrant or Pass, to let Goods be removed from place to place.

TRANSMUTATION. Sir *Is. Newton*, at the end of his Book of *Opticks*, *Edit. Lat.* seems to be of opinion, That *Grosse*, or thick *Bodies*, and *Light* may be mutually *converted* and *transmuted* into one another; and that all Bodies receive their *active Force* from the Particles of Light which enter into their Composition. For all fixed Bodies, when well heated, emit Light as long as they continue so: And on the other hand, Light intermingles itself, and inheres in Bodies as often as its Rays fall upon the solid Particles of those Bodies, as he shews before. There is no one Body (saith he) which is less apt to shine than *Water*: But yet *Water*, as Mr. *Boyle* found by repeated Distillations, is capable of being transmuted into a fixed Earth; and that Earth will be capable of bearing Heat enough to be made by that means to emit Light, and shine as well as other Bodies. And he thinks this mutual Transmutation of Bodies and Light into one another, to be very agreeable to the Order of Nature, which seems to delight in such Transmutations.

*Water*, which is a Salt very fluid, volatile, and tasteless, is by Heat changed into *Vapour*, which is a kind of Air; and by Cold, into *Ice*, which is a hard, transparent, fragile Stone, easily meltable; and this Stone is convertable into Water again by Heat, as Vapour is by Cold. *Earth*, by Heat, becomes *Fire*, and by Cold is turned into Earth again. *Dense Bodies*, by Fermentation, are rarefied into various kinds of *Air*; and that Air, by Fermentation also, and sometimes without it, reverts into dense Bodies again. *Quick-silver* sometimes puts on the form of a fluid Metal, sometimes of a hard and fragile one: Sometimes it appears in the shape of a pellucid and fragile Salt, which they call *Sublimate*, and sometimes in that of a pellucid, volatile, tasteless white Earth, which is called *Mercurius Dulcis*: Sometimes it looks like a red, opake, and volatile Earth, and then 'tis called *Cinnabar*: Sometimes 'tis in the form of a *red*, and sometimes of a *white Precipitate*, and sometimes of a *fluid Salt*: By Distillation it becomes a *Vapour*, and by *Agitation in Vacuo*, it shines like Fire. And yet after all these, and many other Changes, is capable of being brought back again into running Mercury. The Eggs of Insects, &c. as far as Sense can judge, are by little and little evolved, explicated, and encreased in Magnitude, and so turned into Animals: Tadpoles are turned into Frogs; little Worms, or Maggots, into Flies.

All Birds, Beasts, Fishes, Insects, Trees, and Plants, with all their so very different Parts, grow and encrease out of Water, and aqueous and saline Tinctures; and on Putrefaction, all of them revert into Water, or an aqueous Liquor again. Moreover, Water exposed a while to the open Air, puts on a Tincture, which (like the Tincture of Barley, macerated without boiling) in process of Time hath a Sediment and a Spirit, and before Putrefaction, yields Nourishment both for Animals and Plants. Now among all these many various and wonderful Transmutations, why should not Nature turn *Light* into *Bodies*, and *vice versa*?

The great Objection againſt the practical Tranſmuting of a baſer Metal into a nobler, ſeems to be, that the ſpecifick Gravities of Metals cannot be altered: But in Dr. *Hook*'s Life, before his *Opera Poſth.* I find, that Dr. *Hook*, in 1679, is ſaid to have made ſome Experiments about the mixing of Metals; and particularly, that in a Mixture of Copper and Tin, the ſpecifick Gravity of the Compoſitum was *really increaſed*; for that of the Copper was 8½ to one, and that of the Tin but 7 17/10 to 1; and yet that of the Mixture was 8¼ to 1.

TRANSOM, in Architecture, is the piece of Timber which is framed a-croſs in a Double-Light Window.

TRANSPARENT, the opakeſt Bodies that are, if their Parts be ſubtilly divided (as Metals when diſſolved in Acids, &c.) become perfectly *Tranſparent*; from whence, and from ſome other Reaſons, Sir *Iſ. Newton*, in his Opticks, concludes, That Water, Salt, Glaſs, ſome Stones, &c. and ſuch like Subſtances, are Tranſparent, becauſe tho' they may be as full of Pores or Interſtices between their Parts, as other Bodies; yet their Parts and Interſtices are too *ſmall to cauſe Reflexions in their common Surfaces.* He ſhews alſo, that the leaſt Parts of all natural Bodies are in ſome meaſure tranſparent; and that their Opacity ariſes from the multitude of Reflexions cauſed in their internal Parts. 'Tis plain alſo, as he ſhews, that opake Subſtances are rendered tranſparent, by filling their Pores with any Subſtance of equal, or almoſt equal Denſity with their Parts.

Thus Paper dipped in Water or Oil, the *Oculus Mundi* Stone ſteep'd in the former of thoſe Liquors, Linnen-cloth oiled or varniſhed, and many other Subſtances ſoaked in ſuch Liquors as will intimately pervade their little Pores, become more tranſparent by that means than they were before.

And the true Reaſon why all opake Bodies, when reduced into very ſmall Parts, become tranſparent, is becauſe the thickneſs of the Particles being *much leſs* than the Intervals of the Fits of eaſy Reflexion and Tranſmiſſion of the Rays of Light, the Body loſeth its reflecting Power; for if the Rays, which at their entring into the Body, are put into Fits of eaſy Tranſmiſſion, arrive at the furtheſt Surface of the Body before they be out of thoſe Fits, they muſt be tranſmitted.

TRANSVERSALIS *Pedis.* Dr. *Douglas*, in his comparative Deſcription of the Muſcles, ſaith that *this* is only part of the *Muſculus accelerator Urinæ*, ariſing from the Knob of the *Iſchium*; for it is not inſerted into the *Cavum Ovale*, or Bulb of the *Urethra*, but joins in with the *Accelerator*, of which it makes a ſecond beginning.

TRAVERSE, in Fortification, is a Trench with a ſmall Parapet, and ſometimes with two, one on each ſide; it ſerves as a Cover from the Enemy, when they come on their Flank. Sometimes 'tis covered over with Planks on the top, and is alſo loaded with Earth; they are of good uſe to ſtop an Enemy's way, and to prevent being enfiladed. It is alſo a good Defence in a dry Ditch, when the Parapet is made on that ſide next the oppoſite Flank. There is alſo a *Traverſe* in a wet Ditch, which is made by throwing into the Foſs or Ditch over againſt the Place where the Miner is to be put to the Foot of the Wall, Sauciſſons, Joiſts, and other pieces of Wood, with Faſcines, Stones, Earth, &c. in order to fill up the Ditch, and to carry a Gallery over it. Alſo a Wall of Stone or Earth, built a-croſs a Work which is commanded, in order to cover the Men, is called a *Traverſe*.

TREASURER, is an Officer of great Truſt. The Treaſurer of *England* is a Lord by his Office, and under his Charge and Government is all the Queen's Money in the *Exchequer*, and alſo the Clerks of all Officers any way employed in collecting the Impoſts, Taxes, Tributes, or other Revenues belonging to the Crown. He hath alſo, by virtue of his Office, the Nomination of all Eſcheators yearly throughout *England*; and giveth the Place of all Cuſtomers and Searchers in all the Ports of the Kingdom, with divers other Matters,

TREASURER *of the Queen's Houſhold*, is an Officer in the Court, who is of the Privy-Council, and in the Abſence of the *Steward of the Queen's Houſhold*, hath Power, with the *Controller and Steward of the Marſhalſea*, without Commiſſion, to hear and determine Treaſons, Miſpriſions of Treaſon, Murder, Homicide, and Bloodſhed, committed within the Queen's Palace.

TRENTALS, ſee *Tricennalia*, were thirty Maſſes, ſaid in ſo many Days for the Souls of Perſons deceaſed; and the Offerings which were made, and the Prieſts for this Service, were alſo called *Trentals*.

TRICENNALIA / TRIGINTALIA — were *Trentals*, or, as they were called in *Engliſh*, a *Months Mind*, becauſe the Service laſted a Month, or thirty Days; in which they ſaid ſo many Maſſes.

TRIDENT is a Name given by Sir *Iſ. Newton* to that kind of *Parabola*, by which *Des Cartes* conſtructed Equations of ſix Dimenſions. This Figure hath four infinite Legs, of which, two are Hyperbolical, tending contrary ways, but placed about an Aſymptote; and the other two are Parabolical and Converging, and which, with the other two, form the Figure of the *Trident*. See *Curves*.

TRIMMERS, in Architecture, are thoſe Pieces of Timber framed at right Angles to the Joyſts againſt the ways for Chimneys, and Well-holes for Stairs. *Build. Dictionary.*

TRINODA *Neceſſitas*, was a three-fold neceſſary Tax, or Impoſition, to which all Lands were Subject in the *Saxons* Time, *i.e.* towards the Repairing of Bridges, the maintaining of Caſtles and Gariſons, and Expeditions to repel invading Enemies.

TRINODA *Terræ*, was a Quantity of Land, containing three *Rods* or *Perches*.

TRISTIS, *Triſta*, and *Triſtris*, was formerly an Immunity, whereby a Man was freed from his Attendance on the Lord of a Foreſt, and ſhould not be compelled to hold a Dog, follow the Chace, nor to ſtand at a Place appointed; which, otherwiſe, he might be under pain of Amerciaments.

TRONAGE, is a Toll or Cuſtom taken for weighing of Wool, eſpecially in open Market or Staple, by a common Beam (*Trona*) or legal Standard.

TROY-WEIGHT: the Original of all Weights here in *England*, was a Corn of Wheat gathered from the middle of the Ear, and well dried. Of

theſe

theſe, 32 were to make one Penny-weight, 20 Penny-weight an Ounce, and 12 Ounces a Pound; but afterwards, they came to divide the Penny-weight into 24 equal Parts, which have ever ſince been called Grains. *See Tables of Weight* under *Weights*, in Vol. I. Formerly the *Moneyers* did, and perhaps do ſtill, ſubdivide the Grain thus: 24 Blanks make a Periot, 20 Periots a Droite, 24 Droites a Mite, and 20 Mites one Grain. *See Ward's Introduct. to Mathemat. p.* 32.

TUBA-*Euſtachiana*, is the Canal of Communication between the Mouth and the Barrel of the Ear; 'tis ſo called by *Antonius Valſalva* from its *Figure*, and its firſt Diſcoverer, *Barthol. Euſtachius*.

TUMBREL, *Tumbrellum*, *Turbicketum*, is an Engine of Puniſhment, which ought to be in every Liberty that hath view of Frank-Pledge, for the Correction of Scolds and unquiet Women; and was what we now call a *Cucking-ſtool*.

TUNICA *Vaginalis*, is the firſt of the proper Integuments of the *Teſtes*; 'tis formed by the Dilation of the Productions of the external Membrane of the *Peritonæum*. Its internal Superficies is ſmooth, its external rough: It contains the *Vaſa Deferentia* and *Præparantia*; it embraces looſely the whole Body of the Teſticle, adhering to one end of the *Epydidimis*; and on the out-ſide of it runs the Muſcle called *Cremaſter*, which ſee.

TYCHONIAN *Syſtem* or *Hypotheſis*, is ſo called from having been advanced to ſolve the *Phænomena* of Aſtronomy, by the Noble *Tycho Brahe*. He ſuppoſes the Earth *fixed* and *immoveable* in the Centre of the Univerſe, or of the Sphere of the fixed Stars; ſo that all the Stars and Planets, are ſuppoſed to revolve round the Earth in the ſpace of 24 Hours. The Moon alſo he ſuppoſes to move round the Earth, as the Centre of her menſtrual Motion: But the five other Planets, *Saturn*, *Jupiter*, *Mars*, *Venus*, and *Mercury*, he ſuppoſes to revolve round the Sun in their ſeveral Periods; as the Sun doth round the Earth in a Year's time. But this Hypotheſis is ſo embaraſs'd and perplex'd, that it hath had few Eſpouſers: And, inſtead of it, *Longomontanus*, and ſome few others, have advanced another Hypotheſis, that may be called *Semi-Tychonian*; in which, holding all things according to *Tycho*, they allow a *Diurnal Motion* to the Earth, tho' they deny an *Annual* one. But tho' this be a good deal more probable than the *Tychonian Syſtem*, yet it is ſtill ſo intricate and confuſed, and ſo inconſiſtent with Obſervation, and the ſimple Uniform Laws of Nature, which eſtabliſh the *Pythagorean* or *Copernican* Hypotheſis; that I ſhall ſay no more of it, but that 'tis not worth while for any one to enquire into it, nor to invent Laws to ſolve it; ſince all the *Phænomena* of the Heavenly Bodies, are much better accounted for in the other Syſtem laſt mentioned. See *Greg. Aſtron. Book* I. *Sect.* II.

TYTHES, are of three Sorts. (1.) *Prædial Tythes*, which ariſe wholly or chiefly from the Earth; as of Corn, Hay, Underwood, Fruits, *&c.* (2.) *Mixt Tythes*, are ſuch as ariſe from Beaſts, and other Animals paſtured or fed with the Fruits of the Earth; as Colts, Calves, Lambs, Wool, Milk, Fowls, *&c.* (3.) *Perſonal Tythes*, which are the Profits ariſing from the Labour, Art, Trade, Negotiation, and Induſtry of Men. *Great Tythes*, are of the Tenths of Corn, Hay, and Wood only. All others being called *Small Tythes*.



VACUUM: To what hath been ſaid on this Subject, under this Head in Vol. I. may be added by way of Illuſtration; That ſince all Bodies do (by what Sir *Iſa. Newton* aptly calls the *Vis Inertiæ*) reſiſt as far as they can, any Change or Alteration of their preſent State, whether of Motion or Reſt; and ſince this Reſiſtance is always the ſame in the ſame Body, and in different Bodies is ſtill Proportionable to the Quantity of Matter they contain: And ſince alſo of conſequence, if two Bodies contain equal Quantities of Matter, and move towards one another with contrary Directions, and equal Velocities; they will neceſſarily both ſtop at the Point of Concourſe: And *Converſely*, ſince 'tis certain alſo that two Bodies moving thus, with contrary Directions and equal Celerities, if at the Point of Concourſe they do both reſt, muſt be equally heavy: It plainly follows, that two Bodies, containing each an equal Quantity of Matter, muſt be equally heavy; wherefore, were there no ſuch thing as Poroſity or Vacuity, two Spheres of equal Diameters, muſt contain equal Quantities of Matter, and be equally heavy; that is, two Spheres of different Matter, ſuppoſe one of Wood, and the other of Gold, if they had equal Diameters, muſt have equal or the ſame Specifick Gravities. But this being directly contrary to all experience, there is an unavoidable neceſſity of ſuppoſing Vacuities in the Sphere of Wood, to render it lighter bulk for bulk, than that of Gold.

The Planetary Regions in which the Heavenly Bodies move, muſt needs be almoſt devoid of all Body or Matter; for otherwiſe a *Reſiſtance* muſt accrue to the Planets Motions, which tho' never ſo ſmall, would in time be ſenſible, and have an effect in retarding the Motion of the Heavenly Bodies; but no ſuch thing hath ever yet been obſerved or diſcovered, but the contrary is certain. And beſides, ſuch a thin Vapour as the Tail of a Comet, can move thro' the *Æther*, as ſome will call it, with incredible ſwiftneſs, without being diſſipated or drawn from its natural Courſe; which is in it ſelf a demonſtration, that there muſt be a kind of *Vacuum* in thoſe Celeſtial Regions. And Dr. *Hook*, who was a *Pleniſt*, ſaith, That the vaſt *Expanſum* of the World, muſt be a Body ſo exceedingly fluid, (that is, *no Body at all*) as hardly

to

to hinder the Motion of any Body thro' it. And Sir *Isa. Newton* shows, *p.* 213. *of his Latin Opticks*, That if the Planetary Regions were, as the *Plenists* assert, entirely full of Matter, and without any interspersed Vacuities at all; let their Matter be never so subtile and fluid, they would have a greater Resistance to any Bodies moving in them, than Mercury or Quick-silver hath. *And in such a* Medium *as That, even a perfectly solid Globe must lose half its Motion, before it can move thrice the length of its own Diameter.* And Globes or Spheres, such as the Planets are, would be stopt much sooner; wherefore 'tis absolutely necessary for continuing the Motions of the Planets and Comets, that the Places they move in, be almost entirely devoid of all Matter.

The feigned Romantick Subtile Matter, with which the *Cartesians* have filled the Celestial Regions, and all other Parts of the Universe, is by no means useful to explain the Phænomena of Nature: since the Motions of the Planets and Comets, is much better explained by *Gravitation* without it, and the Cause and Nature of Gravity hath not yet been explained by that *Materia Subtilis*, nor I believe ever can be. And if there were any such thing as that *Matter*, it would only serve to do mischief, to disturb and retard the Motions of the Heavenly Bodies, and the Order and Course of Nature. And if there were any such thing within the hidden Pores and *Meatus* of Bodies, it would serve for no good purpose; it would only hinder and stop the *vibrating Motion of their Parts*, in which their *Heat* and all their *active Force* consists.

That Whim therefore of the *Materia Subtilis*, must be entirely banished out of our Philosophical Faith; and then, along with it, will sink all those imaginary Schemes and Hypotheses, for the explaining the Nature of the Phænomena of Light, by the means of *Pressure* or the *Motion* of the *Medium*. See *Pressure*.

VADIARE *Duellum*, was formerly to *wage a Combat*; that is, when any Person challenged another to decide a Controversy by Camp-fight, or Duel, and threw down a Gauntlet, or made some such like sign of Defiance, then if the other took it up, or accepted of the Challenge, he was said *Vadiare Duellum*; to give and take a mutual Pledge of Fighting.

VAGINALIS *Tunica*. See *Tunica Vaginalis*.

VALE *of a Pump*, at Sea, is the Term for the Trough by which the Water runs from the Pump along the Ship sides, to the Scupper-holes.

VAPOURS: In order to explain the Circulation of Vapour experimentally, Mr. *Edm. Halley* (See *Philos. Trans.* N° 212.) caused an Experiment of the Quantity of Water, arising simply from the warmth of the Weather, without being exposed to either Sun or Wind, to be made in *Gresham-College*: Which was performed with great Care and Accuracy, by the Operator to the Royal Society. And having added up into one Sum, the Evaporations of the whole Year, he found, that from a Surface, as near as could be measured, of eight Inches square, there did evaporate during the Year, 16292 Grains of Water, which is 64 Cubick Inches; and that divided by eight Inches, the Area of the Water's Surface, shews that the Depth of Water evaporated in one Year amounts to eight Inches. But this is much too little to answer the Experiments of the *French*, who found that it rained 19 Inches of Water in a Year at *Paris*: Or those of Mr. *Townly*, which, by a long continued Series of Observations, hath sufficiently proved, that in *Lancashire*, at the Foot of the Hills, there falls above 40 Inches of Water in a Year; from whence it is very obvious, that the Sun and Wind are much more the Causes of Evaporation, than any internal Heat or Agitation of the Water.

The same Observations do likewise shew an *odd Quality* in the Vapours of Water, which is that of adhering to the Surface that exhales them, which they clothe, as it were, with a Fleece of vaporous Air; which once investing it, the Vapour rises afterwards in much less quantity. And this was shewn by the small Quantity of Water that was lost in 24 Hours time, when the Air was very still from Wind, in proportion to what went away, when there blew a strong Gale; altho' the Experiment was made in a Place as close from the Wind as could be well contrived. For which reason I do not at all doubt (saith he) that had the Experiment been made where the Wind had come freely, it would have carried away at least three times as much more, without the Assistance of the Sun, which might perhaps have doubled it. By the same Experiment it likewise appears, that the Evaporations in *May*, *June*, *July*, and *August*, (which in each Month are nearly equal) are about three times as much as what evaporated in the four Months of *November*, *December*, *January*, *February*, which are likewise nearly equal; *March* and *April* answering nearly also to *September* and *October*.

This *Fleece* of Vapour, in still Weather, hanging on the Surface of the Water, is the occasion of very strange Appearances, by the Refraction of the said Vapours differing from that of the common Air, whereby every thing appears raised; Houses like Steeples, Ships as on Land above the Water, and the Land raised and lifted up, as it were, from the Sea, and many times seeming to over-hang. And this may give a tolerable account of what I have heard of seeing the Cattel at High-water-time, in the Isle of *Dogs*, from *Greenwich*, when none are to be seen at Low-water, (which some have endeavoured to explain, by supposing the Isle of *Dogs* to have been lifted up, by the Tide coming under it.) But the vaporous *Effluvia* of Water having a greater degree of Refraction than the common Air, may suffice to bring those Beams down to the Eye; with which, when the Water is refined, and the Vapours subsided with it, pass over, and consequently the Objects seen at the one time, may be conceived to disappear at the other.

Sir *Isa. Newton* in his Opticks, Book 2. p. 60. thinks that the Azure Colour of the Sky, which he takes to be a *Blue*, of what he calls the *first Order*, is caused by the Vapours, when they first begin to condense and coalesce into small Parcels; for then they become first of such a *bigness*, whereby such an Azure may be reflected, before they can constitute Clouds of other Colours: So that this Azure being the first Colour which Vapours begin to reflect, it ought to be the Colour of the finest and most transparent Skies, in which Vapours are not arrived to that *Grossness* requisite to reflect other Colours, as we find it by experience.

VA-

VARIABLE QUANTITIES, in Fluxions, are ſuch as are ſuppoſed to be continually increaſing or decreaſing; and ſo do, by the motion of their ſaid increaſe or decreaſe, generate Lines, Area's or Solidities.

VARIATION, or Permutation of Quantities; is the changing any Number of given Quantities, with reſpect to their Places. See *Combination*.

VASSAL, ſignifies him that holds Land in Fee of his Lord, (now he is called uſually a *Tenant in Fee*) whereof ſome owe Fidelity and Service, and ſuch are *Vaſſalli Jurati*.

VAVASOR, *alias* VALVASOR, is one that in Dignities is next to a Baron: *vid. Bracton, l.* 1. *c.* 8. and *Camden, p.* 188. and *Spelman's Gloſſary*.

VECTIS; when the Weight lies beyond the *Fulcrum* or *Hypomochlion* with regard to the Power, then the *Vectis* is called *Heterodromus*; but when the Weight lies between the *Fulcrum* and the Power, ſo that 'tis not moved a contrary way with the Power, as in the former Caſe, but aſcends or deſcends as the Power doth; then 'tis called *Vectis Homodromus*.

VENA PNEUMONICA; is a ſmall Vein which creeps along upon the *Bronchia* of the *Aſpera Arteria*, or *Trachæa* in the Lungs; 'tis deſcribed and ſo called by *Sommichellius*.

VENTRICULUS: the Stomach or *Ventriculus* is placed immediately under the Midriff; the Liver covers part of its Right-ſide, and the Spleen touches it on its Left, and the *Colon* at its bottom; to which alſo the Cawl is tied. Its figure is like that of a *Scotch* Bag-pipe, being long, large, wide, and pretty round at the bottom, but ſhorter and leſs convex on its upper Part, where its two Orifices are. The left Orifice is called *Cardia*; to it the *Oeſophagus* is joined, and by it the Aliments enter the Stomach, where being digeſted, they aſcend obliquely to the *Pylorus* or right Orifice, which is united to the firſt of the Inteſtines. At this Orifice the Tunicks of the Stomach are much thicker than they are any where elſe, and the inmoſt hath a thick and ſtrong Duplicature in form of a Ring, which ſerves as a Valve to the *Pylorus*, when it contracts and ſhuts.

The Stomach is made of four Membranes or Coats. The firſt and inmoſt is made of ſhort Fibres, which ſtand perpendicularly upon the Fibres of the next Coat; they are to be ſeen plainly towards the *Pylorus*. When the Stomach is diſtended with Meat, theſe Fibres become thick and ſhort: whilſt they endeavour to reſtore themſelves by their natural Elaſticity, they contract the Cavity of the Stomach, for the attrition and expulſion of the Aliments. This Coat is much larger than the reſt, being full of Plaits and Wrinkles, and chiefly about the *Pylorus*. Theſe Plaits retards the Chyle, that it runs not out of the Stomach before it be ſufficiently digeſted. In this Coat there are alſo a great Number of ſmall Glands, which ſeparate a Liquor which beſmears all the Cavity of the Stomach; therefore this Coat is called *Tunica Glanduloſa*.

The Second is much finer and thinner; it is altogether Nervous; it is of an exquiſite Senſe, and is called *Nervoſa*.

The third is Muſcular, being made of ſtraight and circular Fibres; the ſtraight run upon the upper part of the Stomach, between its ſuperiour and inferiour Orifices; and the circular run obliquely from the upper part of the Stomach to the bottom. Theſe Fibres, by their Contraction and continual Motion, help the Attrition and Digeſtion of the Aliments.

The Fourth Tunicle is common; it comes from the *Peritonæum*.

The Stomach receives Veins from the *Porta*, *viz.* the *Gaſtrica*, *Pylorica*, and *Vas Breve*, and Branches from the *Gaſtroepiplois dextra & ſiniſtra*, which are accompanied with Branches of the *Arteria Cœliaca*, all which lie immediately under the fourth Coat of the Stomach.

The Eighth Pair of Nerves, or *Par Vagum*, gives two conſiderable Branches to the Stomach, which deſcending by the ſides of the Gullet, divide each into two Branches, the external and internal. The two external Branches unite in one, and the internal do ſo likewiſe; both which piercing the Midriff, form, by a great Number of ſmall Twigs, upon the upper Orifice of the Stomach, a *Plexus*: and then the internal Branch ſpreads it ſelf down to the bottom of the Stomach; and the external Branch ſpreads it ſelf upon the inſide, about the upper Orifice of the Stomach. This great Number of Nerves which is about the upper Orifice, renders it very ſenſible, and from them alſo proceeds the great Sympathy betwixt the Stomach, Head and Heart; upon which account *Van Helmont* thought, that the Soul had its ſeat in the upper Orifice of the Stomach.

The *Plexus Nervoſus* of the *Hypochondria* and *Meſenterium*, give ſeveral Branches to the bottom of the Stomach; therefore in Hyſterick and Hypochondriack Paſſions, the Stomach is alſo affected.

The Uſe of the Stomach is Digeſtion, which is the diſſolution or ſeparation of the Aliments into ſuch minute Parts, as are fit to enter our Lacteal Veſſels, and circulate with the Maſs of Blood: Or it is the ſimple breaking of the Cohæſion of all the little *Moleculæ*, which compoſe the Subſtances we feed upon. Now the principal Agents employed in this Action, are, firſt, the *Saliva*, the *Succus* of the Glands in the Stomach, and the Liquors we drink, whoſe chief Property is to ſoften the Aliments, as they are Fluids, which eaſily enter the Pores of moſt Bodies, and ſwelling them, break their moſt intimate Cohæſions. When the Aliments are thus prepared, their Parts are ſoon ſeparated from one another, and diſſolved into a Fluid, with the Liquors in the Stomach, by the continual Motion of its Side, whoſe Power in this Action, is, by that great Improver of the true Theory of *Phyſick*, the learned *Pitcairne*, demonſtrated to be equal to the Preſſure of 12951 Pound weight: To which if we add the force of the *Diaphragma*, and Muſcles of the *Abdomen*, which likewiſe conduce to Digeſtion, the Sum will amount to 261086 Pound weight. Theſe two Actions we ſee more clearly in Birds, becauſe they are performed in two Stomachs. In the firſt the Corn is only ſwelled and ſoftened by the Liquor of its Glands, but broken and diſſolved in the ſecond, which is compoſed of very ſtrong Muſcles, becauſe thoſe of the *Abdomen* and *Diaphragma* are weak, neither do they act upon the Stomach, as in Men. *Keil's Anatomy*.

VERDITER, is made thus: Into an hundred Pound weight of Whiting put into a Tub, the Refiners pour their *Copper Water*, (ſee *Refining*) and ſtir them together every Day for ſome Hours together, till the Water grows pale: Then they

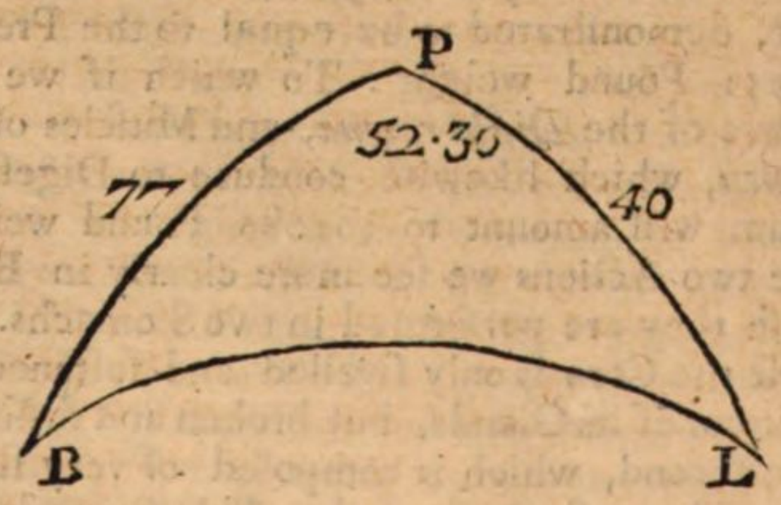
pour that away, and ſet it by for further uſe, and pour on more of the green Water, and ſo continue till the *Verditer* be made; which being taken out, is laid on large Pieces of *Chalk* in the Sun, till it be *dry* for the Market. The Water mentioned to be drawn or poured off from the *Verditer*, (which remains at the Bottom of the Tub) is put into a Copper and boiled, till it come to the thickneſs of Water-Gruel, now conſiſting principally of Salt-Peter reduced, moſt of the Spirit of Vitriol being gone with the *Copper* into the *Verditer*; and a Diſh full of this being put into the other Materials for *Aqua-Fortis*, is re-diſtilled, and makes what they call a *Double Water*, which is near twice as good as that made without it. *Phil. Tranſ.* N° 142.

VERSED-SINE; what it is, ſee in Vol. I. under *Trigonometry* and *Scale*, as well as under *Verſed-Sine*.

*From the Radius or Sine of any Ark, to find the Verſed-Sine.*

If the Ark be leſs than 90°. the Co-Sine taken out of the Radius leaves the Verſed-Sine: But if the Ark be greater than a Quadrant, the Radius added to the Co-Sine, makes the Verſed-Sine. By the Sector, the Diſtance from 90 to 80 on the Line of Sines taken laterally, is the Verſed-Sine of 10°: The Diſtance between 90 and 70, the Verſed-Sine of 20°. *&c.* But if the right Sine were 50°. and you would have the Verſed-Sine of 50°. make a parallel entrance of the Sine given between 50 and 50 in the Lines of Sines; and by that means, the Diſtance between 90 and 90, will give the Length of the *Radius*: Then out of that Radius take parallelly found the Sine of 40°. (the Co-Sine of 50°.) the Remainder will be the Verſed-Sine 50°.

In Sir *Jonas Moor*'s *New Syſtem of Math.* Vol. II. in the New Book of *Logarithms*, (and in ſome other Books) you have *Tables of Verſed-Sines*, both natural and artificial, whoſe Uſes are very many; and eſpecially in ſolving *ſome* of the *moſt uſeful* Caſes of Spherick Triangles: As in *calculating the Diſtances of Places on the Earth's Surface, according to the Arch of a great Circle*, by having their Longitudes and Latitudes; *The Diſtances of two Stars*, by having their right Aſcenſions and Declinations, or their Longitudes and Latitudes; by which means, the Altitudes of two Stars not on the Meridian, or of the Sun, with the Difference of *Time* or *Azimuth* being obſerved, the Latitudes of Places may be found.




As in the Spherick Triangle B P L, let the Legs B P, and P L be given, and the contained Angle B P L. To find the ſide B L:

I ſay, as the Cube of Radius, to the Rectangle of the Sines of the Legs; ſo is the Square of half the Sine of the contained Angle, to ½ Difference of the Verſed-Sines of the third Side, and of the Ark of Difference between the two containing ſides.

Therefore, in Practice, double the Logarithmick Sine of half the Angle given, and to it add the Log. Sines of the Legs; and from the Left-hand of the Sum, ſtrike out 3 for the Cube of the Radius, there will remain the Logarithm of half the Difference of thoſe two Verſed-Sines.

Which half Difference doubled, and added to the Verſed-Sine of the Difference of the Legs, gives the Verſed-Sine of the Side ſought.

*EXAMPLE.*

| | | |
|---|---|---|
| The Log. Sine of 40°. | - | 9.8080675 |
| The Log. Sine of 77°. | - | 9.9887239 |
| The Log. Sine of 26°. 15 when doubled | - | 19.2914116 |
| The natural Sine againſt 39.0882030 | is | 1227355 |
| Whoſe double is | — — | 2454710 |
| The natural Verſed Sine of 37°. the Difference of the Legs, is | — | 2013645 |
| Their Sum is | — — | 4468355 |

Which is the Verſed-Sine of 57 deg. 53 min. the Side required or ſought.

VERTICAL-PLANE, *in Conicks*, is a Plane paſſing thro' the Vertex of the Cone, and parallel to any Conick Section.

VERTICAL-LINE, *in Conicks*, is a right Line drawn on the Vertical-Plane, and paſſing thro' the Vertex of the Cone.

VERTICAL-LINE, *in Dialling*, is a Line on any Plane perpendicular to the Horizon; this is beſt found and drawn on an erect or reclining Plane, by holding up a String and heavy Plummet ſteadily, and then marking two Points of the Shadow of the Thread on the Plane, a good diſtance from one another, and then drawing a Line thro' thoſe Marks.

VIBRATING-MOTION, is a very quick and ſhort Motion of the ſolid Parts of Bodies, cauſed by the Pulſe or Stroke of ſome Body upon them. Thus the Rays of Light or Fire ſtriking upon the ſmall Particles of Bodies, do excite in them ſuch Vibrations, and cauſe them to grow hot and ſhine. For all fixed ſolid Bodies when heated to a due degree, will emit Light, and ſhine; and Bodies which abound with *earthy Particles*, (as the Chymiſts ſpeak) and eſpecially ſulphureous ones, do emit Light; which way ſoever their Parts come to be agitated into theſe *vibrating* Motions, whether by *Heat*, by *Rubbing*, by *Striking*, or by Putrefaction, or ſome animal or vital Motion. Thus the *Sea-Water ſhines* or *burns*, as they call it, in a Storm; *Quick-ſilver* emits a Light when ſhook *in Vacuo*: an Horſe's Neck, or Cat's Back, when rubb'd with one's Hand in the dark; Wood, Fleſh and Fiſh, when 'tis rotten and putrefied: ſo ſhine Vapours ariſing from putrid Waters, as the *Ignes Fatui*, *&c.* thus kindles wet Hay, *&c.* thus *Diamonds* rubb'd in the dark, emit a Light, like the *Phoſphorus*; and thus Iron will grow hot, and burn with quick and forcible hammering on an Anvil.

Of the vibrating Motion of the Parts of ſolid Bodies, a good Inſtance alſo you have in Bells, or the Brims of Drinking-Glaſſes half full of Liquor, and then rubbed ſtrongly with one's Finger a little wetted.

Dr. *Hooke* ſaith, he hath obſerved the Direction of this vibrating Motion, to be from the Center outwards, & *vice verſa*.

VICAR; the Prieſt of every Pariſh is called *Rector*, unleſs the *Predial* Tythes be impropriated; and then he is called *Vicar*, *quaſi vicem fungens Rectoris*. The *Vicar* is called perpetual, becauſe every Vicarage hath a conſtant Succeſſion (like a Corporation) and never dies.

VICE-CHAMBERLAIN; is a great Officer in the Queen's Court, next under the Lord Chamberlain; and in his abſence hath the Controul and Command of all Officers whatſoever, appertaining to that part of her Majeſty's Houſhold, which is called the *Chamber*, or above Stairs.

VIÆ *primæ*, ſo the Phyſicians call the Stomach and Guts, accounting the whole length of the Canal which reaches from the Mouth to the *Sphincter Ani*.

VIGIL; tho' the Civil Day begins from Midnight, yet the Eccleſiaſtical or Scriptural Day begins at ſix in the Evening, and holds till ſix in the Evening of the enſuing Day. Hence the *Collect* for every Sunday and Holiday (by Order of our Church) is to be read at the preceding Evening Service, or at the Veſpers or Even-ſong at ſix a-clock the Day before; from which Time the Religious Day was ſuppoſed to begin: and this firſt part of the Holiday, from ſix a clock of the Day before, was by the Primitive Chriſtians ſpent in Hymns, and other Devotions; and theſe being often continued till late in the Night, were thence called *Vigils*. Tho', by degrees, theſe *Vigils* became ſo enlarged, that at laſt all the Day preceding the Holiday, came to be called by this Name, as it is now.

VILLANIS *Regis ſubactis reducendis*, was a Writ that lay for bringing back the King's Bondmen, that had been carried away out of his Mannors to which they belonged.

VINCULUM, is a Term in Fluxions, implying that ſome compound ſurd Quantity is multiplied into a Fluxion, &c. Thus, in this Expreſſion, $a\,x\,\surd\,a\,x - o\,a$ the *Vinculum* is the compound Surd $\surd\,o\,x - a\,a$. which is $\times_d$ into $a\,x$.

VIRGATE, or *Yard-Land*, was originally no more than a certain extent or compaſs of Ground, ſurrounded with ſuch Bounds and Limits; and therefore the quantity was uncertain, according to the difference of Places and Cuſtoms.

VIRTUE; is a free elective and acquired Habit of the Mind, whereby we are conſtantly inclined to do, and do in Fact act or not act, purſue or avoid, according to the Rules of true Prudence.

VISCOUNT, *Vicecomes*, *Vicount*, ſignifies as much as Sheriff; betwixt which two Words there is no other Difference, but that the one comes from the *Normans*, and the other from the *Saxons*. See *Sheriff*. With us now, a *Viſcount* or *Vicount*, is a Perſon having the next degree of Nobility below an Earl; and tho' it be an old Name of Office, 'tis a new one in Dignity, being not in uſe with us till the time of *Hen. 6*. But 'tis of greater Antiquity in other Countries. See *Selden*'s *Titles of Hon. fol.* 761.

VISION: the Phyſical Cauſe of Viſion ſeems to be, That the Rays of Light ſtriking on the Bottom of the Eye, do there excite certain Vibrations in the *Tunica Retina*; which Vibrations being propagated as far as the Brain, by the *ſolid Fibres of the Optick Nerves*, do there cauſe the Senſe of *Seeing*. For as *Denſe* Bodies do retain their Heat longeſt, and that in proportion to their denſity, they retain it longer, as they are more denſe; ſo the Vibrations of their Particles are of a more durable nature, than thoſe of rarer Bodies, and therefore can be propagated to greater Diſtances: Wherefore the ſolid and denſe Fibres of the Nerves, whoſe Matter is of an homogeneal and uniform Nature, are very proper to tranſmit to the Brain ſuch Motions as are impreſſed on the external Organs of all our Senſes. For that Motion which can preſerve it ſelf a good while, in one and the ſame Part of any Body, can alſo be propagated a great way from one Part of it to another; provided the Body be of an homogeneal Nature, and that the Motion be not reflected, refracted, interrupted, or diſturbed by any Inequality in that Body.

Rays of Light therefore of divers kinds, will excite Vibrations in the *Retina* of *different Magnitudes*; and theſe Vibrations, according to ſuch their different Magnitudes, will produce the Senſations of different kinds of Colours; juſt almoſt as in the Air, Vibrations of different Magnitudes produce the Senſation of different Sounds. *v. gr.* (as you will find under *Colour*) Such Rays of Light as are moſt Refrangible, excite the moſt ſhort Vibrations, and cauſe the Senſation of a deep Violet Colour: While ſuch Rays as are leaſt Refrangible, do excite the *longeſt* Vibrations; and cauſe the Senſation of a deep Red Colour. And Rays of Light of all intermediate kinds, do excite accordingly intermediate Vibrations, and ſo cauſe the Senſations of the other intermediate Colours, between the two Extremes of Violet and Red.

VIS INERTIÆ *Materiæ*: This *Vis Inertiæ* is no where more conſpicuous, than in the ſudden Motion of a Veſſel full of Liquor upon a horizontal Plane; at firſt the Liquor ſeems to move with a Direction contrary to that of the Veſſel, not that there is any ſuch Motion really impreſs'd upon the Liquor, but that the *Vis Inertiæ* endeavouring to continue it in its ſtate of Reſt, the Veſſel cannot immediately communicate its Motion to the Liquor: But the Liquor perſeveres in its ſtate of Reſt, whilſt the Veſſel moves forward, and ſo ſeems to move a contrary way. But when once the Liquor has the Motion of the Veſſel communicated to it, and begins to move with a Velocity equal to that of the Veſſel; if the Veſſel be ſuddenly ſtop'd, the Liquor continues its Motion, and daſhes over the ſides of the Veſſel.

The Reſiſtance of all fluid Mediums againſt Bodies moving thro' them, is chiefly owing to this *Vis Inertiæ*; as you will find under *Reſiſtance* in this Vol.

VIS STIMULANS; a Term uſed by Dr. *Cheyne* in his Book of Fevers, and by ſome other Phyſicians, and they underſtand by it ſuch a Quality in any Fluid, whereby the Particles of it are diſpoſed to make a real Diviſion, or a violent Inflexion of the nervous and membranous Fibres of

the Body; which occaſions frequent and forcible Reciprocations, Succuſſions, and Derivations of the *Liquidum Nervorum* into the Muſcles and Contractile Fibres of the Canals of the Body, whereby all the involuntary Muſcles are brought into violent Contractions, and the *Emiſſaries* of the Glands are ſqueezed. See *Bellini de Urinis & Pulſibus, & de Motu Cordis.*

VISUAL-ANGLE, is the ſame with the Optick-Angle; which you will find under Optick Pyramid and Optick Triangle.

VITRIOL or *Copperas*, is made at *Brickleſey* in *Eſſex*, according to Mr. *Ray*'s Account thus: They lay the Copperas Stones (which *Wormius* in his *Muſ. c.* 13. *Sect.* 2. ſaith, are chiefly found in the Iſle of *Shepey*; but are indeed gather'd upon the Coaſts of *Kent* and *Suſſex* in many Places) on a large Bed or Floor prepared in the open Air, underneath which there are Gutters or Troughs, diſpoſed to receive and carry away the Liquor impregnated with the Mineral to a Ciſtern, where it is reſerved. For the Air and Weather diſſolving the Stones, the falling Rain carries away along with it, the Vitriolick Juice or Salt which is diſſolved thereby. This Liquor they boil in large Leaden-Pans, putting in a good quantity of old Iron: When 'tis ſufficiently evaporated, they pour it out into large Troughs wherein it cools; and the Vitriol chryſtallizes to the Sides, and to Croſs-Bars of Wood, which are placed in the Troughs. The Liquor remaining after this Chryſtallization, they call the *Mother*, which is reſerved to be boiled and evaporated again.

*Wormius* ſaith, the Liquor is ſix or ſeven Days boiling to a due conſiſtence; and that it can be boiled in nothing but a Leaden Veſſel.

*Matthiolus* deſcribes the way of making Vitriol in *Italy*, to be ſomething different from ours; for, *he ſaith*, they burn the Copperas Stones in ſmall heaps, till the greateſt Part is reduced to a Calx or Aſhes, which being poudered, is mingled and agitated with Water, in large Veſſels, to get out the Vitriolick Matter; then they draw off the clear Water after the groſſer Matter hath ſubſided, and boil it to a due conſiſtence, throwing in pieces of old Iron or Braſs (according to the deſign of the Operator) and then put it to chryſtallize in wooden Veſſels.

VIVO, is the Shaft of a Column in any of the Orders of Pillars in Architecture.

UNCUTH, in *Saxon* is *unknown*, and, in the old *Saxon* Laws, is uſed for a Perſon that comes to an Inn, and lies but one Night: In which Caſe his Hoſt was not anſwerable for any Offence he ſhould commit, whereof he was guiltleſs himſelf. But if he lay there a ſecond Night, then he was called a *Guſt*, *Hoſpes*; and then the Hoſt was to anſwer for him, as for one of his Family. If he tarried any longer, he was then called *Agenhine*, (or, as ſome write it, *Hogenhine*) and the third Night, *Awnhine*, that is, *Familiaris*: and then if he offended againſt the King's Peace, his Hoſt was to ſee him forth-coming; and if he could not produce him in a Month and a Day, he was obliged to ſatisfy for his Offences.

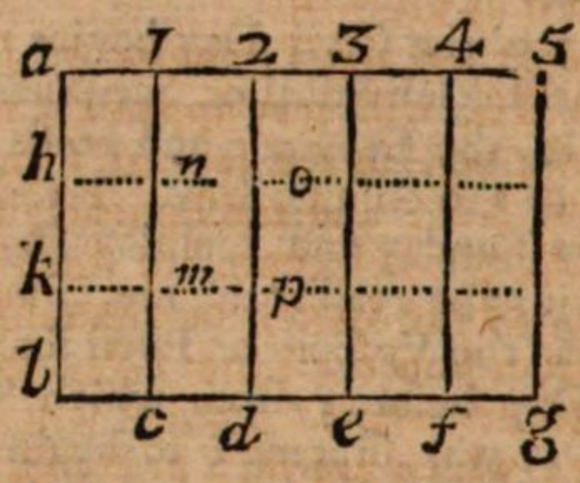
UNDER-*Chamberlain* of the *Exchequer*, is an Officer there that cleaves the Tallies, and reads the ſame; ſo that the Clerk of the Pell, and the Controllers thereof, may ſee that the Entries be true; he alſo makes ſearches for all Records in the Treaſury, and hath the Cuſtody of the Doomſday-Book. There are two Officers there of this Name.

UNGULA, in Geometry, is the Section of a Cylinder cut off by a Plane, which paſſes obliquely thro' the Plane of the Baſe, and part of the Cylindrick Surface.

## *Uniform Motion.*

UNIFORM *or equable Motion*, and all its Properties, may be very well explained by the equiangular Parallelograms in this Figure. Where the Dirigent *a* 5 repreſents the Time, and the Lines *a b*, 1 *c*, 2 *d*, *&c.* the uniform or equable Velocities with which any Body is moved, in any Parts or Moments of Time. And the *Parallelograms a c*, *c* 2, 2 *e*, *e* 4, 4 *g*, do truly repreſent the Spaces deſcribed or run thro' with the Velocity *a b*, in the Times *a* 1; 1, 2; 2, 3; 3, 4; 4, 5,

From the bare Conſideration of which only, it will follow;




1. That the *Spaces* deſcribed by any Moveable, with an equable or uniform Velocity, are always as the *Times*.

For the Parallelograms *a c*, *a d*, *&c.* having all the ſame Altitude, muſt be as their Baſes, *b c*, *c d*, *&c.*

2. Or if the *Times* be equal, the *Spaces* muſt be as the *Velocities*; that is, the Parallelograms *a n* to *a m*, will be as *a h* to *a k*, *&c.*

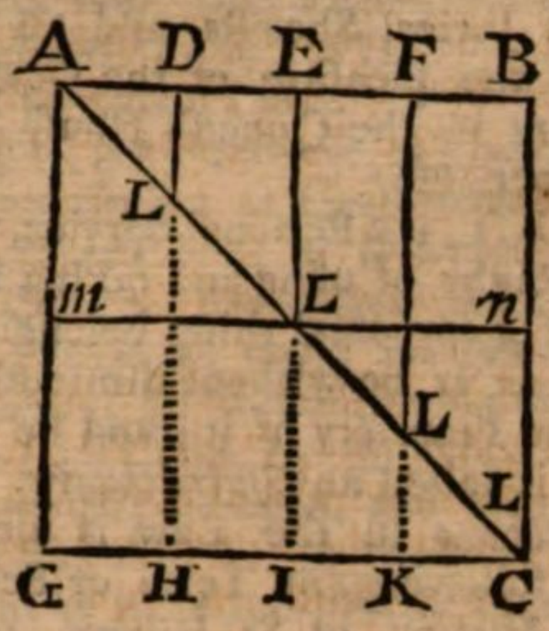
3. And from hence it will follow, that if the *Spaces* are as the *Velocities*, the *Times* will be equal; if as the *Times*, the *Velocities* will be equal.

4. Where the *Spaces* are equal, the *Times* muſt be *reciprocally* as *Velocities*: for the ſimilar and parallel Rectangles have their Sides reciprocally proportionable; and *vice verſa*, where the *Times* and *Velocities* are reciprocally proportionable, the *Spaces* muſt be equal.

5. Wherefore the *Ratio's* of the *Spaces* are always *compounded* of the *Ratio's* of the *Times* and *Velocities*: And conſequently, deducting the *Ratio* of the *Time* out of *that* of the *Velocity*; or, which is all one, dividing the *Space* by the *Time*, there will reſult the *Velocity*; dividing by the *Velocity*, the Quotient will be the *Time*.

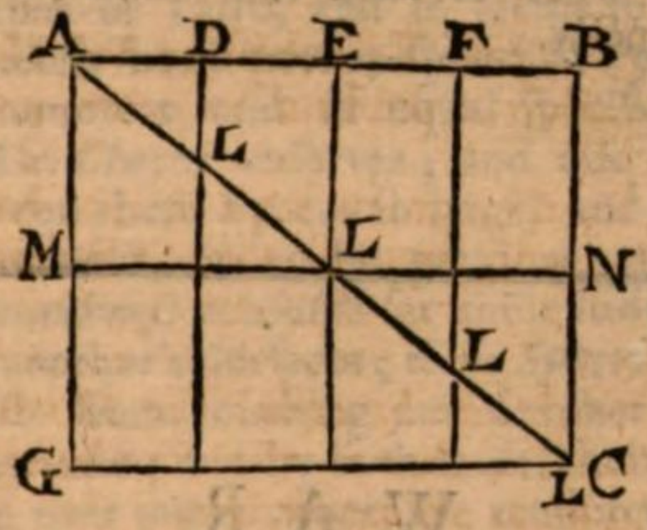
After much the ſame manner alſo may the uniform or equable Acceleration or Retardation of any Motion, be expreſſed very eaſily and clearly by *Lines*.

As




As ſuppoſe the right-lined Triangle A B C, the Side A B denotes the *Time* in which a Body may move from a Point of *Reſt*, as in A; and having its Velocity continually encreaſing in the uniform *Ratio* of the Lines D L, E L, F L, and B C; or decreaſing equally back again in the ſame *Ratio*, from any determinate degree of it in B C, to none at all in A.

In this Figure then, the Triangles A L D, A L E, A L F, and A B C, will very appoſitely repreſent the *Spaces* deſcribed in the ſeveral Times A D, A E, A F, and A B; and conſequently the *Trapezia* D L, D C, *&c.* will repreſent the *ſtill aggregated Velocity*, and the *Spaces* correſponding thereunto. And from hence all the Laws and Affections of *equable accelerated Motions* will be eaſily accounted for; which are ſuch as theſe, *viz.*

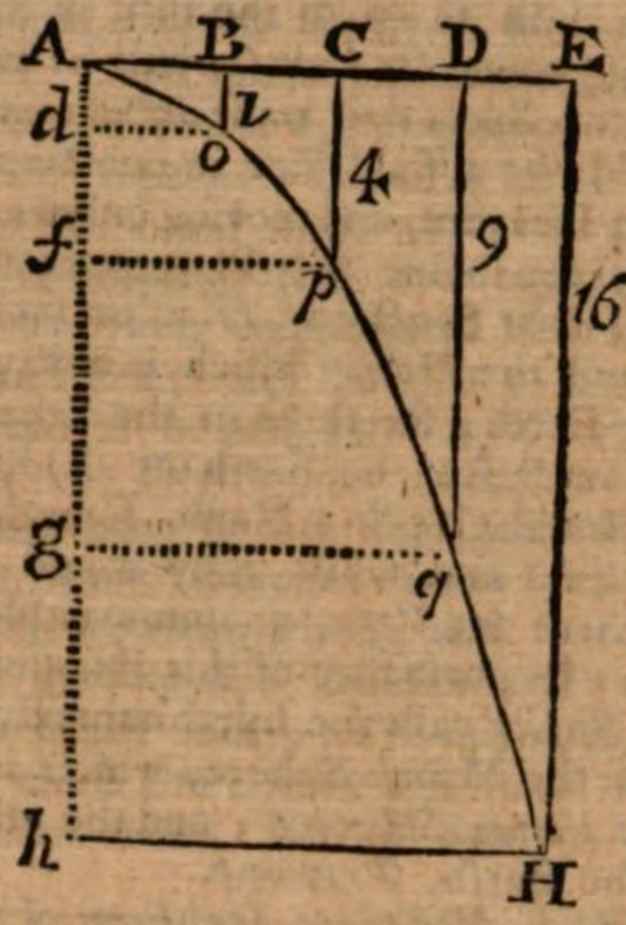



1. That the *Space* deſcribed at the end of the accelerated Motion, will be equal to *that* which would have been deſcribed by an uniform equal Motion in the ſame time, and with half the degree of Velocity which the accelerated Body did at laſt acquire: For the Triangle A C B is equal to the Square M B; each being the half of the Square G B.

2. That the Spaces deſcribed by the Motion of a Body, beginning from Reſt, and *uniformly accelerated*, are as the *Squares* of the *Times*. For the Area's of the ſimilar Triangles A D L, A E L, *&c.* are as the Squares of A D, A E, *&c.*

3. And comparing divers Motions, thus *uniformly accelerated* one with another, it will be plain that the *Spaces* run thro', will be to one another in a *Compound Ratio* of the *Times*, and of the greateſt Velocities at any time acquired, (becauſe ſimilar Squares are in a *Ratio* compounded of that of their Sides.)

4. And from hence 'tis plain, that the Caſe of Bodies accelerating their Motion uniformly, ſo as that the Spaces deſcribed, ſhall be as the Squares of the Times, (which is the known Caſe of the Deſcent of heavy Bodies towards the Centre of the Earth) may be very well expreſſed by the Complement of the *Semi-parabola* A E H;




where the vertical Tangent A E, repreſents the determinate *Time* divided into equal Parts; and the Lines B O, C P, D *q*, and E H, the ſeveral Velocities required in the ſeveral Deſcents. Now the *Spaces* deſcribed, A B O, A C P, *&c.* are as the Squares of the *Times* A B, A C, *&c.* that is, as the Squares of the *Ordinates do*, *fp*, *gq*, *&c.* which Squares are (by the *Parabola*) as the *Abſciſſa* A *d*, A *f*, A *g*, *&c.*

Wherefore the *Velocities* acquired at the end of any Deſcents, will be as the Squares of the Times in which theſe Deſcents are made.

That is, the *Velocity* at the end of the ſecond Moment, or Part of Time, to the *Velocity* at the end of the firſt Moment, will be as the Square of the ſecond to the Square of the firſt, or as the fourth to the firſt, *&c.*

UNION of two Churches, is a conſolidating or combining them into one, which may be done by the Conſent of the Biſhop, Patron, and Incumbent. See *Linwood's Provincials*, and 37 *H.* 8. *c.* 21 as alſo 17 *Car.* 2. *c.* 3.

UNISONS. It hath been long ſince obſerved, that if a Viol-String, *&c.* be ſtruck with the Bow or Hand, another String on the ſame, or another Inſtrument not far from it, will (if an Uniſon to it) tremble at the ſame time of its own accord. But Dr. *Wallis*, in *Philoſ. Tranſ.* N°. 134 tells us, that 'tis not the whole of the unſtruck String that trembles, but the ſeveral Parts ſeverally, according as they are Unrſons to the whole, or the Parts of that String which is ſo ſtruck: *v. gr.* If one String be an upper Octave to another, and therefore an Uniſon to each half of it when 'tis ſtopt in the middle; then I ſay, if the former be ſtruck while the latter is open, the two halves only of the latter will tremble, and not the middle Point: as you may eaſily try, by laying a bit of Paper lightly wrapt about the middle of the ſecond String. See a Solution of this in *Plot's Hiſt. of Oxfordſhire*, by Dr. *Narciſſus Marſh*, and of other ſuch Phænomena.

UNMOOR, a Term uſed at Sea for a Ship that before *rid*, or was held by two Anchors, to begin to get them up, and prepare to *weigh*. See *Moor*.

VOLVA, the great *Kepler*, conſidering how our Earth will appear to the Inhabitants of the Moon, if there be any ſuch, *viz.* that it will ſeem a large Moon to them 15 times greater than their Planet doth to us at the full, in 24 Hours time *revolving* round its Axis (as will be eaſily diſcovered by the Spots that muſt appear in it) but yet alſo fix'd like a fix'd Star in one determinate Place in the Heavens, and moving only as they appear to do; this being the Phænomenon of the Earth to a Lunar Spectator, (*i. e.* to ſuch as live on that ſide of the Moon, which is always turn'd towards the Earth; for thoſe in the other Hemiſphere can never ſee the Earth at all) he fancies that they would give it a Name ſomething like that of *Volva*; and while they would conſider their own Earth as a *Veſta*, an immoveable Seat or Habitation. In purſuance of this imaginary State of Things, *Kepler* calls the Inhabitants that live in that half of the Moon's Sphere, which is turned towards the *Volva*, *Subvolvæ*; and the others that never ſee the Earth, *Privolvæ*.

VOMITIVE *Medicines*, ſee *Emeticks*; where there is an Account of their Operation, in Vol. I. and II.

URBICARIÆ *Regiones*. See *Suburbicariæ*.

USE in the *Civil Law*, is one of the *Perſonal Services*, and ſignifies a Right that a Man hath of uſing a corporeal thing belonging to another, without prejudice to the Proprietor of it: This Right is not ſo great as an *Uſufruct*; for he that hath this Right, cannot take the Profits generally, but only for his daily Uſe and neceſſary Subſiſtence.

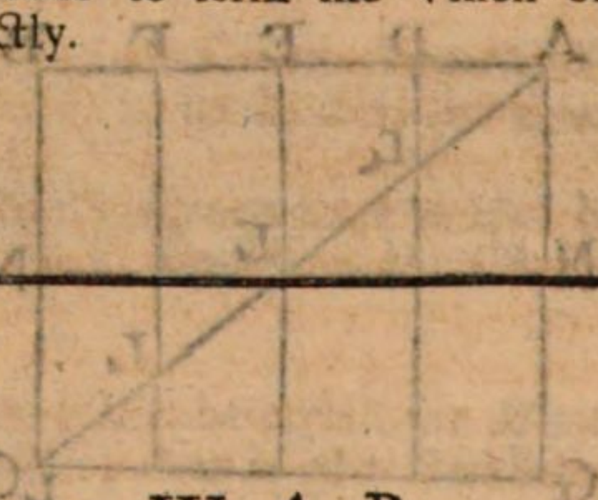
USHER, *Oſtiarius*, from the *French Huiſſier*, a Door-keeper of a Court, is an Officer in the Exchequer, of which ſort three or four attend the chief Officers and Barons at the Court at *Weſtminſter*; and Juries, Sheriffs, and all other Accountants, at the pleaſure of the Court. There are alſo *Uſhers* in the Queen's Houſe, as of the Privy-Chamber, &c.

USUFRUCT, is a Perſonal Service, whereby a Man hath a Right of uſing and taking all manner of Profits, of a corporeal thing belonging to another Perſon, ſo it be without diminution or prejudice to the Propriety of it; and he that hath this Right, is called an *Uſufructuary*.

UTAS *Octava* in the Law is uſed for the eighth Day following any Term or Feaſt; as the *Utas* of St. *Michael*, of St. *Hillary*, of St. *John Baptiſt*, &c. and any Day between the Feaſt and the Octave, is ſaid to be within the *Utas*. The Uſe of this is in Return of Writs, as appears by 51 *H.* 3. and *Preamble* to 43 *E.* 3.

UTFANGTHEF, *Fur extra captus*, is an antient Privilege or Royalty granted to a Lord of a Mannor by the Sovereign, giving him a Power to puniſh a Thief dwelling out of his Liberty, and committing the Theft alſo without the ſame, if ſo be that he be taken within the Fee of that Lord.

UVEA, this is reckoned the fifth Coat of the Eye, and ſeems to be only the Circumference of the *Pupilla*; it is compoſed of circular and ſtrait Fibres, to contract and dilate according to the Strength or Weakneſs of the Light: for when the Light is too ſtrong, the circular Fibres contract the *Pupilla*, that the Force of the Rays may not hurt the Eye; and when the Light is too weak, the ſtrait Fibres dilate the *Pupilla*, to let in more Rays, in order to form the Viſion of Objects more diſtinctly.





WAGA, or VAGA, the ſame with *Weigh*, which ſee in this Vol.

WAGE, *Vadiare*, from the *French Gager*, *dare Pignus*, ſignifies in our Law the giving Security for the Performance of any thing: As, to *wage Law*, is to put in Security, that you will *make* Law at a Day aſſigned; and *to make Law*, is to take an Oath that a Man owes not a Debt which is claimed of him, and alſo to bring with him ſo many Men as the Court ſhould aſſign, to avow on their Oaths, that they believe he ſwears truly.

WAGER *of Law*. See *Law*.

WARDAGE, the ſame with *Ward-peny*.

WARDECORN, is the Duty of keeping Watch and Ward, with a Horn to blow, on any occaſion of Surprize, &c.

WARD-PENY, *Warpen*, *Warthpenny*, *Warſcot*, *Warth*, was formerly a cuſtomary Due paid to the Sheriff, and other Officers, for maintaining Watch and Ward; it was payable at the Feaſt of St. *Martin*. This cuſtomary Acknowledgment is ſtill paid within the Mannor of *Sutton Colfield*, in *Warwickſhire*; and with ſome Ceremonies that are as ſingular as ſurprizing. *Cowel's Interp.*

WARDMOTE, in *London*, is a Court ſo called, and which is kept in every Ward.

WARDEN of the Mint. See *Maſter*.

WARDS and *Liveries*, was a Court firſt erected by King *H.* 8. and afterwards augmented by him with the Office of Liveries: But 'tis now abſolutely taken away and aboliſhed, by a Statute made 12 *Car.* 2. *cap.* 24.

WARD-STAFF, was formerly the Term for a Conſtable's Watchman's Staff: And the Mannor of *Lamborn* in *Eſſex*, is held by *Service of the Ward-Staff*, *viz.* to carry a Load of Straw in a Cart, with ſix Horſes, two Ropes, and two Men in Harneſs, to watch the *Ward-Staff*, when it is brought to the Town of *Aibridge*.

WARRANTIA *Cuſtodiæ*, is a Writ judicial; and formerly, before the Court of Wards was aboliſhed, lay for him who was challenged, when a Ward to another, in reſpect of Land ſaid to be holden in Knight-Service; which when it was bought by the Anceſtors of the *Ward*, was war-

warranted, to be free from ſuch Thraldom; and it lay againſt the *Warranter* and his Heirs.

WARRECTUM and *Warrecta Terra*, is Land long neglected and uncultivated; for in old Records you will find, that *Tempus Warrecti* ſignifies the Time that Land lies fallow. *Warrectare* alſo ſignifies to *fallow* Land.

WARREN, is a Franchiſe, or Place privileged, either by Preſcription or Grant from the Crown, to keep *Beaſts and Fowl of Warren*; which are Hares and Conies, Partridges and Pheaſants: And if any Perſon be found an Offender in any ſuch *Fee-Warren*, he is puniſhable for the ſame at Common-Law; and by the Statute 21 *Ed.* 3. a *Fee-Warren* may lie open, and there is no neceſſity of cloſing that in, as there is of a Park; for that ought to be ſeized into the Queen's hands, if it be not encloſed.

WASSEL-BOWL, was a large Cup or Bowl of Silver or Wood, wherein the *Saxons* at their publick Entertainments drank a Health to one another, in the Phraſe *Was-heal (i.e.) Health be to you*. This *Waſſel-Bowl* ſeems plainly to be meant by the word *Vaſtellum*, in the Lives of the Abbots of *St. Albans*, by M. *Paris*, *p.* 144. where he ſaith, *Abbas ſolus prandebit ſupremis in Refectorio habens Vaſtellum*; that is, the Abbot had ſet by him at the upper-end of the Table, the *Waſtell*, or *Waſſel-Bowl*, to drink a Health to the Fraternity, or the *Poculum Charitatis*. So Cakes and White-Bread (which were commonly ſopped in this Bowl) are called *Waſtell-Bread*. And hence the Cuſtom of going a *Waſſailing*, as 'tis ſtill called and uſed in *Suſſex*, and ſome other Places, ſeems to have taken its Name.

WATER. Sir *Iſ. Newton* defines Water (when pure) to be a very fluid Salt, volatile, and void of all Sapor or Taſte, and it ſeems to conſiſt of ſmall ſmooth hard porous ſpherical Particles, of equal Diameters, and of equal ſpecifick Gravities, as Dr. *Cheyne* obſerves; and alſo that there are between them Spaces ſo large, and ranged in ſuch a manner, as to be pervious on all ſides. Their *Smoothneſs* accounts for their ſliding eaſily over one another's Surfaces; their *Sphericity* keeps them alſo from touching one another in more Points than one; and by both theſe, their *Frictions* in ſliding over one another, are rendered the leaſt poſſible. Their *Hardneſs* accounts for the *Incompreſſibility* of Water, when 'tis free from the Intermixture of Air.

The *Poroſity* of Water is ſo very great, that there is at leaſt 40 times as much Space as Matter in it; for Water is 19 times ſpecifically lighter than Gold, and conſequently *rarer* in the ſame Proportion: but Gold will, by Preſſure, let Water paſs through its Pores, and therefore may be ſuppoſed to have (at leaſt) more Pores than ſolid Parts. Now 'tis this great Poroſity of Water that accounts for its different ſpecifick Gravity, in compariſon of *Mercury* or other Fluids; and alſo why 'tis more eaſily concreted into a ſolid Form, by adventitious Matter in freezing, than other Fluids are.

Dr. *Cheyne* obſerves rightly, that the Quantity of Water on this ſide our Globe, doth daily decreaſe, ſome part thereof being every day turn'd into *Animal*, *Vegetable*, *Metalline*, or *Mineral* Subſtances; which are not eaſily diſſolved again into their component Parts; for ſeparate a few Particles of any Fluid, and faſten them to a ſolid Body, or keep them aſunder one from another, and they are no more fluid: for to produce *Fluidity*, a conſiderable number of ſuch Particles is required. (See *Fluidity* in this Vol.) Moſt of the Liquors we know are formed by the Coheſion of Particles of different Figures, Magnitudes, Gravities, and *attractive* Powers, (See *Attraction* and *Particles*) ſwimming in pure Water, or an aqueous Fluid; which ſeems to be the common Baſis of all. And the only Reaſon why there are ſo many ſorts of Water differing from one another by different Properties, certainly is, here the Corpuſcles of *Salts* and *Minerals*, with which that Element is impregnated, are equally various. *Wine* is only Water impregnated with Particles of Grapes, and Beer with Particles of Barley. All *Spirits* ſeem to be nothing but *Water*, ſaturated with *ſaline* or ſulphureous Particles. And all Liquors are more or leſs fluid, according to the *greater* or *ſmaller* Coheſion of the Particles which ſwim in the aqueous Fluid; and there is hardly any Fluid without this Coheſion of Particles, not even *pure Water* itſelf; as is apparent from the Bubbles which ſometimes will ſtand on its Surface, as well as on that of Spirits, and other Liquors.

WATER-*Bayliff*, was an Officer in Port-Towns, appointed for the ſearching of Ships, as ſeems from 28 *H.* 6. *c.* 5. Now there is ſuch an Officer in the City of *London*, who ſuperviſes and ſearches all Fiſh brought thither; and he gathers the Toll ariſing from the River *Thames*. He alſo attends on the Lord-Mayor, and hath the principal Care of marſhalling the Gueſts at the Table. And he arreſts Men for Debt, or other perſonal or criminal Matters, on the River of *Thames*, by Warrant of his Superiors, *&c.*

WATER-*Meaſure*, is a Meaſure mention'd in the 22 *Stat.* of *Car.* 2. and exceeds the *Winchester* Meaſure by about 3 Gallons in a Buſhel. 'Tis now uſed for ſelling of Coals in the Pool, *&c.*

WATER-*Ordeal*, was one of the old *Saxon* Ways of *Purgation*, or Tryal of a Perſon's Innocence, when ſuſpected of a Crime; 'twas called *Judicium Dei*, as the *Fire-Ordeal* was. This by Water, was, for the Perſon accuſed either to put his Hands into ſcalding Water, or to be thrown into ſome River, Pond, *&c.* if he eſcaped being burnt or ſcalded, or of being drowned, he was concluded innocent. This Water-Ordeal was for Churls, Bondmen, and other Ruſticks: But the Fire-Ordeal was for Freemen, and Perſons of better Condition.

WATER-*Table*, in Architecture, is a ſort of Ledge left in Stone or Brick-Walls, about 18 or 20 Inches from the Ground, and there the Thickneſs of the Wall begins to abate.

WATLING-*Street*, is the Name of one of the four *Roman* Ways, by that Nation made here in *England*, and by them were called *Conſulares*, *Prætorias*, *Militares*, & *Publicas*. In the Laws of *Edw.* the Confeſſor, it appears that theſe Publick Ways, had the Privilege of the King's Peace. This of *Watling-ſtreet*, or otherwiſe *Werlam-ſtreet*, (ſee *Hoveden*, *Part. prior. Annal. Fol.* 248.) was made from *Dover* to *London*, thence to *St. Albans*, *Dunſtable*, *Towceſter*, *Atherſton*, and the *Severn*; near the *Wrekin* in *Shropſhire*, extending itſelf to *Angleſey* in *Wales*. *Anno* 39 *Eliz. c.* 2.

The

The second of these Ways is called *Ikemild-street*, (*ab Icenis*) and reached from *Southampton* over the River *Isis*, at *Newbridge*; thence by *Cambden* and *Litchfield*, and so over the *Derwent* by *Derby*, thence to *Bolseover-Castle*, and ends at *Tinmouth*.

The third was called the *Fosse*, because in some Places it was never finished, but lies as a large Ditch, leading from *Cornwall* thro' *Devonshire*, by *Tetbury*, near *Stow* in the *Wold*, and besides *Coventry* to *Leicester*, *Newark*, and so to *Lincoln*.

The fourth was called *Ermine*, or *Erminage-street*, beginning at *St. David's* in *Wales*, and going to *Southampton*. See *Hollingshed's Chron.* Vol. 1. *c.* 19. and *Henry of Huntington*, Book 1. at the beginning.

WAVESON, is the Term for such Goods as, after Shipwreck, do appear swimming on the Waves.

WEALD, or *Weld*, is a *Saxon* Word, signifying the woody part of a Country: As the *Weald* of *Sussex* and of *Kent*, in the Collect. of Statutes, 14 *Car.* 2. *c.* 6. 'Tis mis-printed, as 'tis vulgarly pronounced, *The Wild of* Suffex, *&c.*

WEAR, a Term used by the Seamen for bringing a Ship to, on a different Tack.

WEED, in the Miners Language, is the Degeneracy of a *Load* or Vein of fine Metal, into an useless Marchasite.

WEDGE. See *Cuneus* in this Vol.

WEIGH, a Term used by the Seamen, for taking up a Ship's Anchor, and getting ready to sail; which they call Weighing Anchor.

WEIGH of Cheese, Wool, *&c. Waga*, alias *Vaga*, is 256 Pound Weight Averdupois; for by 9 *H.* 6. *c.* 8. a Weigh of Cheese ought to contain 32 Cloves, and each Clove 8 Pound; tho' some say but 7.

WEDBEDRIP, was formerly a customary Service that inferior Tenants paid to their Lords, in cutting down their Corn, or doing other Harvest Duties, *&c.*

WEIGHTS, in use in *England*, are chiefly of two sorts: One called *Troy-Weight*, having 12 Ounces in the Pound; and by this, Jewels, Silver, Gold, Corn, Bread, and all Liquors are usually weighed; and the other is called *Averdupois*, containing 16 Ounces in the Pound; by this all coarse drossy wastable Wares, such as Grocery, Pitch, Tar, Rosin, Wax, Tallow, Copper, Tin, Lead, Iron, *&c.* are weighed.

*Georg. Agricola*, in his Book *de Ponderibus & Mensuris*, calls the Pound of twelve Ounces, or the Pound Troy, *Libram Medicam*, which we retain in our Apothecaries Weight, (see the Table of it under *Weights*, in Vol. I.) and the other Pound of 16 Ounces, he calls *Libram Civilem*: and he saith also, that *Medica & Civilis Libra Numero non Gravitate Unciarum differunt*.

The Original of all our *English* Weights was a Corn of Wheat, gathered out of the middle of the Ear; and being well dried, 32 of these made one Penny-Weight, or were the Weight of the *Penny-Sterling*; twenty of these Pence or Penny-Weights, were to make an Ounce, and twelve such Ounces made the Pound Troy. See 51 *H.* 3. 31 *Edw.* 1. and 12 *H.* 7.

But in latter Times, it was thought sufficient to divide the aforesaid Penny-Weight into 24 equal Parts, which came to be called *Grains*, being the smallest Weight now in common Use; tho' the Moneyers subdivide the Grain thus:

| | | |
|---|---|---|
| 24 Blanks<br>20 Periots<br>24 Droits<br>20 Mites | make | 1 Periot.<br>1 Droite.<br>1 Mite.<br>1 Grain. |

WELDING-HEAT, is a Degree of Heat which Smiths give their Iron in the Forge, when there is occasion to *double up* the Iron, and to *weld* or work in the Doublings, so that the Iron shall grow a Lump thick enough for your purpose: 'Tis used also when two Bars of Iron are to be joined together at the ends, to make a Length.

WEREGILD, *Wergeld*, *Wergildus*, also *Were* (*Werræ*) alone without *Gild*, was formerly the Price that was paid partly to the King, and partly to the Relations of the Deceased, for killing a Man; when such Crimes were not punished with Death, but with pecuniary Mulcts.

WHEEL, in the Art Military, is the Word of Command, when a Battalion is to alter its Front, either one way or other. If the Battalion is to *wheel to the Right*, the Man in the right Angle turns very slowly, and every one else moves and wheels from the Left to the Right, regarding him as the Centre; and *vice versa*, when they are to *wheel to the Left*. When a Division of Men are on a March, if the Word be, *Wheel to the Right*, or to the *Left*, then the *Right* or *Left-hand* Man keeps his ground, turning only on his Heel, and the rest of the Rank move about quick, till they make an even Line with the said *Right* or *Left-hand* Man. Squadrons of Horse wheel much after the same manner.

WHERLICOTS, were the open Chariots used here in *England* by Persons of Quality, before the Use of Coaches. See *Stow's* Survey of *London*, *p.* 70. Perhaps hence comes our Word *Whirligig*.

WHITE or *Flame* Heat, is a Degree of Heat given by Smiths to their Iron in the Forge, when it hath not yet its Form and Size, but must be forged into both; this is a less Heat than a *Welding Heat*: Iron in this Heat is batter'd or drawn out usually with the *Pen* or Edge of the Hammer; and afterwards hath the Dents of the Pen smoothed out with the *Face* of the *Hand-Hammer*.

WHITENESS. The excellent Sir *Is. Newton*, in his late Book of Opticks, demonstrates, that Whiteness is a dissimilar Mixture of all Colours, and that the common Light of the Sun is a Mixture of Rays, endued with all those Colours; for by the multitude of those Rings of Colours, which appear in the Compression of the two Prisms, or Object-Glasses of Telescopes together, (see *Observ.* 3, 12, 24. Book 2. Part 1.) it is manifest, that these do so interfere and mingle with one another at last, as after 8 or 9 Revolutions, to dilate one another wholly, and constitute an even and sensibly uniform Whiteness. Wherefore it appears from hence, as well as from other Experiments, mention'd elsewhere, that Whiteness is certainly a Mixture of all Colours, and that the Light which conveys it to the Eye, is a Mixture of Rays indued with all those Colours. And he shews that Whiteness, if it be most strong and luminous, is to be reckoned of the *first Order* of Colours, but if less, to be a Mixture of the Colours of several Orders: Of the former sort, he reckons

reckons White Metals; and of the latter, the Whiteneſs of Froth, Paper, Linen, and moſt other white Subſtances. And as the White of the firſt order is the ſtrongeſt that can be made by Plates of tranſparent Subſtances, ſo it ought to be ſtronger in the denſer Subſtances of Metals, than in the rarer ones of Air, Water, and Glaſs. Gold or Copper, mixed either by Fuſion or Amalgamation, with a very little *Mercury*, with Silver, Tin, or Regulus of Antimony, becomes *White*; which ſhews both that the Particles of *White Metals* have much more Surface, and therefore are ſmaller, than thoſe of Gold or Copper; and alſo that they are ſo Opake, as not to ſuffer the Particles of Gold or Copper to ſhine through them: And as he doubts not but that the Colours of Gold and Copper are of the ſecond or third Order, therefore the Particles of White Metals can't be much bigger than is requiſite to make them reflect the White of the firſt Order: And this he concludes alſo from other Obſervations and Experiments.

WHITE-*Hart Silver*, is a Mulct paid into the *Exchequer* out of certain Lands, in or near the Foreſt of *White-Hart*; and it hath continued ever ſince *Henry* the Third's time, who impoſed it upon *Thomas de Lynde*, for killing a moſt beautiful *White Hart*, which the King had before purpoſely ſpared in Hunting. *Camd. Brit.*

WHITSON *Farthings*. See *Pentecoſtals*.

WIDOW *of the King*, was ſhe who after her Husband's Death, being the King's Tenant *in Capite*, was forced to recover her Dower by the Writ *de Dote aſſignanda*, and could not marry again without the King's Conſent.

WILL. See *Teſtament*.

WINDAGE *of a Gun*, is the Difference between the Diameter of the Bore, and the Diameter of the Balls.

WIND. The Reverend Mr. *Derham*, of *Upminſter* in *Eſſex*, and F. R. S. in a curious and accurate Diſcourſe about the Motion of Sound, in *Phil. Tranſ.* N° 313. takes occaſion to ſay ſomething of the Velocity of the Motion of Wind: And by many Trials he found, that the Wind in the greateſt Storm doth not move above 50 or 60 *Engliſh* Miles in an hour: That a common briſk Wind moves about 15 Miles in an hour: But that the Courſe of many is ſo gentle, as not to exceed, if they come up to, one Mile in an hour.

WINDING-STAIRS, are ſuch as wind round a Newel, either Circular or Square, Cloſe, *i. e. Solid*, or Open.

WOLD, *Walda*, is a Down, or Champagne-Ground, Hilly, and void of Wood; as *Stow* in the *Wold*, and *Cotſwold* in *Glouceſterſhire*.

WORD, in an Army or a Gariſon, is ſome peculiar Word or Sentence, by which the Soldiers know and diſtinguiſh one another in the Night, *&c.* and by which Spies and treacherous Perſons are diſcovered: 'Tis uſed alſo to prevent Surprizes. It is given out in an Army every Night by the General to the Lieutenant or Major-General of the Day, who gives it to the Majors of the Brigades, and they to the Adjutants, who give it firſt to the Field-Officers, and afterwards to a Serjeant of each Company, who carry it to the *Subalterns*. In Gariſons 'tis given after the Gate is ſhut, to the Town-Major, who gives it to the Adjutants, and they to the Serjeants.

WRIT *Breve*, is the Queen's Precept, whereby any thing is commanded to be done touching a Suit or Action: As the Defendant or Tenant to be ſummoned, a Diſtreſs to be taken, a Diſſeiſin to be redreſſed, *&c.* And theſe *Writs* are diverſly divided in divers reſpects; ſome in reſpect of their Order or Manner of granting, are called

WRITS *Original*, which are ſent out for the ſummoning of the Defendant in a perſonal, or the Tenant in a real Action, before the Suit begins; or indeed rather to begin the Suit.

WRITS *Judicial*, are ſuch as are ſent out by Order of that Court where the Cauſe depends, on Occaſion after the Suit is begun. And theſe are diſtinguiſhed from the *Original Writs* thus: The *Teſte* of the *Judicial Writ* bears the Name of the Chief Juſtice of that Court whence it iſſues; whereas in the *Teſte* of the *Original Writ*, the Queen's Name is inſerted. Again alſo, there are

WRITS *Perſonal and Real*, *Writs of Entry*, *Writs of Right*, *Writs of Privilege*, &c. of which, ſee the *New Book of Entries*.

WRIT *of Rebellion*. See *Commiſſion of Rebellion*.

WRIT *of Aſſiſtance*, iſſues out of the *Exchequer* to authorize any Perſon, to take a Conſtable or other Publick Officer, to ſeize Goods or Merchandiſe uncuſtomed or prohibited. There is alſo a *Writ* of Aſſiſtance which iſſues out of the Chancery, to give a Poſſeſſion.

YARD-LAND, *Virgata Terræ*, is a Quantity of Land, various according to the Place: At *Wimbleton* in *Surrey* 'tis accounted fifteen Acres; in other Counties 'tis twenty; in ſome twenty-four, in ſome thirty, and in others even four Acres. In a MS. of the Abbacy of *Maimesbury*, a *Virgate of Land* is ſaid to contain twenty-four Acres. This uncertain Quantity in 28 *E.* 1. is called a *Verge of Land*.

YATCHES, are Veſſels with one Deck, carrying from 4 to 12 Guns, with from 20 to 40 Men; and are of Burden from 30 to 160 Tun. They draw little Water, and are uſed for running, and making ſhort Trips, *&c.* They are of ſeveral Makes and Forms.

YEARS-DAY, YEARS-MIND, } See *Annualia*, this Vol.

YEOMAN, a Derivative from the *Saxon Geman*, i. e. *Communis*, a Commoner; is our *Engliſh* Word for a Rank next in order below a Gentleman. *Camden* calls them *Ingenuous*; and his Notion of them the Statute confirms 6 *Rich.* 2. *cap.* 4. and 20 *Rich.* 2. *cap.* 2. Sir *Tho. Smith*, (in his *Republ. Anglor. lib.* 1. *cap.* 23.) ſaith, that Yeoman is the ſame with what our Law calls *Legalis Homo*, an *Engliſh* Free-born Man; and who can diſpend of his own Free-Land, in yearly Revenue, the Sum of Forty Shillings *Sterling*.



ZACCO, is the Term ſometimes uſed for the lower part of the Pedeſtal of a Column; and is in the form of a ſquare Brick or Tile.

ZOPERUS, a Term in Architecture, ſignifying the ſame with *Frieze*.

*FINIS.*

A

# TABLE

OF

Natural and Artificial *Sines*, *Tangents*, and *Secants*, to every Degree and Minute of the

# QUADRANT,

The *Radius* of the Artificial being 10,0000000 and of the Natural 10,000,000:

0 DEGREES

| M | *N. Sine* | *N. Co-Sine* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant.* | *N. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 10000000 | 0 | Infinit. | 10000000 | Infinit. | 60 |
| 1 | 2909 | 9999999 | 2909 | 343774667 | 10000000 | 343774682 | 59 |
| 2 | 5818 | 9999998 | 5818 | 171887319 | 10000002 | 171887348 | 58 |
| 3 | 8727 | 9999996 | 8727 | 114591530 | 10000004 | 114591574 | 57 |
| 4 | 11636 | 9999993 | 11636 | 85943630 | 10000007 | 85943689 | 56 |
| 5 | 14544 | 9999989 | 14544 | 68754887 | 10000011 | 68754960 | 55 |
| 6 | 17453 | 9999989 | 17453 | 57295721 | 10000016 | 57295809 | 54 |
| 7 | 20362 | 9999979 | 20362 | 49110600 | 10000021 | 49110702 | 53 |
| 8 | 23271 | 9999973 | 23271 | 42971757 | 10000027 | 42971873 | 52 |
| 9 | 26180 | 9999966 | 26180 | 38197099 | 10000034 | 38197230 | 51 |
| 10 | 29089 | 9999958 | 29089 | 34377371 | 10000042 | 34377516 | 50 |
| 11 | 31998 | 9999949 | 31998 | 31252137 | 10000051 | 31252297 | 49 |
| 12 | 34906 | 9999939 | 34907 | 28647773 | 10000061 | 28647948 | 48 |
| 13 | 37815 | 9999928 | 37816 | 26444080 | 10000072 | 26444269 | 47 |
| 14 | 40724 | 9999917 | 40725 | 24555198 | 10000083 | 24555402 | 46 |
| 15 | 43633 | 9999905 | 43033 | 22918166 | 10000095 | 22918385 | 45 |
| 16 | 46542 | 9999892 | 46542 | 21485762 | 10000108 | 21485995 | 44 |
| 17 | 49451 | 9999878 | 49451 | 20221872 | 10000122 | 20222122 | 43 |
| 18 | 52360 | 9999863 | 52360 | 19098419 | 10000137 | 19098680 | 42 |
| 19 | 55268 | 9999847 | 55269 | 18093200 | 10000153 | 18093496 | 41 |
| 20 | 58177 | 9999831 | 58178 | 17188540 | 10000170 | 17188831 | 40 |
| 21 | 61086 | 9999813 | 61087 | 16370019 | 10000187 | 16370325 | 39 |
| 22 | 63995 | 9999795 | 63996 | 15625908 | 10000205 | 15626228 | 38 |
| 23 | 66904 | 9999776 | 66905 | 14946502 | 10000224 | 14946837 | 37 |
| 24 | 69813 | 9999756 | 69814 | 14323712 | 10000244 | 14324061 | 36 |
| 25 | 72721 | 9999736 | 72723 | 13750745 | 10000265 | 13751108 | 35 |
| 26 | 75630 | 9999714 | 75632 | 13221851 | 10000286 | 13222229 | 34 |
| 27 | 78539 | 9999692 | 78541 | 12732134 | 10000308 | 12732526 | 33 |
| 28 | 81448 | 9999668 | 81450 | 12277396 | 10000331 | 12277803 | 32 |
| 29 | 84357 | 9999644 | 84360 | 11854018 | 10000355 | 11854440 | 31 |
| 30 | 87265 | 9999619 | 87269 | 11458865 | 10000380 | 11459301 | 30 |
| 31 | 90174 | 9999593 | 90178 | 11089205 | 10000406 | 11089656 | 29 |
| 32 | 93083 | 9999566 | 93087 | 10742648 | 10000433 | 10743114 | 28 |
| 33 | 95992 | 9999539 | 95996 | 10417094 | 10000461 | 10417574 | 27 |
| 34 | 98900 | 9999511 | 98905 | 10110690 | 10000489 | 10111185 | 26 |
| 35 | 101809 | 9999482 | 101814 | 98217943 | 10000518 | 98223033 | 25 |
| 36 | 104718 | 9999452 | 104724 | 95489475 | 10000548 | 95494711 | 24 |
| 37 | 107627 | 9999421 | 107633 | 92908487 | 10000579 | 92913869 | 23 |
| 38 | 110532 | 9999389 | 110542 | 90463336 | 10000611 | 90468863 | 22 |
| 39 | 113444 | 9999356 | 113451 | 88143572 | 10000644 | 88149244 | 21 |
| 40 | 116353 | 9999323 | 116361 | 85939791 | 10000677 | 85945609 | 20 |
| 41 | 119261 | 9999289 | 119270 | 83843507 | 10000711 | 83849470 | 19 |
| 42 | 122170 | 9999254 | 122179 | 81847041 | 10000746 | 81853150 | 18 |
| 43 | 125079 | 9999218 | 125088 | 79943430 | 10000782 | 79949684 | 17 |
| 44 | 127987 | 9999181 | 127998 | 78126342 | 10000819 | 78132742 | 16 |
| 45 | 130896 | 9999143 | 130907 | 76390009 | 10000857 | 76396554 | 15 |
| 46 | 133805 | 9999104 | 133817 | 74729165 | 10000896 | 74735856 | 14 |
| 47 | 136713 | 9999065 | 136726 | 73138991 | 10000935 | 73145827 | 13 |
| 48 | 139622 | 9999025 | 139635 | 71615070 | 10000975 | 71622052 | 12 |
| 49 | 142530 | 9998984 | 142545 | 70153346 | 10001016 | 70160474 | 11 |
| 50 | 145439 | 9998942 | 145454 | 68750087 | 10001058 | 68757360 | 10 |
| 51 | 148348 | 9998899 | 148364 | 67401854 | 10001101 | 67409272 | 9 |
| 52 | 151256 | 9998855 | 151273 | 66105473 | 10001145 | 66113036 | 8 |
| 53 | 154165 | 9998811 | 154183 | 64858008 | 10001189 | 64865716 | 7 |
| 54 | 157073 | 9998766 | 157093 | 63656741 | 10001234 | 63664595 | 6 |
| 55 | 159982 | 9998720 | 160002 | 62499154 | 10001280 | 62507153 | 5 |
| 56 | 162890 | 9998673 | 162912 | 61382905 | 10001327 | 61391050 | 4 |
| 57 | 165799 | 9998625 | 165821 | 60305820 | 10001375 | 60314110 | 3 |
| 58 | 168707 | 9998576 | 168731 | 59265872 | 10001424 | 59274308 | 2 |
| 59 | 171616 | 9998527 | 171641 | 58261174 | 10001473 | 58269755 | 1 |
| 60 | 174524 | 9998477 | 174551 | 57289962 | 10001523 | 57298689 | 0 |
| | *N. Co-Sine.* | *N. Sine* | *N. Co Tang.* | *N. Tangent.* | *N.Co-Secant* | *N. Secant.* | M |

89 DEGREES.

0 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co-Tang.* | *L. Secant.* | *L. Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 10.0000000 | 0 | Infinit. | 10.0000000 | Infinit. | 60 |
| 1 | 6.4637261 | 9.9999999 | 6.4637261 | 13.5362739 | 10.0000000 | 13.5362739 | 59 |
| 2 | 6.7647561 | 9.9999999 | 6.7647562 | 13.2352438 | 10.0000001 | 13.2352439 | 58 |
| 3 | 6.9408473 | 9.9999998 | 6.9408475 | 13.0591525 | 10.0000002 | 13.0591527 | 57 |
| 4 | 7.0657360 | 9.9999997 | 7.0657863 | 12.9342137 | 10.0000003 | 12.9342140 | 56 |
| 5 | 7.1626960 | 9.9999995 | 7.1626964 | 12.8373036 | 10.0000005 | 12.8373040 | 55 |
| 6 | 7.2418771 | 9.9999993 | 7.2418778 | 12.7581222 | 10.0000007 | 12.7581229 | 54 |
| 7 | 7.3088239 | 9.9999991 | 7.3088248 | 12.6911752 | 10.0000009 | 12.6911761 | 53 |
| 8 | 7.3668157 | 9.9999988 | 7.3668169 | 12.6331831 | 10.0000012 | 12.6331843 | 52 |
| 9 | 7.4179681 | 9.9999985 | 7.4179696 | 12.5820304 | 10.0000015 | 12.5820319 | 51 |
| 10 | 7.4637255 | 9.9999982 | 7.4637273 | 12.5362727 | 10.0000018 | 12.5362745 | 50 |
| 11 | 7.5051181 | 9.9999978 | 7.5051203 | 12.4948797 | 10.0000022 | 12.4948819 | 49 |
| 12 | 7.5429065 | 9.9999974 | 7.5429091 | 12.4570909 | 10.0000026 | 12.4570935 | 48 |
| 13 | 7.5776684 | 9.9999969 | 7.5776715 | 12.4223285 | 10.0000031 | 12.4223316 | 47 |
| 14 | 7.6098530 | 9.9999964 | 7.6098566 | 12.3901434 | 10.0000036 | 12.3901470 | 46 |
| 15 | 7.6398160 | 9.9999959 | 7.6398201 | 12.3601799 | 10.0000041 | 12.3601840 | 45 |
| 16 | 7.6678445 | 9.9999953 | 7.6678492 | 12.3321508 | 10.0000047 | 12.3321555 | 44 |
| 17 | 7.6941733 | 9.9999947 | 7.6941786 | 12.3058214 | 10.0000053 | 12.3058267 | 43 |
| 18 | 7.7189966 | 9.9999940 | 7.7190026 | 12.2809974 | 10.0000060 | 12.2810034 | 42 |
| 19 | 7.7424775 | 9.9999934 | 7.7424841 | 12.2575159 | 10.0000066 | 12.2575225 | 41 |
| 20 | 7.7647537 | 9.9999927 | 7.7647610 | 12.2352390 | 10.0000073 | 12.2352463 | 40 |
| 21 | 7.7859427 | 9.9999919 | 7.7850508 | 12.2140492 | 10.0000081 | 12.2140173 | 39 |
| 22 | 7.8061458 | 9.9999911 | 7.8061547 | 12.1938453 | 10.0000089 | 12.1938542 | 38 |
| 23 | 7.8254507 | 9.9999903 | 7.8254604 | 12.1745396 | 10.0000097 | 12.1745493 | 37 |
| 24 | 7.8439338 | 9.9999894 | 7.8439444 | 12.1560556 | 10.0000106 | 12.1560662 | 36 |
| 25 | 7.8616623 | 9.9999885 | 7.8616738 | 12.1383262 | 10.0000115 | 12.1383377 | 35 |
| 26 | 7.8786953 | 9.9999876 | 7.8787077 | 12.1212923 | 10.0000124 | 12.1213047 | 34 |
| 27 | 7.8950854 | 9.9999866 | 7.8950988 | 12.1049012 | 10.0000134 | 12.1049146 | 33 |
| 28 | 7.9108793 | 9.9999856 | 7.9108938 | 12.0891062 | 10.0000144 | 12.0891207 | 32 |
| 29 | 7.9261190 | 9.9999845 | 7.9261344 | 12.0738656 | 10.0000155 | 12.0738810 | 31 |
| 30 | 7.9408419 | 9.9999835 | 7.9408584 | 12.0591416 | 10.0000165 | 12.0591581 | 30 |
| 31 | 7.9550819 | 9.9999823 | 7.9550996 | 12.0449004 | 10.0000177 | 12.0449181 | 29 |
| 32 | 7.9688698 | 9.9999812 | 7.9688886 | 12.0311114 | 10.0000188 | 12.0311302 | 28 |
| 33 | 7.9822334 | 9.9999800 | 7.9822534 | 12.0177466 | 10.0000200 | 12.0177066 | 27 |
| 34 | 7.9951980 | 9.9999788 | 7.9952192 | 12.0047808 | 10.0000212 | 12.0048020 | 26 |
| 35 | 8.0077867 | 9.9999775 | 8.0078092 | 11.9921908 | 10.0000225 | 11.9922133 | 25 |
| 36 | 8.0200207 | 9.9999762 | 8.0200445 | 11.9799555 | 10.0000238 | 11.9799793 | 24 |
| 37 | 8.0319195 | 9.9999748 | 8.0319446 | 11.9680554 | 10.0000252 | 11.9680805 | 23 |
| 38 | 8.0435009 | 9.9999735 | 8.0435274 | 11.9564726 | 10.0000265 | 11.9564991 | 22 |
| 39 | 8.0547814 | 9.9999721 | 8.0548094 | 11.9451906 | 10.0000279 | 11.9452186 | 21 |
| 40 | 8.0657763 | 9.9999706 | 8.0658057 | 11.9341943 | 10.0000294 | 11.9342237 | 20 |
| 41 | 8.0764997 | 9.9999691 | 8.0765306 | 11.9234694 | 10.0000309 | 11.9235003 | 19 |
| 42 | 8.0869646 | 9.9999676 | 8.0869970 | 11.9130030 | 10.0000324 | 11.9130354 | 18 |
| 43 | 8.0971832 | 9.9999660 | 8.0972172 | 11.9027828 | 10.0000340 | 11.9028168 | 17 |
| 44 | 8.1071669 | 9.9999644 | 8.1072025 | 11.8927975 | 10.0000356 | 11.8928331 | 16 |
| 45 | 8.1169262 | 9.9999628 | 8.1169634 | 11.8830366 | 10.0000372 | 11.8830738 | 15 |
| 46 | 8.1264710 | 9.9999611 | 8.1265099 | 11.8734901 | 10.0000389 | 11.8735290 | 14 |
| 47 | 8.1358104 | 9.9999594 | 8.1358510 | 11.8641490 | 10.0000406 | 11.8641896 | 13 |
| 48 | 8.1449532 | 9.9999577 | 8.1449956 | 11.8550044 | 10.0000423 | 11.8550468 | 12 |
| 49 | 8.1539075 | 9.9999559 | 8.1539516 | 11.8460484 | 10.0000441 | 11.8460925 | 11 |
| 50 | 8.1626808 | 9.9999541 | 8.1627267 | 11.8372733 | 10.0000459 | 11.8373192 | 10 |
| 51 | 8.1712804 | 9.9999522 | 8.1713282 | 11.8286718 | 10.0000478 | 11.8287196 | 9 |
| 52 | 8.1797129 | 9.9999503 | 8.1797626 | 11.8202374 | 10.0000497 | 11.8202871 | 8 |
| 53 | 8.1879848 | 9.9999484 | 8.1880364 | 11.8119636 | 10.0000516 | 11.8120152 | 7 |
| 54 | 8.1961020 | 9.9999464 | 8.1961556 | 11.8038444 | 10.0000536 | 11.8038980 | 6 |
| 55 | 8.2040703 | 9.9999444 | 8.2041259 | 11.7958741 | 10.0000556 | 11.7959297 | 5 |
| 56 | 8.2118949 | 9.9999424 | 8.2119526 | 11.7880474 | 10.0000576 | 11.7881051 | 4 |
| 57 | 8.2195811 | 9.9999403 | 8.2196408 | 11.7803592 | 10.0000597 | 11.7804189 | 3 |
| 58 | 8.2271335 | 9.9999382 | 8.2271953 | 11.7728047 | 10.0000618 | 11.7728665 | 2 |
| 59 | 8.2345568 | 9.9999360 | 8.2346208 | 11.7653792 | 10.0000640 | 11.7654432 | 1 |
| 60 | 8.2418553 | 9.9999338 | 8.2419215 | 11.7580785 | 10.0000662 | 11.7581447 | 0 |
| | *L. Co Sine.* | *L. Sine.* | *L. Co-Tang* | *L. Tangent* | *L. Co-Secant* | *L. Secant.* | M |

89 DEGREES.

1 DEGREE

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 174524 | 9998477 | 174551 | 57289962 | 10001523 | 57298688 | 60 |
| 1 | 177432 | 9998426 | 177460 | 56350590 | 10001574 | 56359462 | 59 |
| 2 | 180341 | 9998374 | 180370 | 55441517 | 10001626 | 55450534 | 58 |
| 3 | 183249 | 9998321 | 183280 | 54561300 | 10001679 | 54570463 | 57 |
| 4 | 186158 | 9998267 | 186190 | 53708587 | 10001733 | 53717896 | 56 |
| 5 | 189066 | 9998212 | 189100 | 52882109 | 10001788 | 52891564 | 55 |
| 6 | 191974 | 9998157 | 192010 | 52080673 | 10001843 | 52090272 | 54 |
| 7 | 194883 | 9998101 | 194920 | 51303157 | 10001899 | 51312902 | 53 |
| 8 | 197791 | 9998044 | 197830 | 50548506 | 10001956 | 50558396 | 52 |
| 9 | 200699 | 9997986 | 200740 | 49815726 | 10002014 | 49825762 | 51 |
| 10 | 203608 | 9997927 | 203650 | 49103881 | 10002073 | 49114062 | 50 |
| 11 | 206516 | 9997867 | 206560 | 48412084 | 10002133 | 48422411 | 49 |
| 12 | 209424 | 9997806 | 209470 | 47739501 | 10002194 | 47749974 | 48 |
| 13 | 212332 | 9997745 | 212380 | 47085343 | 10002255 | 47095961 | 47 |
| 14 | 215241 | 9997682 | 215291 | 46448862 | 10002317 | 46459625 | 46 |
| 15 | 218149 | 9997620 | 218201 | 45829351 | 10002380 | 45840260 | 45 |
| 16 | 221057 | 9997556 | 221111 | 45226141 | 10002444 | 45237195 | 44 |
| 17 | 223965 | 9997491 | 224021 | 44638596 | 10002509 | 44649795 | 43 |
| 18 | 226873 | 9997425 | 226932 | 44066113 | 10002575 | 44077458 | 42 |
| 19 | 229781 | 9997359 | 229842 | 43508122 | 10002641 | 43519612 | 41 |
| 20 | 232690 | 9997292 | 232752 | 42964077 | 10002708 | 42975713 | 40 |
| 21 | 235598 | 9997224 | 235663 | 42433464 | 10002776 | 42445245 | 39 |
| 22 | 238506 | 9997155 | 238574 | 41915790 | 10002845 | 41927717 | 38 |
| 23 | 241414 | 9997085 | 241484 | 41410588 | 10002915 | 41422660 | 37 |
| 24 | 244322 | 9997014 | 244395 | 40917412 | 10002986 | 40929629 | 36 |
| 25 | 247230 | 9996943 | 247305 | 40435837 | 10003058 | 40448201 | 35 |
| 26 | 250138 | 9996871 | 250216 | 39965460 | 10003130 | 39977969 | 34 |
| 27 | 253046 | 9996798 | 253127 | 39505895 | 10003203 | 39518549 | 33 |
| 28 | 255954 | 9996724 | 256038 | 39056771 | 10003277 | 39069571 | 32 |
| 29 | 258862 | 9996649 | 258948 | 38617738 | 10003352 | 38630683 | 31 |
| 30 | 261769 | 9996573 | 261859 | 38188459 | 10003428 | 38201550 | 30 |
| 31 | 264677 | 9996496 | 264770 | 37768613 | 10003505 | 37781849 | 29 |
| 32 | 267585 | 9996419 | 267681 | 37357892 | 10003582 | 37371273 | 28 |
| 33 | 270493 | 9996341 | 270592 | 36956001 | 10003660 | 36969528 | 27 |
| 34 | 273401 | 9996262 | 273503 | 36562659 | 10003739 | 36576332 | 26 |
| 35 | 276309 | 9996182 | 276414 | 36177596 | 10003819 | 36191414 | 25 |
| 36 | 279210 | 9996101 | 279325 | 35800553 | 10003900 | 35814517 | 24 |
| 37 | 282124 | 9996019 | 282236 | 35431282 | 10003982 | 35445391 | 23 |
| 38 | 285032 | 9995936 | 285148 | 35069546 | 10004065 | 35083800 | 22 |
| 39 | 287940 | 9995853 | 288059 | 34715115 | 10004148 | 34729515 | 21 |
| 40 | 290847 | 9995769 | 290970 | 34367771 | 10004232 | 34382316 | 20 |
| 41 | 293755 | 9995684 | 293882 | 34027303 | 10004317 | 34041994 | 19 |
| 42 | 296662 | 9995598 | 296793 | 33693509 | 10004403 | 33708345 | 18 |
| 43 | 299570 | 9995511 | 299705 | 33366194 | 10004490 | 33381167 | 17 |
| 44 | 302478 | 9995424 | 302616 | 33045173 | 10004578 | 33060300 | 16 |
| 45 | 305385 | 9995336 | 305528 | 32730264 | 10004667 | 32745536 | 15 |
| 46 | 308293 | 9995247 | 308439 | 32421295 | 10004756 | 32436713 | 14 |
| 47 | 311200 | 9995157 | 311351 | 32118099 | 10004846 | 32133663 | 13 |
| 48 | 314108 | 9995066 | 314263 | 31820516 | 10004937 | 31836125 | 12 |
| 49 | 317015 | 9994974 | 317174 | 31528392 | 10005029 | 31544246 | 11 |
| 50 | 319922 | 9994881 | 320086 | 31241577 | 10005122 | 31257577 | 10 |
| 51 | 322830 | 9994788 | 322998 | 30959928 | 10005215 | 30976074 | 9 |
| 52 | 325737 | 9994694 | 325910 | 30683307 | 10005309 | 30699598 | 8 |
| 53 | 328644 | 9994599 | 328822 | 30411580 | 10005405 | 30428017 | 7 |
| 54 | 331552 | 9994503 | 331734 | 30144619 | 10005501 | 30161201 | 6 |
| 55 | 334459 | 9994406 | 334646 | 29882299 | 10005598 | 29899026 | 5 |
| 56 | 337366 | 9994308 | 337558 | 29624499 | 10005696 | 29641373 | 4 |
| 57 | 340273 | 9994209 | 340471 | 29371106 | 10005795 | 29388124 | 3 |
| 58 | 343181 | 9994109 | 343383 | 29122005 | 10005894 | 29139169 | 2 |
| 59 | 346088 | 9994009 | 346295 | 28877089 | 10005995 | 28894398 | 1 |
| 60 | 348995 | 9993908 | 349208 | 28636253 | 10006095 | 28653708 | 0 |
| | N. Co-Sine. | N. Sine | N. Co Tang. | N. Tangent. | N.Co-Secant | N. Secant. | M |

88 DEGREES.

1 DEGREE.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Targ. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 8.2418553 | 9.9999338 | 8.2419215 | 11.7580785 | 10.0000661 | 11.7581447 | 60 |
| 1 | 8.2490332 | 9.9999316 | 8.2491015 | 11.7508985 | 10.0000684 | 11.7509668 | 59 |
| 2 | 8.2560943 | 9.9999294 | 8.2561649 | 11.7438351 | 10.0000706 | 11.7439057 | 58 |
| 3 | 8.2630424 | 9.9999271 | 8.2631153 | 11.7368847 | 10.0000729 | 11.7369576 | 57 |
| 4 | 8.2698810 | 9.9999247 | 8.2699563 | 11.7300437 | 10.0000753 | 11.7301890 | 56 |
| 5 | 8.2766136 | 9.9999224 | 8.2766912 | 11.7233088 | 10.0000776 | 11.7233864 | 55 |
| 6 | 8.2832434 | 9.9999200 | 8.2833234 | 11.7166766 | 10.0000800 | 11.7167566 | 54 |
| 7 | 8.2897734 | 9.9999175 | 8.2898559 | 11.7101441 | 10.0000825 | 11.7102260 | 53 |
| 8 | 8.2962067 | 9.9999150 | 8.2962917 | 11.7037083 | 10.0000850 | 11.7037933 | 52 |
| 9 | 8.3025460 | 9.9999125 | 8.3026335 | 11.6973665 | 10.0000875 | 11.6974540 | 51 |
| 10 | 8.3087941 | 9.9999100 | 8.3088842 | 11.6911158 | 10.0000900 | 11.6912059 | 50 |
| 11 | 8.3149536 | 9.9999074 | 8.3150462 | 11.6849538 | 10.0000926 | 11.6850464 | 49 |
| 12 | 8.3210269 | 9.9999047 | 8.3211221 | 11.6788779 | 10.0000953 | 11.6789731 | 48 |
| 13 | 8.3270163 | 9.9999021 | 8.3271143 | 11.6728857 | 10.0000979 | 11.6729837 | 47 |
| 14 | 8.3329243 | 9.9998994 | 8.3330249 | 11.6669751 | 10.0001006 | 11.6670757 | 46 |
| 15 | 8.3387529 | 9.9998966 | 8.3388563 | 11.6611437 | 10.0001034 | 11.6612471 | 45 |
| 16 | 8.3445043 | 9.9998939 | 8.3446105 | 11.6553895 | 10.0001061 | 11.6554957 | 44 |
| 17 | 8.3501805 | 9.9998911 | 8.3502895 | 11.6497105 | 10.0001089 | 11.6498195 | 43 |
| 18 | 8.3557835 | 9.9998882 | 8.3558953 | 11.6441047 | 10.0001118 | 11.6442165 | 42 |
| 19 | 8.3613150 | 9.9998853 | 8.3614297 | 11.6385703 | 10.0001147 | 11.6386850 | 41 |
| 20 | 8.3667769 | 9.9998824 | 8.3668945 | 11.6331055 | 10.0001176 | 11.6332231 | 40 |
| 21 | 8.3721710 | 9.9998794 | 8.3722915 | 11.6277085 | 10.0001206 | 11.6278290 | 39 |
| 22 | 8.3774988 | 9.9998764 | 8.3776223 | 11.6223777 | 10.0001236 | 11.6225012 | 38 |
| 23 | 8.3827620 | 9.9998734 | 8.3828886 | 11.6171114 | 10.0001266 | 11.6172380 | 37 |
| 24 | 8.3879622 | 9.9998703 | 8.3880918 | 11.6119082 | 10.0001297 | 11.6120378 | 36 |
| 25 | 8.3931008 | 9.9998672 | 8.3932336 | 11.6067664 | 10.0001328 | 11.6068992 | 35 |
| 26 | 8.3981793 | 9.9998641 | 8.3983152 | 11.6016848 | 10.0001359 | 11.6018207 | 34 |
| 27 | 8.4031990 | 9.9998609 | 8.4033381 | 11.5966619 | 10.0001391 | 11.5968010 | 33 |
| 28 | 8.4081614 | 9.9998577 | 8.4083037 | 11.5916963 | 10.0001423 | 11.5918386 | 32 |
| 29 | 8.4130676 | 9.9998544 | 8.4132132 | 11.5867868 | 10.0001456 | 11.5869324 | 31 |
| 30 | 8.4179190 | 9.9998512 | 8.4180679 | 11.5819321 | 10.0001488 | 11.5820810 | 30 |
| 31 | 8.4227168 | 9.9998478 | 8.4228690 | 11.5771310 | 10.0001522 | 11.5772832 | 29 |
| 32 | 8.4274621 | 9.9998445 | 8.4276176 | 11.5723824 | 10.0001555 | 11.5725379 | 28 |
| 33 | 8.4321561 | 9.9998411 | 8.4323150 | 11.5676850 | 10.0001589 | 11.5678439 | 27 |
| 34 | 8.4367999 | 9.9998376 | 8.4369622 | 11.5630378 | 10.0001624 | 11.5632001 | 26 |
| 35 | 8.4413949 | 9.9998342 | 8.4415603 | 11.5584397 | 10.0001658 | 11.5586056 | 25 |
| 36 | 8.4459409 | 9.9998306 | 8.4461103 | 11.5538897 | 10.0001694 | 11.5540591 | 24 |
| 37 | 8.4504402 | 9.9998271 | 8.4506131 | 11.5493869 | 10.0001729 | 11.5495598 | 23 |
| 38 | 8.4548934 | 9.9998235 | 8.4550699 | 11.5449301 | 10.0001765 | 11.5451066 | 22 |
| 39 | 8.4593013 | 9.9998199 | 8.4594814 | 11.5405186 | 10.0001801 | 11.5406987 | 21 |
| 40 | 8.4636649 | 9.9998162 | 8.4638486 | 11.5361514 | 10.0001838 | 11.5363351 | 20 |
| 41 | 8.4679850 | 9.9998125 | 8.4681725 | 11.5318275 | 10.0001875 | 11.5320150 | 19 |
| 42 | 8.4722626 | 9.9998088 | 8.4724538 | 11.5275462 | 10.0001912 | 11.5277374 | 18 |
| 43 | 8.4764984 | 9.9998050 | 8.4766933 | 11.5233067 | 10.0001950 | 11.5235016 | 17 |
| 44 | 8.4806932 | 9.9998012 | 8.4808920 | 11.5191080 | 10.0001980 | 11.5193068 | 16 |
| 45 | 8.4848479 | 9.9997974 | 8.4850505 | 11.5149495 | 10.0002026 | 11.5151521 | 15 |
| 46 | 8.4889632 | 9.9997935 | 8.4891696 | 11.5108304 | 10.0002065 | 11.5110368 | 14 |
| 47 | 8.4930398 | 9.9997896 | 8.4932502 | 11.5067498 | 10.0002104 | 11.5069602 | 13 |
| 48 | 8.4970784 | 9.9997856 | 8.4972928 | 11.5027072 | 10.0002144 | 11.5029216 | 12 |
| 49 | 8.5010798 | 9.9997817 | 8.5012982 | 11.4987018 | 10.0002183 | 11.4989202 | 11 |
| 50 | 8.5050447 | 9.9997776 | 8.5052672 | 11.4947329 | 10.0002224 | 11.4949553 | 10 |
| 51 | 8.5089736 | 9.9997736 | 8.5092001 | 11.4907999 | 10.0002264 | 11.4910264 | 9 |
| 52 | 8.5128673 | 9.9997695 | 8.5130978 | 11.4869022 | 10.0002305 | 11.4871327 | 8 |
| 53 | 8.5167264 | 9.9997653 | 8.5169610 | 11.4830387 | 10.0002347 | 11.4832736 | 7 |
| 54 | 8.5205514 | 9.9997612 | 8.5207902 | 11.4792098 | 10.0002388 | 11.4794486 | 6 |
| 55 | 8.5243430 | 9.9997570 | 8.5245860 | 11.4754140 | 10.0002430 | 11.4756570 | 5 |
| 56 | 8.5281017 | 9.9997527 | 8.5283490 | 11.4716510 | 10.0002473 | 11.4718983 | 4 |
| 57 | 8.5318281 | 9.9997484 | 8.5320797 | 11.4679203 | 10.0002516 | 11.4681719 | 3 |
| 58 | 8.5355228 | 9.9997441 | 8.5357787 | 11.4642213 | 10.0002559 | 11.4644772 | 2 |
| 59 | 8.5391863 | 9.9997398 | 8.5394466 | 11.4605534 | 10.0002602 | 11.4608137 | 1 |
| 60 | 8.5428192 | 9.9997354 | 8.5430838 | 11.4569162 | 10.0002646 | 11.4571808 | 0 |
| | L. Co-Sine. | L. Sine | L. Co. Tang. | L. Tangent. | L Co-Secant. | L. Secant. | M |

88 DEGREES.

2 DEGREES.

| M | N Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 348995 | 9993908 | 349208 | 28636253 | 10006095 | 28653708 | 60 |
| 1 | 351902 | 9993805 | 352120 | 28399397 | 10009197 | 28416997 | 59 |
| 2 | 354809 | 9993703 | 355033 | 28166422 | 10006300 | 28184168 | 58 |
| 3 | 357716 | 9993599 | 357945 | 27937233 | 10006404 | 27955125 | 57 |
| 4 | 360623 | 9993495 | 360858 | 27711740 | 10006509 | 27729777 | 56 |
| 5 | 363530 | 9993390 | 363771 | 27489853 | 10006615 | 27508035 | 55 |
| 6 | 366437 | 9993284 | 366683 | 27271486 | 10006721 | 27289814 | 54 |
| 7 | 369344 | 9993177 | 369596 | 27056557 | 10006828 | 27075030 | 53 |
| 8 | 372251 | 9993069 | 372509 | 26844984 | 10006936 | 26863603 | 52 |
| 9 | 375158 | 9992960 | 375422 | 26636690 | 10007045 | 26655455 | 51 |
| 10 | 378065 | 9992851 | 378335 | 26431600 | 10007155 | 26450510 | 50 |
| 11 | 380071 | 9992740 | 381248 | 26229638 | 10007266 | 26248694 | 49 |
| 12 | 388878 | 9992629 | 384161 | 26030736 | 10007377 | 26049937 | 48 |
| 13 | 386785 | 9992517 | 387074 | 25834823 | 10007489 | 25854169 | 47 |
| 14 | 389691 | 9992404 | 389988 | 25641832 | 10007602 | 25661324 | 46 |
| 15 | 392598 | 9992290 | 392901 | 25451700 | 10007716 | 25471337 | 45 |
| 16 | 395505 | 9992175 | 395814 | 25264361 | 10007831 | 25284144 | 44 |
| 17 | 398411 | 9992060 | 398728 | 25079757 | 10007947 | 25099685 | 43 |
| 18 | 401318 | 9991944 | 401641 | 24897826 | 10008063 | 24917900 | 42 |
| 19 | 404224 | 9991827 | 404555 | 24718512 | 10008180 | 24738731 | 41 |
| 20 | 407131 | 9991709 | 407469 | 24541758 | 10008298 | 24562123 | 40 |
| 21 | 410037 | 9991590 | 410383 | 24367509 | 10008417 | 24388020 | 39 |
| 22 | 412944 | 9991440 | 413296 | 24195714 | 10008537 | 24216370 | 38 |
| 23 | 415850 | 9991349 | 416210 | 24026320 | 10008658 | 24047121 | 37 |
| 24 | 418757 | 9991228 | 419124 | 23859277 | 10008780 | 23880224 | 36 |
| 25 | 421663 | 9991106 | 422038 | 23694537 | 10008902 | 23715630 | 35 |
| 26 | 424569 | 9990983 | 424952 | 23532052 | 10009025 | 23553290 | 34 |
| 27 | 427475 | 9990859 | 427866 | 23371777 | 10009149 | 23393161 | 33 |
| 28 | 430382 | 9990734 | 430781 | 23213666 | 10009274 | 23235196 | 32 |
| 29 | 433288 | 9990608 | 433695 | 23057677 | 10009400 | 23079351 | 31 |
| 30 | 436194 | 9990482 | 436609 | 22903765 | 10009527 | 22925586 | 30 |
| 31 | 439100 | 9990355 | 439524 | 22751892 | 10009655 | 22773857 | 29 |
| 32 | 442006 | 9990227 | 442438 | 22602015 | 10009783 | 22624126 | 28 |
| 33 | 444912 | 9990098 | 445353 | 22454096 | 10009912 | 22476352 | 27 |
| 34 | 447818 | 9989968 | 448268 | 22308097 | 10010042 | 22330499 | 26 |
| 35 | 450724 | 9989837 | 451182 | 22163980 | 10010173 | 22186528 | 25 |
| 36 | 453630 | 9989705 | 454097 | 22021710 | 10010305 | 22044402 | 24 |
| 37 | 456536 | 9989573 | 457012 | 21881251 | 10010438 | 21904090 | 23 |
| 38 | 459442 | 9989440 | 459927 | 21742569 | 10010571 | 21765553 | 22 |
| 39 | 462347 | 9989306 | 462842 | 21605630 | 10010705 | 21628759 | 21 |
| 40 | 465253 | 9989171 | 465757 | 21470401 | 10010840 | 21493676 | 20 |
| 41 | 468159 | 9989035 | 468673 | 21336851 | 10010976 | 21360272 | 19 |
| 42 | 471064 | 9988898 | 471588 | 21204949 | 10011113 | 21228515 | 18 |
| 43 | 473970 | 9988761 | 474503 | 21074664 | 10011251 | 21098375 | 17 |
| 44 | 476876 | 9988623 | 477419 | 20945966 | 10011390 | 20969824 | 16 |
| 45 | 479781 | 9988484 | 480334 | 20818828 | 10011530 | 20842830 | 15 |
| 46 | 482687 | 9988344 | 483250 | 20693220 | 10011670 | 20717368 | 14 |
| 47 | 485592 | 9988203 | 486166 | 20569115 | 10011811 | 20593409 | 13 |
| 48 | 488498 | 9988061 | 489082 | 20446486 | 10011953 | 20470925 | 12 |
| 49 | 491403 | 9987918 | 491997 | 20325307 | 10012096 | 20349892 | 11 |
| 50 | 494308 | 9987775 | 494913 | 20205553 | 10012240 | 20230284 | 10 |
| 51 | 497214 | 9987631 | 497829 | 20087199 | 10012385 | 20112075 | 9 |
| 52 | 500119 | 9987486 | 500746 | 19970219 | 10012530 | 19995241 | 8 |
| 53 | 503024 | 9987340 | 503662 | 19854591 | 10012676 | 19879758 | 7 |
| 54 | 505929 | 9987193 | 506578 | 19740291 | 10012823 | 19765604 | 6 |
| 55 | 508835 | 9987045 | 509495 | 19627296 | 10012971 | 19652754 | 5 |
| 56 | 511740 | 9986897 | 512411 | 19515584 | 10013120 | 19541187 | 4 |
| 57 | 514645 | 9986748 | 515328 | 19405133 | 10013270 | 19430882 | 3 |
| 58 | 517550 | 9986598 | 518244 | 19295922 | 10013420 | 19321816 | 2 |
| 59 | 520455 | 9986447 | 521161 | 19187930 | 10013571 | 19213970 | 1 |
| 60 | 523360 | 9986295 | 524078 | 19081137 | 10013723 | 19107323 | 0 |
| | N Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

87 DEGREES.

2 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 8.5428192 | 9.9997354 | 8.5430838 | 11.4569162 | 10.0002646 | 11.4[illegible] | 60 |
| 1 | 8.5464218 | 9.9997309 | 8.5466909 | 11.4533091 | 10.0002691 | 11.4535782 | 59 |
| 2 | 8.5499948 | 9.9997265 | 8.5502683 | 11.4497317 | 10.0002735 | 11.4500052 | 58 |
| 3 | 8.5535386 | 9.9997220 | 8.5538166 | 11.4461834 | 10.0002780 | 11.4464614 | 57 |
| 4 | 8.5570536 | 9.9997174 | 8.5573362 | 11.4426638 | 10.0002826 | 11.4429464 | 56 |
| 5 | 8.5605404 | 9.9997128 | 8.5608276 | 11.4391724 | 10.0002872 | 11.4394596 | 55 |
| 6 | 8.5639994 | 9.9997082 | 8.5642912 | 11.4357088 | 10.0002918 | 11.4360006 | 54 |
| 7 | 8.5674310 | 9.9997036 | 8.5677275 | 11.4322725 | 10.0002964 | 11.4325690 | 53 |
| 8 | 8.5708357 | 9.9996989 | 8.5711368 | 11.4288632 | 10.0003011 | 11.4291643 | 52 |
| 9 | 8.5742139 | 9.9996942 | 8.5745197 | 11.4254803 | 10.0003058 | 11.4257861 | 51 |
| 10 | 8.5775660 | 9.9996894 | 8.5778766 | 11.4221234 | 10.0003106 | 11.4224340 | 50 |
| 11 | 8.5808923 | 9.9996846 | 8.5812077 | 11.4187923 | 10.0003154 | 11.4191077 | 49 |
| 12 | 8.5841933 | 9.9996798 | 8.5845136 | 11.4154864 | 10.0003202 | 11.4158067 | 48 |
| 13 | 8.5874694 | 9.9996749 | 8.5877945 | 11.4122055 | 10.0003251 | 11.4125306 | 47 |
| 14 | 8.5907209 | 9.9996700 | 8.5910509 | 11.4089491 | 10.0003300 | 11.4092791 | 46 |
| 15 | 8.5939483 | 9.9996650 | 8.5942832 | 11.4057168 | 10.0003350 | 11.4060517 | 45 |
| 16 | 8.5971517 | 9.9996601 | 8.5974917 | 11.4025083 | 10.0003399 | 11.4028483 | 44 |
| 17 | 8.6003317 | 9.9996550 | 8.6006767 | 11.3993233 | 10.0003450 | 11.3996683 | 43 |
| 18 | 8.6034886 | 9.9996500 | 8.6038386 | 11.3961614 | 10.0003500 | 11.3965114 | 42 |
| 19 | 8.6066226 | 9.9996449 | 8.6069777 | 11.3930223 | 10.0003551 | 11.3933774 | 41 |
| 20 | 8.6097341 | 9.9996398 | 8.6100943 | 11.3899057 | 10.0003602 | 11.3902659 | 40 |
| 21 | 8.6128235 | 9.9996346 | 8.6131889 | 11.3868111 | 10.0003654 | 11.3871765 | 39 |
| 22 | 8.6158910 | 9.9996294 | 8.6162616 | 11.3837384 | 10.0003706 | 11.3841090 | 38 |
| 23 | 8.6189369 | 9.9996242 | 8.6193127 | 11.3806873 | 10.0003758 | 11.3810631 | 37 |
| 24 | 8.6219616 | 9.9996189 | 8.6223427 | 11.3776573 | 10.0003811 | 11.3780384 | 36 |
| 25 | 8.6249653 | 9.9996136 | 8.6253518 | 11.3746482 | 10.0003864 | 11.3750347 | 35 |
| 26 | 8.6279484 | 9.9996082 | 8.6283402 | 11.3716598 | 10.0003918 | 11.3720516 | 34 |
| 27 | 8.6309111 | 9.9996028 | 8.6313083 | 11.3686917 | 10.0003972 | 11.3690889 | 33 |
| 28 | 8.6338537 | 9.9995974 | 8.6342563 | 11.3657437 | 10.0004026 | 11.3661463 | 32 |
| 29 | 8.6367764 | 9.9995919 | 8.6371845 | 11.3628155 | 10.0004181 | 11.3632236 | 31 |
| 30 | 8.6396796 | 9.9995865 | 8.6400931 | 11.3599059 | 10.0004135 | 11.3603204 | 30 |
| 31 | 8.6425634 | 9.9995809 | 8.6429825 | 11.3570175 | 10.0004191 | 11.3574366 | 29 |
| 32 | 8.6454282 | 9.9995753 | 8.6458528 | 11.3541472 | 10.0004247 | 11.3545718 | 28 |
| 33 | 8.6482742 | 9.9995697 | 8.6487044 | 11.3512956 | 10.0004303 | 11.3517258 | 27 |
| 34 | 8.6511016 | 9.9995641 | 8.6515375 | 11.3484625 | 10.0004359 | 11.3488984 | 26 |
| 35 | 8.6539107 | 9.9995584 | 8.6543522 | 11.3456478 | 10.0004416 | 11.3460893 | 25 |
| 36 | 8.6567017 | 9.9995527 | 8.6571490 | 11.3428510 | 10.0004473 | 11.3432983 | 24 |
| 37 | 8.6594748 | 9.9995469 | 8.6599279 | 11.3400721 | 10.0004530 | 11.3405252 | 23 |
| 38 | 8.6622303 | 9.9995411 | 8.6626891 | 11.3373109 | 10.0004589 | 11.3377697 | 22 |
| 39 | 8.6649684 | 9.9995353 | 8.6654331 | 11.3345669 | 10.0004647 | 11.3350316 | 21 |
| 40 | 8.6676893 | 9.9995295 | 8.6681598 | 11.3318402 | 10.0004705 | 11.3323107 | 20 |
| 41 | 8.6703932 | 9.9995236 | 8.6708697 | 11.3291303 | 10.0004764 | 11.3296068 | 19 |
| 42 | 8.6730804 | 9.9995176 | 8.6735628 | 11.3264372 | 10.0004824 | 11.3269196 | 18 |
| 43 | 8.6757510 | 9.9995116 | 8.6762393 | 11.3237607 | 10.0004884 | 11.3242490 | 17 |
| 44 | 8.6784052 | 9.9995056 | 8.6788996 | 11.3211004 | 10.0004944 | 11.3215948 | 16 |
| 45 | 8.6810433 | 9.9994996 | 8.6815437 | 11.3184563 | 10.0005004 | 11.3189567 | 15 |
| 46 | 8.6836654 | 9.9994935 | 8.6841719 | 11.3158281 | 10.0005065 | 11.3163346 | 14 |
| 47 | 8.6862718 | 9.9994874 | 8.6867844 | 11.3132156 | 10.0005126 | 11.3137282 | 13 |
| 48 | 8.6888625 | 9.9994812 | 8.6893813 | 11.3106187 | 10.0005188 | 11.3111375 | 12 |
| 49 | 8.6914379 | 9.9994750 | 8.6919629 | 11.3080371 | 10.0005250 | 11.3085621 | 11 |
| 50 | 8.6939980 | 9.9994688 | 8.6945292 | 11.3054708 | 10.0005312 | 11.3060019 | 10 |
| 51 | 8.6965431 | 9.9994625 | 8.6970806 | 11.3029194 | 10.0005375 | 11.3034569 | 9 |
| 52 | 8.6990734 | 9.9994562 | 8.6996173 | 11.3003828 | 10.0005438 | 11.3009266 | 8 |
| 53 | 8.7015889 | 9.9994498 | 8.7021390 | 11.2978610 | 10.0005502 | 11.2984111 | 7 |
| 54 | 8.7040899 | 9.9994435 | 8.7046465 | 11.2953535 | 10.0005565 | 11.2959101 | 6 |
| 55 | 8.7065766 | 9.9994370 | 8.7071395 | 11.2928605 | 10.0005630 | 11.2934234 | 5 |
| 56 | 8.7090490 | 9.9994306 | 8.7096185 | 11.2903815 | 10.0005694 | 11.2909510 | 4 |
| 57 | 8.7115075 | 9.9994241 | 8.7120834 | 11.2879166 | 10.0005759 | 11.2884925 | 3 |
| 58 | 8.7139520 | 9.9994176 | 8.7145345 | 11.2854655 | 10.0005824 | 11.2860480 | 2 |
| 59 | 8.7163829 | 9.9994110 | 8.7169719 | 11.2830281 | 10.0005890 | 11.2836171 | 1 |
| 60 | 8.7188002 | 9.9994044 | 8.7193958 | 11.2806042 | 10.0005956 | 11.2811998 | 0 |
| | L. CoSine. | L. Sine | L. Co. Tang. | L. Tangent. | L Co-Secant. | L. Secant. | M |

87 DEGREES.

3 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 523360 | 9986295 | 524078 | 19081137 | 10013723 | 19107323 | 60 |
| 1 | 526264 | 9986142 | 526995 | 18975523 | 10013876 | 19004854 | 59 |
| 2 | 529169 | 9985989 | 529912 | 18871058 | 10014030 | 18897545 | 58 |
| 3 | 532074 | 9985835 | 532829 | 18767754 | 10014185 | 18794376 | 57 |
| 4 | 534979 | 9985680 | 535746 | 18665562 | 10014341 | 18692330 | 56 |
| 5 | 537883 | 9985524 | 538663 | 18564473 | 10014498 | 18591387 | 55 |
| 6 | 540788 | 9985367 | 541581 | 18464471 | 10014655 | 18491530 | 54 |
| 7 | 543693 | 9985209 | 544498 | 18365537 | 10014813 | 18392742 | 53 |
| 8 | 546597 | 9985050 | 547416 | 18267654 | 10014972 | 18295005 | 52 |
| 9 | 549502 | 9984891 | 550333 | 18170807 | 10015132 | 18198303 | 51 |
| 10 | 552406 | 9984731 | 553251 | 18074977 | 10015293 | 18102619 | 50 |
| 11 | 555311 | 9984570 | 556169 | 17980150 | 10015455 | 18007937 | 49 |
| 12 | 558215 | 9984408 | 559087 | 17886310 | 10015617 | 17914243 | 48 |
| 13 | 561119 | 9984245 | 562005 | 17793442 | 10015780 | 17821520 | 47 |
| 14 | 564024 | 9984081 | 564923 | 17701529 | 10015944 | 17729753 | 46 |
| 15 | 566928 | 9983916 | 567841 | 17610559 | 10016109 | 17638928 | 45 |
| 16 | 569832 | 9983751 | 570759 | 17520516 | 10016275 | 17549030 | 44 |
| 17 | 572736 | 9983585 | 573678 | 17431385 | 10016442 | 17460046 | 43 |
| 18 | 575640 | 9983418 | 576596 | 17343155 | 10016610 | 17371960 | 42 |
| 19 | 578544 | 9983250 | 579515 | 17255809 | 10016778 | 17284761 | 41 |
| 20 | 581448 | 9983081 | 582434 | 17169337 | 10016947 | 17198434 | 40 |
| 21 | 584352 | 9982911 | 585352 | 17083724 | 10017117 | 17112960 | 39 |
| 22 | 587256 | 9982741 | 588271 | 16998957 | 10017288 | 17028346 | 38 |
| 23 | 590160 | 9982570 | 591190 | 16915025 | 10017460 | 16944559 | 37 |
| 24 | 593064 | 9982398 | 594109 | 16831915 | 10017633 | 16861594 | 36 |
| 25 | 595967 | 9982225 | 597029 | 16749614 | 10017807 | 16779439 | 35 |
| 26 | 598871 | 9982051 | 599948 | 16668112 | 10017981 | 16698082 | 34 |
| 27 | 601775 | 9981876 | 602867 | 16587396 | 10018156 | 16617512 | 33 |
| 28 | 604678 | 9981701 | 605787 | 16507455 | 10018332 | 16537717 | 32 |
| 29 | 607582 | 9981525 | 608706 | 16428279 | 10018509 | 16458686 | 31 |
| 30 | 610485 | 9981348 | 611626 | 16349856 | 10018687 | 16380408 | 30 |
| 31 | 613389 | 9981170 | 614546 | 16272174 | 10018866 | 16302873 | 29 |
| 32 | 616292 | 9980991 | 617466 | 16195225 | 10019046 | 16226069 | 28 |
| 33 | 619196 | 9980811 | 620386 | 16118998 | 10019226 | 16149987 | 27 |
| 34 | 622099 | 9980630 | 623306 | 16043482 | 10019407 | 16074617 | 26 |
| 35 | 625002 | 9980449 | 626226 | 15968667 | 10019589 | 15999948 | 25 |
| 36 | 627905 | 9980267 | 629147 | 15894545 | 10019772 | 15925971 | 24 |
| 37 | 630808 | 9980084 | 632067 | 15821104 | 10019956 | 15852676 | 23 |
| 38 | 633711 | 9979900 | 634988 | 15748337 | 10920141 | 15780054 | 22 |
| 39 | 636614 | 9979715 | 637908 | 15676233 | 10020326 | 15708096 | 21 |
| 40 | 639517 | 9979529 | 640829 | 15604784 | 10020512 | 15636793 | 20 |
| 41 | 642420 | 9979343 | 643750 | 15533981 | 10020699 | 15566135 | 19 |
| 42 | 645323 | 9979156 | 646671 | 15463814 | 10020887 | 15496114 | 18 |
| 43 | 648226 | 9978968 | 649592 | 15394276 | 10021076 | 15426721 | 17 |
| 44 | 651129 | 9978779 | 652513 | 15325358 | 10021266 | 15357949 | 16 |
| 45 | 654031 | 9978589 | 655435 | 15257052 | 10021457 | 15289788 | 15 |
| 46 | 656934 | 9978398 | 658356 | 15189349 | 10021649 | 15222231 | 14 |
| 47 | 659836 | 9978206 | 661278 | 15122242 | 10021841 | 15155270 | 13 |
| 48 | 662739 | 9978014 | 664199 | 15055723 | 10022034 | 15088896 | 12 |
| 49 | 665641 | 9977821 | 667121 | 14989784 | 10022228 | 15023103 | 11 |
| 50 | 668544 | 9977627 | 670043 | 14924417 | 10022423 | 14957882 | 10 |
| 51 | 671446 | 9977432 | 672965 | 14859615 | 10022619 | 14893226 | 9 |
| 52 | 674348 | 9977236 | 675887 | 14795372 | 10022816 | 14829128 | 8 |
| 53 | 677251 | 9977039 | 678809 | 14731679 | 10023013 | 14765580 | 7 |
| 54 | 680153 | 9976842 | 681732 | 14668529 | 10023211 | 14702576 | 6 |
| 55 | 683055 | 9976644 | 684654 | 14605916 | 10023410 | 14640109 | 5 |
| 56 | 685957 | 9976445 | 687577 | 14543833 | 10023610 | 14578171 | 4 |
| 57 | 688859 | 9976245 | 690499 | 14482273 | 10023811 | 14516767 | 3 |
| 58 | 691761 | 9976044 | 693422 | 14421230 | 10024013 | 14455859 | 2 |
| 59 | 694663 | 9975842 | 696345 | 14360696 | 10024216 | 14395471 | 1 |
| 60 | 697565 | 9975640 | 699268 | 14300666 | 10024419 | 14335587 | 0 |
| | N. Co-Sine. | N Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

86 DEGREES.

3 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 8.7188002 | 9.9994044 | 8.7193958 | 11.2806042 | 10.0005956 | 11.2811998 | 60 |
| 1 | 8.7212040 | 9.9993978 | 8.7218063 | 11.2781937 | 10.0006022 | 11.2787960 | 59 |
| 2 | 8.7235946 | 9.9993911 | 8.7242035 | 11.2757965 | 10.0006089 | 11.2764054 | 58 |
| 3 | 8.7259721 | 9.9993844 | 8.7265877 | 11.2734123 | 10.0006156 | 11.2740279 | 57 |
| 4 | 8.7283366 | 9.9993776 | 8.7289589 | 11.2710411 | 10.0006224 | 11.2716634 | 56 |
| 5 | 8.7306882 | 9.9993708 | 8.7313174 | 11.2686826 | 10.0006292 | 11.2693118 | 55 |
| 6 | 8.7330272 | 9.9993640 | 8.7336631 | 11.2663369 | 10.0006360 | 11.2669728 | 54 |
| 7 | 8.7353535 | 9.9993572 | 8.7359964 | 11.2640036 | 10.0006428 | 11.2646465 | 53 |
| 8 | 8.7376675 | 9.9993503 | 8.7383172 | 11.2616828 | 10.0006497 | 11.2623325 | 52 |
| 9 | 8.7399691 | 9.9993433 | 8.7406258 | 11.2593742 | 10.0006567 | 11.2600309 | 51 |
| 10 | 8.7422586 | 9.9993364 | 8.7429222 | 11.2570778 | 10.0006636 | 11.2577414 | 50 |
| 11 | 8.7445360 | 9.9993293 | 8.7452067 | 11.2547933 | 10.0006707 | 11.2554640 | 49 |
| 12 | 8.7468015 | 9.9993223 | 8.7474792 | 11.2525208 | 10.0006777 | 11.2531985 | 48 |
| 13 | 8.7490553 | 9.9993152 | 8.7497400 | 11.2502600 | 10.0006848 | 11.2509447 | 47 |
| 14 | 8.7512973 | 9.9993081 | 8.7519892 | 11.2480108 | 10.0006919 | 11.2487027 | 46 |
| 15 | 8.7535278 | 9.9993009 | 8.7542269 | 11.2457731 | 10.0006991 | 11.2464723 | 45 |
| 16 | 8.7557469 | 9.9992938 | 8.7564531 | 11.2435469 | 10.0007060 | 11.2442531 | 44 |
| 17 | 8.7579546 | 9.9992865 | 8.7586681 | 11.2413319 | 10.0007135 | 11.2420454 | 43 |
| 18 | 8.7601512 | 9.9992793 | 8.7608719 | 11.2391282 | 10.0007207 | 11.2398488 | 42 |
| 19 | 8.7623366 | 9.9992720 | 8.7630647 | 11.2369353 | 10.0007280 | 11.2376634 | 41 |
| 20 | 8.7645111 | 9.9992646 | 8.7652465 | 11.2347535 | 10.0007354 | 11.2354889 | 40 |
| 21 | 8.7666747 | 9.9992572 | 8.7674175 | 11.2325825 | 10.0007428 | 11.2333253 | 39 |
| 22 | 8.7688275 | 9.9992498 | 8.7695777 | 11.2304222 | 10.0007502 | 11.2311723 | 38 |
| 23 | 8.7709697 | 9.9992424 | 8.7717274 | 11.2282726 | 10.0007576 | 11.2290303 | 37 |
| 24 | 8.7731014 | 9.9992349 | 8.7738665 | 11.2261335 | 10.0007651 | 11.2268986 | 36 |
| 25 | 8.7752226 | 9.9992274 | 8.7759952 | 11.2240048 | 10.0007726 | 11.2247774 | 35 |
| 26 | 8.7773334 | 9.9992198 | 8.7781136 | 11.2218864 | 10.0007802 | 11.2226666 | 34 |
| 27 | 8.7794340 | 9.9992122 | 8.7802218 | 11.2197782 | 10.0007878 | 11.2205660 | 33 |
| 28 | 8.7815244 | 9.9992046 | 8.7823199 | 11.2176801 | 10.0007954 | 11.2184756 | 32 |
| 29 | 8.7836048 | 9.9991969 | 8.7844079 | 11.2155921 | 10.0008031 | 11.2163952 | 31 |
| 30 | 8.7856753 | 9.9991892 | 8.7864861 | 11.2135139 | 10.0008108 | 11.2143247 | 30 |
| 31 | 8.7877359 | 9.9991815 | 8.7885544 | 11.2114456 | 10.0008185 | 11.2122641 | 29 |
| 32 | 8.7897867 | 9.9991737 | 8.7906130 | 11.2093870 | 10.0008263 | 11.2102133 | 28 |
| 33 | 8.7918278 | 9.9991659 | 8.7926620 | 11.2073380 | 10.0008341 | 11.2081722 | 27 |
| 34 | 8.7938594 | 9.9991580 | 8.7947014 | 11.2052986 | 10.0008420 | 11.2061406 | 26 |
| 35 | 8.7958814 | 9.9991501 | 8.7967313 | 11.2032687 | 10.0008499 | 11.2041186 | 25 |
| 36 | 8.7978941 | 9.9991422 | 8.7987519 | 11.2012481 | 10.0008578 | 11.2021059 | 24 |
| 37 | 8.7998974 | 9.9991342 | 8.8007632 | 11.1992368 | 10.0008658 | 11.2001026 | 23 |
| 38 | 8.8018915 | 9.9991262 | 8.8027653 | 11.1972347 | 10.0008738 | 11.1981085 | 22 |
| 39 | 8.8038764 | 9.9991182 | 8.8047583 | 11.1952417 | 10.0008818 | 11.1961236 | 21 |
| 40 | 8.8058523 | 9.9991101 | 8.8067422 | 11.1932578 | 10.0008899 | 11.1941477 | 20 |
| 41 | 8.8078192 | 9.9991020 | 8.8087172 | 11.1912828 | 10.0008980 | 11.1921808 | 19 |
| 42 | 8.8097772 | 9.9990938 | 8.8106834 | 11.1892166 | 10.0009062 | 11.1902228 | 18 |
| 43 | 8.8117264 | 9.9990856 | 8.8126407 | 11.1873593 | 10.0009144 | 11.1882736 | 17 |
| 44 | 8.8136668 | 9.9990774 | 8.8145894 | 11.1854106 | 10.0009226 | 11.1863332 | 16 |
| 45 | 8.8155985 | 9.9990691 | 8.8165294 | 11.1834706 | 10.0009309 | 11.1844015 | 15 |
| 46 | 8.8175217 | 9.9990608 | 8.8184608 | 11.1815392 | 10.0009392 | 11.1824783 | 14 |
| 47 | 8.8194363 | 9.9990525 | 8.8203838 | 11.1796162 | 10.0009475 | 11.1805637 | 13 |
| 48 | 8.8213425 | 9.9990441 | 8.8222984 | 11.1777016 | 10.0009559 | 11.1786575 | 12 |
| 49 | 8.8232404 | 9.9990357 | 8.8242046 | 11.1757954 | 10.0009643 | 11.1767596 | 11 |
| 50 | 8.8251299 | 9.9990273 | 8.8261026 | 11.1738974 | 10.0009727 | 11.1748701 | 10 |
| 51 | 8.8270112 | 9.9990188 | 8.8279924 | 11.1720076 | 10.0009812 | 11.1729888 | 9 |
| 52 | 8.8288844 | 9.9990103 | 8.8298741 | 11.1701259 | 10.0009897 | 11.1711156 | 8 |
| 53 | 8.8307495 | 9.9990017 | 8.8317478 | 11.1682522 | 10.0009983 | 11.1692505 | 7 |
| 54 | 8.8326066 | 9.9989931 | 8.8336134 | 11.1663866 | 10.0010069 | 11.1673934 | 6 |
| 55 | 8.8344557 | 9.9989845 | 8.8354712 | 11.1645288 | 10.0010155 | 11.1655443 | 5 |
| 56 | 8.8362969 | 9.9989758 | 8.8373211 | 11.1626789 | 10.0010242 | 11.1637031 | 4 |
| 57 | 8.8381304 | 9.9989671 | 8.8391633 | 11.1608367 | 10.0010329 | 11.1618696 | 3 |
| 58 | 8.8399561 | 9.9989584 | 8.8409977 | 11.1590023 | 10.0010416 | 11.1600439 | 2 |
| 59 | 8.8417741 | 9.9989496 | 8.8428245 | 11.1571755 | 10.0010504 | 11.1582259 | 1 |
| 60 | 8.8435845 | 9.9989408 | 8.8446437 | 11.1553563 | 10.0010592 | 11.1564155 | 0 |
| M | L. CoSine. | L. Sine | L. Co.Tang. | L. Tangent. | L Co-Secant. | L. Secant. | M |

86 DEGREES.

4 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 697565 | 9975640 | 699268 | 14300666 | 10024419 | 14335587 | 60 |
| 1 | 700466 | 9975437 | 702191 | 14241134 | 10024623 | 14276200 | 59 |
| 2 | 703368 | 9975233 | 705115 | 14182092 | 10024828 | 14217304 | 58 |
| 3 | 706270 | 9975028 | 708038 | 14123536 | 10025034 | 14158894 | 57 |
| 4 | 709171 | 9974822 | 710961 | 14065459 | 10025241 | 14100962 | 56 |
| 5 | 712073 | 9974615 | 713885 | 14007856 | 10025449 | 14043504 | 55 |
| 6 | 714974 | 9974407 | 716809 | 13950719 | 10025658 | 13986514 | 54 |
| 7 | 717876 | 9974199 | 719733 | 13894045 | 10025868 | 13929985 | 53 |
| 8 | 720777 | 9973990 | 722657 | 13837827 | 10026078 | 13873913 | 52 |
| 9 | 723678 | 9973780 | 725581 | 13782060 | 10026289 | 13818291 | 51 |
| 10 | 726580 | 9973569 | 728505 | 13726738 | 10026501 | 13763115 | 50 |
| 11 | 729481 | 9973357 | 731430 | 13671856 | 10026714 | 13708379 | 49 |
| 12 | 732382 | 9973144 | 734354 | 13617409 | 10026928 | 13654077 | 48 |
| 13 | 735283 | 9972931 | 737279 | 13563391 | 10027143 | 13600205 | 47 |
| 14 | 738184 | 9972717 | 740203 | 13509799 | 10027358 | 13546758 | 46 |
| 15 | 741085 | 9972502 | 743128 | 13456625 | 10027574 | 13493731 | 45 |
| 16 | 743986 | 9972286 | 746053 | 13403867 | 10027791 | 13441118 | 44 |
| 17 | 746887 | 9972069 | 748979 | 13351518 | 10028009 | 13388914 | 43 |
| 18 | 749787 | 9971851 | 751904 | 13299574 | 10028228 | 13337116 | 42 |
| 19 | 752688 | 9971632 | 754829 | 13248031 | 10028448 | 13285719 | 41 |
| 20 | 755589 | 9971413 | 757755 | 13196883 | 10028668 | 13234716 | 40 |
| 21 | 758489 | 9971193 | 760680 | 13146127 | 10028889 | 13184106 | 39 |
| 22 | 761390 | 9970972 | 763606 | 13095757 | 10029111 | 13133882 | 38 |
| 23 | 764290 | 9970750 | 766532 | 13045769 | 10029334 | 13084040 | 37 |
| 24 | 767190 | 9970527 | 769458 | 12996160 | 10029558 | 13034576 | 36 |
| 25 | 770091 | 9970303 | 772384 | 12946924 | 10029783 | 12985486 | 35 |
| 26 | 772991 | 9970079 | 775311 | 12898058 | 10030009 | 12936765 | 34 |
| 27 | 775891 | 9969854 | 778237 | 12849557 | 10030236 | 12888410 | 33 |
| 28 | 778791 | 9969628 | 781164 | 12801417 | 10030464 | 12840415 | 32 |
| 29 | 781691 | 9969401 | 784090 | 12753634 | 10030693 | 12792779 | 31 |
| 30 | 784591 | 9969173 | 787017 | 12706205 | 10030922 | 12745495 | 30 |
| 31 | 787491 | 9968944 | 789944 | 12659125 | 10031152 | 12698560 | 29 |
| 32 | 790391 | 9968715 | 792871 | 12612390 | 10031383 | 12651971 | 28 |
| 33 | 793290 | 9968485 | 795798 | 12565997 | 10031615 | 12605724 | 27 |
| 34 | 796190 | 9968254 | 798726 | 12519942 | 10031848 | 12559815 | 26 |
| 35 | 799090 | 9968022 | 801653 | 12474221 | 10032081 | 12514240 | 25 |
| 36 | 801989 | 9967789 | 804581 | 12428831 | 10032315 | 12468995 | 24 |
| 37 | 804889 | 9967555 | 807509 | 12383768 | 10032550 | 12424078 | 23 |
| 38 | 807788 | 9967320 | 810437 | 12339028 | 10032786 | 12379484 | 22 |
| 39 | 810687 | 9967085 | 813365 | 12294608 | 10033023 | 12335210 | 21 |
| 40 | 813587 | 9966849 | 816293 | 12250505 | 10033261 | 12291252 | 20 |
| 41 | 816486 | 9966612 | 819221 | 12206716 | 10033500 | 12247608 | 19 |
| 42 | 819385 | 9966374 | 822150 | 12163236 | 10033740 | 12204274 | 18 |
| 43 | 822284 | 9966135 | 825078 | 12120062 | 10033980 | 12161246 | 17 |
| 44 | 825183 | 9965895 | 828007 | 12077192 | 10034221 | 12118522 | 16 |
| 45 | 828082 | 9965655 | 830936 | 12034622 | 10034463 | 12076098 | 15 |
| 46 | 830981 | 9965414 | 833865 | 11992349 | 10034706 | 12033970 | 14 |
| 47 | 833880 | 9965172 | 836794 | 11950370 | 10034950 | 11992137 | 13 |
| 48 | 836778 | 9964929 | 839723 | 11908682 | 10035195 | 11950595 | 12 |
| 49 | 839677 | 9964685 | 842653 | 11867282 | 10035441 | 11909340 | 11 |
| 50 | 842576 | 9964440 | 845583 | 11826167 | 10035687 | 11868370 | 10 |
| 51 | 845474 | 9964194 | 848512 | 11785333 | 10035934 | 11827683 | 9 |
| 52 | 848373 | 9963948 | 851442 | 11744773 | 10036182 | 11787274 | 8 |
| 53 | 851271 | 9963701 | 854372 | 11704500 | 10036431 | 11747141 | 7 |
| 54 | 854169 | 9963453 | 857302 | 11664495 | 10036681 | 11707282 | 6 |
| 55 | 857067 | 9963204 | 860233 | 11624761 | 10036932 | 11667693 | 5 |
| 56 | 859966 | 9962954 | 863163 | 11585294 | 10037184 | 11628372 | 4 |
| 57 | 862864 | 9962703 | 866094 | 11546093 | 10037436 | 11589316 | 3 |
| 58 | 865762 | 9962452 | 869025 | 11507154 | 10037689 | 11550523 | 2 |
| 59 | 868660 | 9962200 | 871956 | 11468474 | 10037943 | 11511990 | 1 |
| 60 | 871557 | 9961947 | 874887 | 11430052 | 10038198 | 11473713 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

85 DEGREES.

4 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 8.8435845 | 9.9989408 | 8.8446437 | 11.1553563 | 10.0010592 | 11.1564155 | 60 |
| 1 | 8.8453874 | 9.9989319 | 8.8464554 | 11.1535446 | 10.0010681 | 11.1546126 | 59 |
| 2 | 8.8471827 | 9.9989230 | 8.8482597 | 11.1517403 | 10.0010770 | 11.1528173 | 58 |
| 3 | 8.8489707 | 9.9989141 | 8.8500566 | 11.1499434 | 10.0010859 | 11.1510293 | 57 |
| 4 | 8.8507512 | 9.9989052 | 8.8518461 | 11.1481539 | 10.0010948 | 11.1492488 | 56 |
| 5 | 8.8525245 | 9.9988962 | 8.8536283 | 11.1463717 | 10.0011038 | 11.1474755 | 55 |
| 6 | 8.8542905 | 9.9988871 | 8.8554034 | 11.1445966 | 10.0011129 | 11.1457095 | 54 |
| 7 | 8.8560493 | 9.9988780 | 8.8571713 | 11.1428287 | 10.0011220 | 11.1439507 | 53 |
| 8 | 8.8578010 | 9.9988689 | 8.8589321 | 11.1410679 | 10.0011311 | 11.1421990 | 52 |
| 9 | 8.8595457 | 9.9988598 | 8.8606859 | 11.1393141 | 10.0011402 | 11.1404543 | 51 |
| 10 | 8.8612833 | 9.9988506 | 8.8624327 | 11.1375673 | 10.0011494 | 11.1387167 | 50 |
| 11 | 8.8630139 | 9.9988414 | 8.8641725 | 11.1358275 | 10.0011586 | 11.1369861 | 49 |
| 12 | 8.8647376 | 9.9988321 | 8.8659055 | 11.1340945 | 10.0011679 | 11.1352624 | 48 |
| 13 | 8.8664545 | 9.9988228 | 8.8676317 | 11.1323683 | 10.0011772 | 11.1335455 | 47 |
| 14 | 8.8681646 | 9.9988135 | 8.8693511 | 11.1306489 | 10.0011865 | 11.1318354 | 46 |
| 15 | 8.8698680 | 9.9988041 | 8.8710638 | 11.1289362 | 10.0011959 | 11.1301320 | 45 |
| 16 | 8.8715646 | 9.9987947 | 8.8727699 | 11.1272301 | 10.0012053 | 11.1284354 | 44 |
| 17 | 8.8732546 | 9.9987853 | 8.8744694 | 11.1255306 | 10.0012147 | 11.1267454 | 43 |
| 18 | 8.8749381 | 9.9987758 | 8.8761623 | 11.1238377 | 10.0012242 | 11.1250619 | 42 |
| 19 | 8.8766150 | 9.9987663 | 8.8778487 | 11.1221513 | 10.0012337 | 11.1233850 | 41 |
| 20 | 8.8782854 | 9.9987567 | 8.8795286 | 11.1204714 | 10.0012433 | 11.1217146 | 40 |
| 21 | 8.8799493 | 9.9987471 | 8.8812022 | 11.1187978 | 10.0012529 | 11.1200507 | 39 |
| 22 | 8.8816069 | 9.9987375 | 8.8828694 | 11.1171306 | 10.0012625 | 11.1183931 | 38 |
| 23 | 8.8832581 | 9.9987278 | 8.8845303 | 11.1154697 | 10.0012722 | 11.1167419 | 37 |
| 24 | 8.8849031 | 9.9987181 | 8.8861850 | 11.1138150 | 10.0012819 | 11.1150969 | 36 |
| 25 | 8.8865418 | 9.9987084 | 8.8878334 | 11.1121666 | 10.0012916 | 11.1134582 | 35 |
| 26 | 8.8881743 | 9.9986986 | 8.8894757 | 11.1105243 | 10.0013014 | 11.1118257 | 34 |
| 27 | 8.8898007 | 9.9986888 | 8.8911119 | 11.1088881 | 10.0013112 | 11.1101993 | 33 |
| 28 | 8.8914209 | 9.9986790 | 8.8927420 | 11.1072580 | 10.0013210 | 11.1085791 | 32 |
| 29 | 8.8930351 | 9.9986691 | 8.8943660 | 11.1056340 | 10.0013309 | 11.1069649 | 31 |
| 30 | 8.8946433 | 9.9986591 | 8.8959842 | 11.1040158 | 10.0013409 | 11.1053567 | 30 |
| 31 | 8.8962455 | 9.9986492 | 8.8975963 | 11.1024037 | 10.0013508 | 11.1037545 | 29 |
| 32 | 8.8978418 | 9.9986392 | 8.8992026 | 11.1007974 | 10.0013608 | 11.1021582 | 28 |
| 33 | 8.8994322 | 9.9986292 | 8.9008030 | 11.0991970 | 10.0013708 | 11.1005678 | 27 |
| 34 | 8.9010168 | 9.9986191 | 8.9023955 | 11.0976023 | 10.0013809 | 11.0989832 | 26 |
| 35 | 8.9025955 | 9.9986090 | 8.9039866 | 11.0960134 | 10.0013910 | 11.0974045 | 25 |
| 36 | 8.9041685 | 9.9985988 | 8.9055697 | 11.0944303 | 10.0014012 | 11.0958315 | 24 |
| 37 | 8.9057358 | 9.9985886 | 8.9071472 | 11.0928528 | 10.0014014 | 11.0942642 | 23 |
| 38 | 8.9072975 | 9.9985784 | 8.9087190 | 11.0912810 | 10.0014216 | 11.0927025 | 22 |
| 39 | 8.9088535 | 9.9985682 | 8.9102853 | 11.0897147 | 10.0014318 | 11.0911465 | 21 |
| 40 | 8.9104039 | 9.9985579 | 8.9118460 | 11.0881540 | 10.0014421 | 11.0895961 | 20 |
| 41 | 8.9119487 | 9.9985475 | 8.9134012 | 11.0865988 | 10.0014525 | 11.0880513 | 19 |
| 42 | 8.9134881 | 9.9985372 | 8.9149509 | 11.0850491 | 10.0014628 | 11.0865119 | 18 |
| 43 | 8.9150219 | 9.9985268 | 8.9164952 | 11.0835048 | 10.0014732 | 11.0849781 | 17 |
| 44 | 8.9165504 | 9.9985163 | 8.9180340 | 11.0819660 | 10.0014837 | 11.0834496 | 16 |
| 45 | 8.9180734 | 9.9985058 | 8.9195675 | 11.0804325 | 10.0014942 | 11.0819266 | 15 |
| 46 | 8.9195911 | 9.9984953 | 8.9210957 | 11.0789043 | 10.0015047 | 11.0804089 | 14 |
| 47 | 8.9211034 | 9.9984848 | 8.9226186 | 11.0773814 | 10.0015152 | 11.0788966 | 13 |
| 48 | 8.9226105 | 9.9984742 | 8.9241363 | 11.0758637 | 10.0015258 | 11.0773895 | 12 |
| 49 | 8.9241123 | 9.9984636 | 8.9256487 | 11.0743513 | 10.0015364 | 11.0758877 | 11 |
| 50 | 8.9256089 | 9.9984529 | 8.9271560 | 11.0728440 | 10.0015471 | 11.0743911 | 10 |
| 51 | 8.9271003 | 9.9984422 | 8.9286581 | 11.0713419 | 10.0015578 | 11.0728997 | 9 |
| 52 | 8.9285866 | 9.9984315 | 8.9301552 | 11.0698448 | 10.0015685 | 11.0714134 | 8 |
| 53 | 8.9300678 | 9.9984207 | 8.9316471 | 11.0683529 | 10.0015793 | 11.0699522 | 7 |
| 54 | 8.9315439 | 9.9984099 | 8.9331340 | 11.0668660 | 10.0015901 | 11.0684561 | 6 |
| 55 | 8.9330150 | 9.9983990 | 8.9346160 | 11.0653840 | 10.0016010 | 11.0669850 | 5 |
| 56 | 8.9344811 | 9.9983881 | 8.9360929 | 11.0639071 | 10.0016119 | 11.0655189 | 4 |
| 57 | 8.9359422 | 9.9983772 | 8.9375650 | 11.0624350 | 10.0016228 | 11.0640578 | 3 |
| 58 | 8.9373983 | 9.9983663 | 8.9390321 | 11.0609679 | 10.0016337 | 11.0626017 | 2 |
| 59 | 8.9388496 | 9.9983553 | 8.9404944 | 11.0595056 | 10.0016447 | 11.0611504 | 1 |
| 60 | 8.9402960 | 9.9983442 | 8.9419518 | 11.0580482 | 10.0016558 | 11.0597040 | 0 |
| | L. Co-Sine. | L. Sine. | L. Co Tang. | L. Tangent | L. Co-Secant | L. Secant. | M |

85 DEGREES.

5 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 871557 | 9961947 | 874887 | 11430052 | 10038198 | 11473713 | 60 |
| 1 | 874455 | 9961693 | 877818 | 11391885 | 10038454 | 11435692 | 59 |
| 2 | 877353 | 9961438 | 880749 | 11353970 | 10038711 | 11397922 | 58 |
| 3 | 880251 | 9961182 | 883681 | 11316304 | 10038969 | 11360402 | 57 |
| 4 | 883148 | 9960926 | 886612 | 11278885 | 10039228 | 11323129 | 56 |
| 5 | 886046 | 9960669 | 889544 | 11241712 | 10039487 | 11286101 | 55 |
| 6 | 888943 | 9960411 | 892476 | 11204780 | 10039747 | 11249316 | 54 |
| 7 | 891840 | 9960152 | 895408 | 11168089 | 10040008 | 11212770 | 53 |
| 8 | 894738 | 9959892 | 898341 | 11131635 | 10040270 | 11176462 | 52 |
| 9 | 897635 | 9959631 | 901273 | 11095416 | 10040533 | 11140389 | 51 |
| 10 | 900532 | 9959369 | 904206 | 11059431 | 10040797 | 11104549 | 50 |
| 11 | 903429 | 9959107 | 907138 | 11023676 | 10041061 | 11068940 | 49 |
| 12 | 906326 | 9958844 | 910071 | 10988150 | 10041326 | 11033560 | 48 |
| 13 | 909223 | 9958580 | 913004 | 10952850 | 10041592 | 10998406 | 47 |
| 14 | 912119 | 9958315 | 915938 | 10917775 | 10041859 | 10963476 | 46 |
| 15 | 915016 | 9958049 | 918871 | 10882921 | 10042127 | 10928763 | 45 |
| 16 | 917913 | 9957782 | 921804 | 10848288 | 10042396 | 10894281 | 44 |
| 17 | 920809 | 9957515 | 924738 | 10813872 | 10042666 | 10860011 | 43 |
| 18 | 923706 | 9957247 | 927672 | 10779673 | 10042937 | 10825957 | 42 |
| 19 | 926602 | 9956978 | 930606 | 10745687 | 10043208 | 10792117 | 41 |
| 20 | 929499 | 9956708 | 933540 | 10711913 | 10043480 | 10788488 | 40 |
| 21 | 932395 | 9956437 | 936474 | 10678348 | 10043753 | 10725070 | 39 |
| 22 | 935291 | 9956165 | 939409 | 10644992 | 10044027 | 10691859 | 38 |
| 23 | 938187 | 9955892 | 942344 | 10611841 | 10044302 | 10658854 | 37 |
| 24 | 941083 | 9955619 | 945278 | 10578895 | 10044578 | 10626054 | 36 |
| 25 | 943979 | 9955345 | 948213 | 10546151 | 10044855 | 10593455 | 35 |
| 26 | 946875 | 9955070 | 951148 | 10513607 | 10045133 | 10561057 | 34 |
| 27 | 949771 | 9954794 | 954084 | 10481261 | 10045411 | 10528857 | 33 |
| 28 | 952666 | 9954517 | 957019 | 10449112 | 10045690 | 10496854 | 32 |
| 29 | 955562 | 9954240 | 959955 | 10417158 | 10045970 | 10465056 | 31 |
| 30 | 958458 | 9953962 | 962890 | 10385397 | 10046251 | 10433430 | 30 |
| 31 | 961353 | 9953683 | 965826 | 10353827 | 10046533 | 10402007 | 29 |
| 32 | 964248 | 9953403 | 968763 | 10322447 | 10046816 | 10370772 | 28 |
| 33 | 967144 | 9953122 | 971699 | 10291255 | 10047099 | 10339726 | 27 |
| 34 | 970039 | 9952840 | 974635 | 10260249 | 10047383 | 10308866 | 26 |
| 35 | 972934 | 9952557 | 977572 | 10229428 | 10047668 | 10278190 | 25 |
| 36 | 975829 | 9952274 | 980509 | 10198789 | 10047690 | 10247954 | 24 |
| 37 | 978724 | 9951990 | 983446 | 10168332 | 10048241 | 10217385 | 23 |
| 38 | 981619 | 9951705 | 986383 | 10138054 | 10048529 | 10187254 | 22 |
| 39 | 984514 | 9951419 | 989320 | 10107954 | 10048818 | 10157300 | 21 |
| 40 | 987408 | 9951132 | 992257 | 10078031 | 10049108 | 10127522 | 20 |
| 41 | 990303 | 9950844 | 995195 | 10048283 | 10049399 | 10097920 | 19 |
| 42 | 993197 | 9950555 | 998133 | 10018708 | 10049690 | 10068491 | 18 |
| 43 | 996092 | 9950266 | 1001071 | 99893050 | 10049982 | 10039234 | 17 |
| 44 | 998986 | 9949976 | 1004009 | 99600724 | 10050275 | 10010147 | 16 |
| 45 | 1001881 | 9949685 | 1006947 | 99310088 | 10050569 | 99812291 | 15 |
| 46 | 1004775 | 9949393 | 1009885 | 99021125 | 10050864 | 99524787 | 14 |
| 47 | 1007669 | 9949100 | 1012824 | 98733823 | 10051160 | 99238943 | 13 |
| 48 | 1010563 | 9948806 | 1015763 | 98448166 | 10051457 | 98954744 | 12 |
| 49 | 1013457 | 9948512 | 1018702 | 98164140 | 10051754 | 98672176 | 11 |
| 50 | 1016350 | 9948217 | 1021641 | 97881732 | 10052052 | 98391227 | 10 |
| 51 | 1019245 | 9947921 | 1024580 | 97600927 | 10052351 | 98111880 | 9 |
| 52 | 1022138 | 9947624 | 1027520 | 97321713 | 10052651 | 97834124 | 8 |
| 53 | 1025032 | 9947326 | 1030460 | 97044075 | 10052952 | 97557944 | 7 |
| 54 | 1027925 | 9947037 | 1033400 | 96768000 | 10053254 | 97283327 | 6 |
| 55 | 1030819 | 9946728 | 1036340 | 96493475 | 10053557 | 97010260 | 5 |
| 56 | 1033712 | 9946428 | 1039280 | 96220486 | 10053860 | 96738730 | 4 |
| 57 | 1036605 | 9946127 | 1042220 | 95949022 | 10054164 | 96468724 | 3 |
| 58 | 1039499 | 9945825 | 1045160 | 95679068 | 10054469 | 96200229 | 2 |
| 59 | 1042392 | 9945522 | 1048101 | 95410613 | 10054775 | 95933233 | 1 |
| 60 | 1045285 | 9945218 | 1051042 | 95143645 | 10055082 | 95667722 | 0 |
| | N. Co-Sine. | N. Sine | N. Co Tang | N. Tangent. | N.Co-Secant | N. Secant. | M |

84 DEGREES.

5 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 8.9402960 | 9.9983442 | 8.9419518 | 11.0580482 | 10.0016558 | 11.0597040 | 60 |
| 1 | 8.9417376 | 9.9983332 | 8.9434044 | 11.0565956 | 10.0016668 | 11.0582624 | 59 |
| 2 | 8.9431743 | 9.9983220 | 8.9448523 | 11.0551477 | 10.0016780 | 11.0568257 | 58 |
| 3 | 8.9446063 | 9.9983109 | 8.9462954 | 11.0537046 | 10.0016891 | 11.0553937 | 57 |
| 4 | 8.9460335 | 9.9982997 | 8.9477338 | 11.0522662 | 10.0017003 | 11.0539665 | 56 |
| 5 | 8.9474561 | 9.9982885 | 8.9491676 | 11.0508324 | 10.0017115 | 11.0525439 | 55 |
| 6 | 8.9488739 | 9.9982772 | 8.9505967 | 11.0494033 | 10.0017228 | 11.0511261 | 54 |
| 7 | 8.9502871 | 9.9982660 | 8.9520211 | 11.0479789 | 10.0017340 | 11.0497129 | 53 |
| 8 | 8.9516957 | 9.9982546 | 8.9534410 | 11.0465590 | 10.0017454 | 11.0483043 | 52 |
| 9 | 8.9530996 | 9.9982433 | 8.9548564 | 11.0451436 | 10.0017567 | 11.0469004 | 51 |
| 10 | 8.9544991 | 9.9982318 | 8.9562672 | 11.0437328 | 10.0017682 | 11.0455009 | 50 |
| 11 | 8.9558940 | 9.9982204 | 8.9576735 | 11.0423265 | 10.0017796 | 11.0441060 | 49 |
| 12 | 8.9572843 | 9.9982089 | 8.9590754 | 11.0409246 | 10.0017911 | 11.0427157 | 48 |
| 13 | 8.9586703 | 9.9981974 | 8.9604728 | 11.0395272 | 10.0018026 | 11.0413297 | 47 |
| 14 | 8.9600517 | 9.9981859 | 8.9618659 | 11.0381341 | 10.0018141 | 11.0399483 | 46 |
| 15 | 8.9614288 | 9.9981743 | 8.9632545 | 11.0367455 | 10.0018257 | 11.0385712 | 45 |
| 16 | 8.9628014 | 9.9981626 | 8.9646388 | 11.0353612 | 10.0018371 | 11.0371986 | 44 |
| 17 | 8.9641697 | 9.9981510 | 8.9660188 | 11.0339812 | 10.0018490 | 11.0358303 | 43 |
| 18 | 8.9655337 | 9.9981393 | 8.9673944 | 11.0326056 | 10.0018607 | 11.0344663 | 42 |
| 19 | 8.9668934 | 9.9981275 | 8.9687658 | 11.0312342 | 10.0018725 | 11.0331066 | 41 |
| 20 | 8.9682487 | 9.9981158 | 8.9701330 | 11.0298670 | 10.0018842 | 11.0317513 | 40 |
| 21 | 8.9695999 | 9.9981040 | 8.9714959 | 11.0285041 | 10.0018960 | 11.0304001 | 39 |
| 22 | 8.9709468 | 9.9980921 | 8.9728547 | 11.0271453 | 10.0019079 | 11.0290532 | 38 |
| 23 | 8.9722895 | 9.9980802 | 8.9742092 | 11.0257908 | 10.0019198 | 11.0277105 | 37 |
| 24 | 8.9736280 | 9.9980683 | 8.9755597 | 11.0244403 | 10.0019317 | 11.0263720 | 36 |
| 25 | 8.9749624 | 9.9980563 | 8.9769060 | 11.0230940 | 10.0019437 | 11.0250376 | 35 |
| 26 | 8.9762926 | 9.9980443 | 8.9782483 | 11.0217517 | 10.0019557 | 11.0237074 | 34 |
| 27 | 8.9776188 | 9.9980323 | 8.9795865 | 11.0204135 | 10.0019677 | 11.0223812 | 33 |
| 28 | 8.9789408 | 9.9980202 | 8.9809206 | 11.0190794 | 10.0019798 | 11.0210592 | 32 |
| 29 | 8.9802589 | 9.9980081 | 8.9822507 | 11.0177493 | 10.0019919 | 11.0197411 | 31 |
| 30 | 8.9815729 | 9.9979960 | 8.9835769 | 11.0164231 | 10.0020040 | 11.0184271 | 30 |
| 31 | 8.9828829 | 9.9979838 | 8.9848991 | 11.0151009 | 10.0020162 | 11.0171171 | 29 |
| 32 | 8.9841889 | 9.9979716 | 8.9862173 | 11.0137827 | 10.0020284 | 11.0158111 | 28 |
| 33 | 8.9854910 | 9.9979593 | 8.9875317 | 11.0124683 | 10.0020407 | 11.0145090 | 27 |
| 34 | 8.9867891 | 9.9979470 | 8.9888421 | 11.0111579 | 10.0020530 | 11.0132109 | 26 |
| 35 | 8.9880834 | 9.9979347 | 8.9901487 | 11.0098513 | 10.0020653 | 11.0119166 | 25 |
| 36 | 8.9893737 | 9.9979223 | 8.9914514 | 11.0085486 | 10.0020777 | 11.0106263 | 24 |
| 37 | 8.9906602 | 9.9979099 | 8.9927503 | 11.0072497 | 10.0020901 | 11.0093398 | 23 |
| 38 | 8.9919429 | 9.9978975 | 8.9940454 | 11.0059546 | 10.0021025 | 11.0080572 | 22 |
| 39 | 8.9932217 | 9.9978850 | 8.9953367 | 11.0046633 | 10.0021150 | 11.0067783 | 21 |
| 40 | 8.9944968 | 9.9978725 | 8.9966243 | 11.0033757 | 10.0021275 | 11.0055032 | 20 |
| 41 | 8.9957681 | 9.9978599 | 8.9979081 | 11.0020918 | 10.0021410 | 11.0042319 | 19 |
| 42 | 8.9970356 | 9.9978473 | 8.9991883 | 11.0008117 | 10.0021524 | 11.0029644 | 18 |
| 43 | 8.9982994 | 9.9978347 | 9.0004647 | 10.9995353 | 10.0021653 | 11.0017006 | 17 |
| 44 | 8.9995595 | 9.9978220 | 9.0017375 | 10.9982625 | 10.0021780 | 11.0004405 | 16 |
| 45 | 9.0008160 | 9.9978093 | 9.0030066 | 10.9969934 | 10.0021907 | 10.9991840 | 15 |
| 46 | 9.0020687 | 9.9977966 | 9.0042721 | 10.9957279 | 10.0022034 | 10.9979313 | 14 |
| 47 | 9.0033179 | 9.9977838 | 9.0055340 | 10.9944660 | 10.0022162 | 10.9966821 | 13 |
| 48 | 9.0045634 | 9.9977710 | 9.0067924 | 10.9932076 | 10.0022290 | 10.9954366 | 12 |
| 49 | 9.0058053 | 9.9977582 | 9.0080471 | 10.9919529 | 10.0022418 | 10.9941947 | 11 |
| 50 | 9.0070436 | 9.9977453 | 9.0092984 | 10.9907016 | 10.0022547 | 10.9929564 | 10 |
| 51 | 9.0082784 | 9.9977323 | 9.0105461 | 10.9894539 | 10.0022677 | 10.9917216 | 9 |
| 52 | 9.0095096 | 9.9977194 | 9.0117903 | 10.9882097 | 10.0022806 | 10.9904904 | 8 |
| 53 | 9.0107374 | 9.9977064 | 9.0130310 | 10.9869690 | 10.0022936 | 10.9892626 | 7 |
| 54 | 9.0119616 | 9.9976933 | 9.0142682 | 10.9857318 | 10.0023067 | 10.9880384 | 6 |
| 55 | 9.0131823 | 9.9976803 | 9.0155021 | 10.9844979 | 10.0023197 | 10.9868177 | 5 |
| 56 | 9.0143996 | 9.9976672 | 9.0167325 | 10.9832675 | 10.0023328 | 10.9856004 | 4 |
| 57 | 9.0156135 | 9.9976540 | 9.0179594 | 10.9820406 | 10.0023460 | 10.9843865 | 3 |
| 58 | 9.0168239 | 9.9976408 | 9.0191831 | 10.9808169 | 10.0023592 | 10.9831761 | 2 |
| 59 | 9.0180309 | 9.9976276 | 9.0204033 | 10.9795967 | 10.0023724 | 10.9819691 | 1 |
| 60 | 9.0192346 | 9.9976143 | 9.0216202 | 10.9783798 | 10.0023857 | 10.9807654 | 0 |
| | *L. Co-Sine.* | *L. Sine.* | *L. Co Tang.* | *L. Tangent* | *L. Co-Secant* | *L. Secant.* | M |

84 DEGREES.

6 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 1045285 | 9945218 | 1051042 | 95143645 | 10055082 | 95667722 | 60 |
| 1 | 1048178 | 9944914 | 1053983 | 94878149 | 10055390 | 95403686 | 59 |
| 2 | 1051070 | 9944609 | 1056924 | 94614116 | 10055699 | 95141110 | 58 |
| 3 | 1053963 | 9944303 | 1059866 | 94351531 | 10056009 | 94879984 | 57 |
| 4 | 1056856 | 9943996 | 1062808 | 94090384 | 10056320 | 94620296 | 56 |
| 5 | 1059748 | 9943688 | 1065750 | 93830663 | 10056631 | 94362033 | 55 |
| 6 | 1062641 | 9943379 | 1068692 | 93572355 | 10056943 | 94105184 | 54 |
| 7 | 1065533 | 9943069 | 1071634 | 93315450 | 10057256 | 93849738 | 53 |
| 8 | 1068425 | 9942759 | 1074576 | 93059936 | 10057570 | 93595682 | 52 |
| 9 | 1071318 | 9942448 | 1077519 | 92805802 | 10057885 | 93343006 | 51 |
| 10 | 1074210 | 9942136 | 1080462 | 92553035 | 10058201 | 93091699 | 50 |
| 11 | 1077102 | 9941823 | 1083405 | 92301627 | 10058518 | 92841749 | 49 |
| 12 | 1079994 | 9941509 | 1086348 | 92051564 | 10058835 | 92593145 | 48 |
| 13 | 1082885 | 9941194 | 1089291 | 91802838 | 10059153 | 92345877 | 47 |
| 14 | 1085777 | 9940879 | 1092234 | 91556486 | 10059472 | 92099934 | 46 |
| 15 | 1088669 | 9940563 | 1095178 | 91309348 | 10059792 | 91855305 | 45 |
| 16 | 1091560 | 9940246 | 1098122 | 91064564 | 10060113 | 91611980 | 44 |
| 17 | 1094452 | 9939928 | 1101066 | 90821074 | 10060435 | 91369949 | 43 |
| 18 | 1097343 | 9939609 | 1104010 | 90578867 | 10060758 | 91129200 | 42 |
| 19 | 1100234 | 9939289 | 1106954 | 90337933 | 10061081 | 90889725 | 41 |
| 20 | 1103126 | 9938969 | 1109899 | 90098261 | 10061405 | 90651512 | 40 |
| 21 | 1106017 | 9938648 | 1112844 | 89859843 | 10061730 | 90414553 | 39 |
| 22 | 1108908 | 9938326 | 1115789 | 89622668 | 10062056 | 90178837 | 38 |
| 23 | 1111799 | 9938003 | 1118734 | 89386726 | 10062383 | 89944354 | 37 |
| 24 | 1114689 | 9937679 | 1121679 | 89152008 | 10062711 | 89711095 | 36 |
| 25 | 1117580 | 9937354 | 1124625 | 88918505 | 10063040 | 89479051 | 35 |
| 26 | 1120471 | 9937028 | 1127571 | 88686206 | 10063370 | 89248211 | 34 |
| 27 | 1123361 | 9936702 | 1130517 | 88455103 | 10063701 | 89018567 | 33 |
| 28 | 1126252 | 9936375 | 1133463 | 88225186 | 10064032 | 88790109 | 32 |
| 29 | 1129142 | 9936047 | 1136409 | 87996446 | 10064364 | 88562828 | 31 |
| 30 | 1132032 | 9935718 | 1139356 | 87768874 | 10064697 | 88336715 | 30 |
| 31 | 1134922 | 9935388 | 1142303 | 87542461 | 10065031 | 88111761 | 29 |
| 32 | 1137812 | 9935058 | 1145250 | 87317198 | 10065366 | 87887957 | 28 |
| 33 | 1140702 | 9934727 | 1148197 | 87093077 | 10065702 | 87665295 | 27 |
| 34 | 1143592 | 9934395 | 1151144 | 86870088 | 10066039 | 87443766 | 26 |
| 35 | 1146482 | 9934062 | 1154091 | 86648223 | 10066377 | 87223361 | 25 |
| 36 | 1149371 | 9933728 | 1157039 | 86427475 | 10066715 | 87004071 | 24 |
| 37 | 1152261 | 9933393 | 1159987 | 86207833 | 10067054 | 86788889 | 23 |
| 38 | 1155151 | 9933057 | 1162935 | 85989290 | 10067394 | 86568805 | 22 |
| 39 | 1158040 | 9932720 | 1165883 | 85771838 | 10067735 | 86352812 | 21 |
| 40 | 1160929 | 9932383 | 1168831 | 85555468 | 10068077 | 86137901 | 20 |
| 41 | 1163818 | 9932045 | 1171780 | 85340172 | 10068420 | 85924065 | 19 |
| 42 | 1166707 | 9931706 | 1174729 | 85125943 | 10068764 | 85711295 | 18 |
| 43 | 1169596 | 9931366 | 1177678 | 84912772 | 10069108 | 85499584 | 17 |
| 44 | 1172485 | 9931025 | 1180628 | 84700651 | 10069453 | 85288923 | 16 |
| 45 | 1175374 | 9930684 | 1183578 | 84489573 | 10069799 | 85079304 | 15 |
| 46 | 1178263 | 9930342 | 1186528 | 84279531 | 10070146 | 84870721 | 14 |
| 47 | 1181151 | 9929999 | 1189478 | 84070515 | 10070494 | 84663165 | 13 |
| 48 | 1184040 | 9929655 | 1192428 | 83862519 | 10070843 | 84456629 | 12 |
| 49 | 1186928 | 9929310 | 1195378 | 83655536 | 10071193 | 84251105 | 11 |
| 50 | 1189816 | 9928964 | 1198328 | 83449557 | 10071544 | 84046586 | 10 |
| 51 | 1192704 | 9928617 | 1201279 | 83244577 | 10071896 | 83843065 | 9 |
| 52 | 1195593 | 9928270 | 1204230 | 83040586 | 10072248 | 83640534 | 8 |
| 53 | 1198481 | 9927922 | 1207181 | 82837579 | 10072601 | 83438986 | 7 |
| 54 | 1201368 | 9927573 | 1210132 | 82635547 | 10072955 | 83238415 | 6 |
| 55 | 1204256 | 9927223 | 1213084 | 82434485 | 10073310 | 83038812 | 5 |
| 56 | 1207144 | 9926872 | 1216036 | 82234384 | 10073666 | 82840171 | 4 |
| 57 | 1210031 | 9926521 | 1218988 | 82035239 | 10074023 | 82642485 | 3 |
| 58 | 1212919 | 9926169 | 1221940 | 81837041 | 10074381 | 82445748 | 2 |
| 59 | 1215806 | 9925816 | 1224893 | 81639786 | 10074740 | 82249952 | 1 |
| 60 | 1218693 | 9925462 | 1227846 | 81443464 | 10075099 | 82055090 | 0 |
| | N. Co-Sine. | N. Sine | N. Co Tang. | N. Tangent. | N. Co-Secant | N. Secant. | M |

83 DEGREES.

6 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co-Tang.* | *L. Secant.* | *L. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.0192346 | 9.9976143 | 9.0216202 | 10.9783798 | 10.0023857 | 10.9807654 | 60 |
| 1 | 9.0204348 | 9.9976011 | 9.0228338 | 10.9771662 | 10.0023989 | 10.9795652 | 59 |
| 2 | 9.0216318 | 9.9975877 | 9.0240441 | 10.9759559 | 10.0024123 | 10.9783682 | 58 |
| 3 | 9.0228254 | 9.9975743 | 9.0252510 | 10.9747490 | 10.0024257 | 10.9771746 | 57 |
| 4 | 9.0240157 | 9.9975609 | 9.0264548 | 10.9735452 | 10.0024391 | 10.9759843 | 56 |
| 5 | 9.0252027 | 9.9975475 | 9.0276552 | 10.9723448 | 10.0024525 | 10.9747973 | 55 |
| 6 | 9.0263865 | 9.9975340 | 9.0288524 | 10.9711476 | 10.0024660 | 10.9736135 | 54 |
| 7 | 9.0275669 | 9.9975205 | 9.0300464 | 10.9699536 | 10.0024795 | 10.9724331 | 53 |
| 8 | 9.0287442 | 9.9975069 | 9.0312373 | 10.9687627 | 10.0024931 | 10.9712558 | 52 |
| 9 | 9.0299182 | 9.9974933 | 9.0324249 | 10.9675751 | 10.0025067 | 10.9700818 | 51 |
| 10 | 9.0310890 | 9.9974797 | 9.0336093 | 10.9663907 | 10.0025203 | 10.9689110 | 50 |
| 11 | 9.0322567 | 9.9974660 | 9.0347906 | 10.9652094 | 10.0025340 | 10.9677433 | 49 |
| 12 | 9.0334212 | 9.9974523 | 9.0359688 | 10.9640312 | 10.0025477 | 10.9665788 | 48 |
| 13 | 9.0345825 | 9.9974386 | 9.0371439 | 10.9628561 | 10.0025614 | 10.9654175 | 47 |
| 14 | 9.0357407 | 9.9974248 | 9.0383159 | 10.9616841 | 10.0025752 | 10.9642593 | 46 |
| 15 | 9.0368958 | 9.9974110 | 9.0394848 | 10.9605152 | 10.0025890 | 10.9631042 | 45 |
| 16 | 9.0380477 | 9.9973971 | 9.0406506 | 10.9593494 | 10.0026029 | 10.9619523 | 44 |
| 17 | 9.0391966 | 9.9973833 | 9.0418134 | 10.9581866 | 10.0026167 | 10.9608034 | 43 |
| 18 | 9.0403424 | 9.9973693 | 9.0429731 | 10.9570269 | 10.0026307 | 10.9596576 | 42 |
| 19 | 9.0414852 | 9.9973554 | 9.0441299 | 10.9558701 | 10.0026446 | 10.9585148 | 41 |
| 20 | 9.0426249 | 9.9973414 | 9.0452836 | 10.9547164 | 10.0026586 | 10.9573751 | 40 |
| 21 | 9.0437617 | 9.9973273 | 9.0464343 | 10.9535657 | 10.0026727 | 10.9562383 | 39 |
| 22 | 9.0448954 | 9.9973132 | 9.0475821 | 10.9524179 | 10.0026868 | 10.9551046 | 38 |
| 23 | 9.0460261 | 9.9972991 | 9.0487270 | 10.9512730 | 10.0027009 | 10.9539739 | 37 |
| 24 | 9.0471538 | 9.9972850 | 9.0498689 | 10.9501311 | 10.0027150 | 10.9528462 | 36 |
| 25 | 9.0482786 | 9.9972708 | 9.0510078 | 10.9489922 | 10.0027292 | 10.9517214 | 35 |
| 26 | 9.0494005 | 9.9972566 | 9.0521439 | 10.9478561 | 10.0027434 | 10.9505995 | 34 |
| 27 | 9.0505194 | 9.9972423 | 9.0532771 | 10.9467229 | 10.0027577 | 10.9494806 | 33 |
| 28 | 9.0516354 | 9.9972280 | 9.0544074 | 10.9455926 | 10.0027720 | 10.9483646 | 32 |
| 29 | 9.0527485 | 9.9972137 | 9.0555349 | 10.9444651 | 10.0027862 | 10.9472515 | 31 |
| 30 | 9.0538588 | 9.9971993 | 9.0566595 | 10.9433405 | 10.0028007 | 10.9461412 | 30 |
| 31 | 9.0549661 | 9.9971849 | 9.0577813 | 10.9422187 | 10.0028151 | 10.9450339 | 29 |
| 32 | 9.0560706 | 9.9971704 | 9.0589002 | 10.9410998 | 10.0028296 | 10.9439294 | 28 |
| 33 | 9.0571723 | 9.9971559 | 9.0600164 | 10.9399836 | 10.0028441 | 10.9428377 | 27 |
| 34 | 9.0582711 | 9.9971414 | 9.0611297 | 10.9388703 | 10.0028586 | 10.9417289 | 26 |
| 35 | 9.0593672 | 9.9971268 | 9.0622403 | 10.9377597 | 10.0028732 | 10.9406328 | 25 |
| 36 | 9.0604604 | 9.9971122 | 9.0633482 | 10.9366518 | 10.0028878 | 10.9395496 | 24 |
| 37 | 9.0615509 | 9.9970976 | 9.0644533 | 10.9355467 | 10.0029024 | 10.9384491 | 23 |
| 38 | 9.0626386 | 9.9970829 | 9.0655556 | 10.9344444 | 10.0029171 | 10.9373614 | 22 |
| 39 | 9.0637235 | 9.9970682 | 9.0666553 | 10.9333447 | 10.0029318 | 10.9362765 | 21 |
| 40 | 9.0648057 | 9.9970535 | 9.0677522 | 10.9322478 | 10.0029465 | 10.9351943 | 20 |
| 41 | 9.0658852 | 9.9970387 | 9.0688465 | 10.9311535 | 10.0029613 | 10.9341148 | 19 |
| 42 | 9.0669619 | 9.9970239 | 9.0699381 | 10.9300619 | 10.0029761 | 10.9330381 | 18 |
| 43 | 9.0680360 | 9.9970090 | 9.0710270 | 10.9289730 | 10.0029910 | 10.9319640 | 17 |
| 44 | 9.0691074 | 9.9969941 | 9.0721133 | 10.9278867 | 10.0030059 | 10.9308926 | 16 |
| 45 | 9.0701761 | 9.9969792 | 9.0731969 | 10.9268031 | 10.0030208 | 10.9298239 | 15 |
| 46 | 9.0712421 | 9.9969642 | 9.0742779 | 10.9257221 | 10.0030358 | 10.9287579 | 14 |
| 47 | 9.0723055 | 9.9969492 | 9.0753563 | 10.9246437 | 10.0030508 | 10.9276945 | 13 |
| 48 | 9.0733663 | 9.9969342 | 9.0764321 | 10.9235679 | 10.0030658 | 10.9266337 | 12 |
| 49 | 9.0744244 | 9.9969191 | 9.0775053 | 10.9224947 | 10.0030809 | 10.9255756 | 11 |
| 50 | 9.0754799 | 9.9969040 | 9.0785760 | 10.9214240 | 10.0030960 | 10.9245201 | 10 |
| 51 | 9.0765329 | 9.9968888 | 9.0796441 | 10.9203559 | 10.0031112 | 10.9234671 | 9 |
| 52 | 9.0775832 | 9.9968736 | 9.0807096 | 10.9192904 | 10.0031264 | 10.9224168 | 8 |
| 53 | 9.0786310 | 9.9968584 | 9.0817726 | 10.9182274 | 10.0031416 | 10.9213690 | 7 |
| 54 | 9.0796762 | 9.9968431 | 9.0828331 | 10.9171669 | 10.0031569 | 10.9203238 | 6 |
| 55 | 9.0807189 | 9.9968278 | 9.0838911 | 10.9161089 | 10.0031722 | 10.9192811 | 5 |
| 56 | 9.0817590 | 9.9968125 | 9.0849466 | 10.9150534 | 10.0031875 | 10.9182410 | 4 |
| 57 | 9.0827966 | 9.9967971 | 9.0859996 | 10.9140004 | 10.0032029 | 10.9172034 | 3 |
| 58 | 9.0838317 | 9.9967817 | 9.0870501 | 10.9129499 | 10.0032183 | 10.9161683 | 2 |
| 59 | 9.0848643 | 9.9967662 | 9.0880981 | 10.9119019 | 10.0032338 | 10.9151357 | 1 |
| 60 | 9.0858945 | 9.9967507 | 9.0891438 | 10.9108562 | 10.0032493 | 10.9141055 | 0 |
| | *L. Co-Sine.* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L Co-Secant.* | *L. Secant.* | M |

83 DEGREES.

7 DEGREES.

| M | N Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 1218693 | 9925462 | 1227846 | 81443464 | 10075099 | 82055090 | 60 |
| 1 | 1221581 | 9925107 | 1230799 | 81248071 | 10075459 | 81861157 | 59 |
| 2 | 1224468 | 9924751 | 1233752 | 81053599 | 10075820 | 81668145 | 58 |
| 3 | 1227355 | 9924394 | 1236705 | 80860042 | 10076182 | 81476048 | 57 |
| 4 | 1230241 | 9924036 | 1239658 | 80667394 | 10076545 | 81284860 | 56 |
| 5 | 1233128 | 9923678 | 1242612 | 80475647 | 10076909 | 81094573 | 55 |
| 6 | 1236015 | 9923319 | 1245566 | 80284796 | 10077274 | 80905182 | 54 |
| 7 | 1238901 | 9922959 | 1248520 | 80094835 | 10077639 | 80716681 | 53 |
| 8 | 1241788 | 9922598 | 1251474 | 79905756 | 10078005 | 80529062 | 52 |
| 9 | 1244674 | 9922236 | 1254429 | 79717555 | 10078372 | 80342321 | 51 |
| 10 | 1247560 | 9921874 | 1257384 | 79530224 | 10078740 | 80156450 | 50 |
| 11 | 1250446 | 9921511 | 1260339 | 79343758 | 10079109 | 79971445 | 49 |
| 12 | 1253332 | 9921147 | 1263294 | 79158151 | 10079479 | 79787298 | 48 |
| 13 | 1256218 | 9920782 | 1266249 | 78973396 | 10079850 | 79604003 | 47 |
| 14 | 1259104 | 9920416 | 1269205 | 78789489 | 10080222 | 79421556 | 46 |
| 15 | 1261990 | 9920049 | 1272161 | 78606423 | 10080595 | 79239950 | 45 |
| 16 | 1264875 | 9919681 | 1275117 | 78424191 | 10080969 | 79059179 | 44 |
| 17 | 1267761 | 9919313 | 1278073 | 78242790 | 10081343 | 78879238 | 43 |
| 18 | 1270646 | 9918944 | 1281029 | 78062212 | 10081718 | 78700120 | 42 |
| 19 | 1273531 | 9918574 | 1283986 | 77882453 | 10082094 | 78521821 | 41 |
| 20 | 1276416 | 9918203 | 1286943 | 77703506 | 10082471 | 78344335 | 40 |
| 21 | 1279301 | 9917831 | 1289900 | 77525366 | 10082849 | 78167656 | 39 |
| 22 | 1282186 | 9917459 | 1292857 | 77348028 | 10083228 | 77991778 | 38 |
| 23 | 1285071 | 9917086 | 1295815 | 77171486 | 10083607 | 77816697 | 37 |
| 24 | 1287956 | 9916712 | 1298773 | 76995735 | 10083988 | 77642406 | 36 |
| 25 | 1290841 | 9916337 | 1301731 | 76820769 | 10084370 | 77468901 | 35 |
| 26 | 1293725 | 9915961 | 1304689 | 76646584 | 10084752 | 77296176 | 34 |
| 27 | 1296609 | 9915584 | 1307648 | 76473174 | 10085135 | 77124227 | 33 |
| 28 | 1299494 | 9915206 | 1310607 | 76300533 | 10085519 | 76953047 | 32 |
| 29 | 1302378 | 9914828 | 1313566 | 76128657 | 10085904 | 76782631 | 31 |
| 30 | 1305262 | 9914449 | 1316525 | 75957541 | 10086290 | 76612976 | 30 |
| 31 | 1308146 | 9914069 | 1319484 | 75787179 | 10086677 | 76444075 | 29 |
| 32 | 1311030 | 9913688 | 1322444 | 75617567 | 10087065 | 76275923 | 28 |
| 33 | 1313913 | 9913306 | 1325404 | 75448699 | 10087453 | 76108516 | 27 |
| 34 | 1316797 | 9912923 | 1328364 | 75280571 | 10087842 | 75941849 | 26 |
| 35 | 1319681 | 9912539 | 1331324 | 75113178 | 10088232 | 75775916 | 25 |
| 36 | 1322564 | 9912155 | 1334285 | 74946514 | 10088623 | 75610713 | 24 |
| 37 | 1325447 | 9911770 | 1337246 | 74780576 | 10089015 | 75446236 | 23 |
| 38 | 1328330 | 9911384 | 1340207 | 74615357 | 10089408 | 75282478 | 22 |
| 39 | 1331213 | 9910997 | 1343168 | 74450855 | 10089802 | 75119437 | 21 |
| 40 | 1334096 | 9910609 | 1346129 | 74287064 | 10090197 | 74957106 | 20 |
| 41 | 1336979 | 9910221 | 1349091 | 74123978 | 10090592 | 74797482 | 19 |
| 42 | 1339862 | 9909832 | 1352053 | 73961595 | 10090988 | 74634560 | 18 |
| 43 | 1342744 | 9909442 | 1355015 | 73799909 | 10091385 | 74474335 | 17 |
| 44 | 1345627 | 9909051 | 1357977 | 73638916 | 10091783 | 74314803 | 16 |
| 45 | 1348509 | 9908659 | 1360940 | 73478610 | 10092182 | 74155959 | 15 |
| 46 | 1351392 | 9908266 | 1363903 | 73318989 | 10092582 | 73997798 | 14 |
| 47 | 1354274 | 9907872 | 1366866 | 73160047 | 10092983 | 73840318 | 13 |
| 48 | 1357156 | 9907478 | 1369829 | 73001780 | 10093385 | 73683512 | 12 |
| 49 | 1360038 | 9907083 | 1372793 | 72844184 | 10093788 | 73527377 | 11 |
| 50 | 1362919 | 9906687 | 1375757 | 72687255 | 10094192 | 73371909 | 10 |
| 51 | 1365801 | 9906290 | 1378721 | 72530987 | 10094596 | 73217102 | 9 |
| 52 | 1368683 | 9905892 | 1381685 | 72375378 | 10095001 | 73062954 | 8 |
| 53 | 1371564 | 9905493 | 1384650 | 72220422 | 10095407 | 72909460 | 7 |
| 54 | 1374445 | 9905094 | 1387615 | 72066116 | 10095814 | 72756616 | 6 |
| 55 | 1377327 | 9904694 | 1390580 | 71912456 | 10096222 | 72604417 | 5 |
| 56 | 1380208 | 9904293 | 1393545 | 71759437 | 10096631 | 72452859 | 4 |
| 57 | 1383089 | 9903891 | 1396510 | 71607056 | 10097041 | 72301940 | 3 |
| 58 | 1385970 | 9903488 | 1399476 | 71455308 | 10097452 | 72151653 | 2 |
| 59 | 1388850 | 9903084 | 1402442 | 71304190 | 10097864 | 72001996 | 1 |
| 60 | 1391731 | 9902680 | 1405408 | 71153697 | 10098276 | 71852965 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

7 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.0858945 | 9.9967507 | 9.0891438 | 10.9108562 | 10.0032493 | 10.9141055 | 60 |
| 1 | 9.0869221 | 9.9967352 | 9.0901869 | 10.9098131 | 10.0032648 | 10.9130779 | 59 |
| 2 | 9.0879473 | 9.9967196 | 9.0912277 | 10.9087723 | 10.0032804 | 10.9120527 | 58 |
| 3 | 9.0889700 | 9.9967040 | 9.0922660 | 10.9077340 | 10.0032960 | 10.9110300 | 57 |
| 4 | 9.0899903 | 9.9966884 | 9.0933020 | 10.9066980 | 10.0033116 | 10.9100097 | 56 |
| 5 | 9.0910082 | 9.9966727 | 9.0943355 | 10.9056645 | 10.0033273 | 10.9089918 | 55 |
| 6 | 9.0920237 | 9.9966570 | 9.0953669 | 10.9046333 | 10.0033430 | 10.9079763 | 54 |
| 7 | 9.0930367 | 9.9966412 | 9.0963955 | 10.9036045 | 10.0033588 | 10.9069633 | 53 |
| 8 | 9.0940474 | 9.9966254 | 9.0974219 | 10.9025781 | 10.0033746 | 10.9059526 | 52 |
| 9 | 9.0950556 | 9.9966096 | 9.0984460 | 10.9015540 | 10.0033904 | 10.9049444 | 51 |
| 10 | 9.0960615 | 9.9965937 | 9.0994678 | 10.9005322 | 10.0034063 | 10.9039385 | 50 |
| 11 | 9.0970651 | 9.9965778 | 9.1004872 | 10.8995128 | 10.0034222 | 10.9029349 | 49 |
| 12 | 9.0980662 | 9.9965619 | 9.1015044 | 10.8984956 | 10.0034381 | 10.9019338 | 48 |
| 13 | 9.0990651 | 9.9965419 | 9.1025192 | 10.8974808 | 10.0034541 | 10.9009349 | 47 |
| 14 | 9.1000616 | 9.9965299 | 9.1035317 | 10.8964683 | 10.0034701 | 10.8999384 | 46 |
| 15 | 9.1010558 | 9.9965138 | 9.1045420 | 10.8954580 | 10.0034862 | 10.8989442 | 45 |
| 16 | 9.1020477 | 9.9964977 | 9.1055500 | 10.8944500 | 10.0035023 | 10.8979523 | 44 |
| 17 | 9.1030373 | 9.9964816 | 9.1065557 | 10.8934443 | 10.0035184 | 10.8969627 | 43 |
| 18 | 9.1040246 | 9.9964655 | 9.1075591 | 10.8924409 | 10.0035345 | 10.8959754 | 42 |
| 19 | 9.1050096 | 9.9964493 | 9.1085604 | 10.8914396 | 10.0035507 | 10.8949904 | 41 |
| 20 | 9.1059924 | 9.9964330 | 9.1095594 | 10.8904406 | 10.0035670 | 10.8940076 | 40 |
| 21 | 9.1069729 | 9.9964167 | 9.1105562 | 10.8894438 | 10.0035833 | 10.8930271 | 39 |
| 22 | 9.1079512 | 9.9964004 | 9.1115508 | 10.8884492 | 10.0035996 | 10.8920488 | 38 |
| 23 | 9.1089272 | 9.9963841 | 9.1125431 | 10.8874569 | 10.0036159 | 10.8910728 | 37 |
| 24 | 9.1099010 | 9.9963677 | 9.1135333 | 10.8864667 | 10.0036323 | 10.8900990 | 36 |
| 25 | 9.1108726 | 9.9963513 | 9.1145213 | 10.8854787 | 10.0036487 | 10.8891274 | 35 |
| 26 | 9.1118420 | 9.9963348 | 9.1155072 | 10.8844928 | 10.0036652 | 10.8881580 | 34 |
| 27 | 9.1128092 | 9.9963183 | 9.1164909 | 10.8835091 | 10.0036817 | 10.8871908 | 33 |
| 28 | 9.1137742 | 9.9963018 | 9.1174724 | 10.8825276 | 10.0036982 | 10.8862258 | 32 |
| 29 | 9.1147370 | 9.9962852 | 9.1184518 | 10.8815482 | 10.0037148 | 10.8852630 | 31 |
| 30 | 9.1156977 | 9.9962686 | 9.1194291 | 10.8805709 | 10.0037314 | 10.8843023 | 30 |
| 31 | 9.1166562 | 9.9962519 | 9.1204043 | 10.8795957 | 10.0037481 | 10.8833438 | 29 |
| 32 | 9.1176125 | 9.9962352 | 9.1213773 | 10.8786227 | 10.0037648 | 10.8823875 | 28 |
| 33 | 9.1185667 | 9.9962185 | 9.1223482 | 10.8776518 | 10.0037815 | 10.8814333 | 27 |
| 34 | 9.1195188 | 9.9962017 | 9.1233171 | 10.8766829 | 10.0037983 | 10.8804812 | 26 |
| 35 | 9.1204688 | 9.9961849 | 9.1243839 | 10.8757161 | 10.0038151 | 10.8795312 | 25 |
| 36 | 9.1214167 | 9.9961681 | 9.1252486 | 10.8747514 | 10.0038319 | 10.8785833 | 24 |
| 37 | 9.1223624 | 9.9961512 | 9.1262112 | 10.8737888 | 10.0038488 | 10.8776376 | 23 |
| 38 | 9.1233061 | 9.9961343 | 9.1271718 | 10.8728282 | 10.0038657 | 10.8766939 | 22 |
| 39 | 9.1242477 | 9.9961174 | 9.1281303 | 10.8718697 | 10.0038826 | 10.8757523 | 21 |
| 40 | 9.1251872 | 9.9961004 | 9.1290867 | 10.8709132 | 10.0038996 | 10.8748128 | 20 |
| 41 | 9.1261246 | 9.9960834 | 9.1300413 | 10.8699587 | 10.0039165 | 10.8738754 | 19 |
| 42 | 9.1270600 | 9.9960663 | 9.1309937 | 10.8690063 | 10.0039337 | 10.8729490 | 18 |
| 43 | 9.1279934 | 9.9960492 | 9.1319442 | 10.8680558 | 10.0039508 | 10.8720066 | 17 |
| 44 | 9.1289247 | 9.9960321 | 9.1328926 | 10.8671074 | 10.0039697 | 10.8710753 | 16 |
| 45 | 9.1298539 | 9.9960149 | 9.1338391 | 10.8661609 | 10.0039851 | 10.8701461 | 15 |
| 46 | 9.1307812 | 9.9959977 | 9.1347835 | 10.8652165 | 10.0040023 | 10.8692188 | 14 |
| 47 | 9.1317064 | 9.9959804 | 9.1357260 | 10.8642740 | 10.0040196 | 10.8682936 | 13 |
| 48 | 9.1326297 | 9.9959631 | 9.1366665 | 10.8633335 | 10.0040369 | 10.8673703 | 12 |
| 49 | 9.1335509 | 9.9959458 | 9.1376051 | 10.8623949 | 10.0040542 | 10.8664491 | 11 |
| 50 | 9.1344702 | 9.9959284 | 9.1385417 | 10.8614583 | 10.0040716 | 10.8655298 | 10 |
| 51 | 9.1353875 | 9.9959111 | 9.1394764 | 10.8605236 | 10.0040889 | 10.8646125 | 9 |
| 52 | 9.1363028 | 9.9958936 | 9.1404092 | 10.8595908 | 10.0041064 | 10.8636972 | 8 |
| 53 | 9.1372161 | 9.9958761 | 9.1413400 | 10.8586600 | 10.0041239 | 10.8627839 | 7 |
| 54 | 9.1381275 | 9.9958586 | 9.1422689 | 10.8577311 | 10.0041414 | 10.8618725 | 6 |
| 55 | 9.1390370 | 9.9958411 | 9.1431959 | 10.8568041 | 10.0041589 | 10.8609630 | 5 |
| 56 | 9.1399445 | 9.9958235 | 9.1441210 | 10.8558790 | 10.0041765 | 10.8600555 | 4 |
| 57 | 9.1408501 | 9.9958059 | 9.1450442 | 10.8549558 | 10.0041941 | 10.8591499 | 3 |
| 58 | 9.1417537 | 9.9957882 | 9.1459655 | 10.8540345 | 10.0042118 | 10.8582463 | 2 |
| 59 | 9.1426555 | 9.9957705 | 9.1468850 | 10.8531150 | 10.0042295 | 10.8573445 | 1 |
| 60 | 9.1435553 | 9.9957528 | 9.1478025 | 10.8521975 | 10.0042472 | 10.8564447 | 0 |
| | L. Co-Sine | L. Sine | L. Co-Tang. | L. Tangent. | L. Co-Secant. | L. Secant. | M |

82 DEGREES.

8 DEGREES

| M. | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 1391731 | 9902680 | 1405408 | 71153697 | 10098276 | 71852965 | 60 |
| 1 | 1394612 | 9902275 | 1408374 | 71003826 | 10098689 | 71704556 | 59 |
| 2 | 1397492 | 9901869 | 1411341 | 70854573 | 10099103 | 71556764 | 58 |
| 3 | 1400372 | 9901462 | 1414308 | 70705934 | 10099518 | 71409587 | 57 |
| 4 | 1403252 | 9901054 | 1417275 | 70557905 | 10099934 | 71263019 | 56 |
| 5 | 1406132 | 9900645 | 1420243 | 70410482 | 10100351 | 71117058 | 55 |
| 6 | 1409012 | 9900236 | 1423211 | 70263662 | 10100769 | 70971700 | 54 |
| 7 | 1411892 | 9899826 | 1426179 | 70117441 | 10101188 | 70826941 | 53 |
| 8 | 1414772 | 9899415 | 1429147 | 69971806 | 10101607 | 70682777 | 52 |
| 9 | 1417651 | 9899003 | 1432115 | 69826781 | 10102027 | 70539205 | 51 |
| 10 | 1420531 | 9898590 | 1435084 | 69682335 | 10102448 | 70396220 | 50 |
| 11 | 1423410 | 9898176 | 1438053 | 69538473 | 10102870 | 70253820 | 49 |
| 12 | 1426289 | 9897762 | 1441022 | 69395192 | 10103293 | 70112001 | 48 |
| 13 | 1429168 | 9897347 | 1443991 | 69352489 | 10103717 | 69970760 | 47 |
| 14 | 1432047 | 9896931 | 1446961 | 69110359 | 10104142 | 69830092 | 46 |
| 15 | 1434926 | 9896514 | 1449931 | 68968799 | 10104568 | 69689994 | 45 |
| 16 | 1437805 | 9896096 | 1452901 | 68827807 | 10104995 | 69550464 | 44 |
| 17 | 1440684 | 9895677 | 1455871 | 68687378 | 10105423 | 69411496 | 43 |
| 18 | 1443562 | 9895257 | 1458842 | 68547508 | 10105851 | 69273089 | 42 |
| 19 | 1446440 | 9894837 | 1461813 | 68408196 | 10106280 | 69135239 | 41 |
| 20 | 1449319 | 9894416 | 1464784 | 68269437 | 10106710 | 68997942 | 40 |
| 21 | 1452197 | 9893994 | 1467755 | 68131227 | 10107141 | 68861195 | 39 |
| 22 | 1455075 | 9893571 | 1470727 | 67993565 | 10107573 | 68724995 | 38 |
| 23 | 1457953 | 9893147 | 1473699 | 67856446 | 10108006 | 68589338 | 37 |
| 24 | 1460830 | 9892723 | 1476671 | 67719867 | 10108440 | 68454222 | 36 |
| 25 | 1463708 | 9892298 | 1479644 | 67583826 | 10108875 | 68319642 | 35 |
| 26 | 1466585 | 9891872 | 1482617 | 67448319 | 10109311 | 68185597 | 34 |
| 27 | 1469463 | 9891445 | 1485590 | 67313341 | 10109747 | 68052082 | 33 |
| 28 | 1472340 | 9891017 | 1488563 | 67178891 | 10110184 | 67919095 | 32 |
| 29 | 1475217 | 9890588 | 1491536 | 67044966 | 10110622 | 67786632 | 31 |
| 30 | 1478094 | 9890158 | 1494510 | 66911562 | 10111061 | 67654691 | 30 |
| 31 | 1480971 | 9889728 | 1497484 | 66778677 | 10111501 | 67523268 | 29 |
| 32 | 1483848 | 9889297 | 1500458 | 66646307 | 10111942 | 67392360 | 28 |
| 33 | 1486724 | 9888865 | 1503433 | 66514449 | 10112384 | 67261965 | 27 |
| 34 | 1489601 | 9888432 | 1506408 | 66383100 | 10112827 | 67132079 | 26 |
| 35 | 1492477 | 9887998 | 1509383 | 66252258 | 10113271 | 67002699 | 25 |
| 36 | 1495353 | 9887563 | 1512358 | 66121919 | 10113715 | 66873822 | 24 |
| 37 | 1498230 | 9887128 | 1515333 | 65992080 | 10114160 | 66745446 | 23 |
| 38 | 1501106 | 9886692 | 1518309 | 65862739 | 10114606 | 66617568 | 22 |
| 39 | 1503981 | 9886255 | 1521285 | 65733892 | 10115053 | 66490184 | 21 |
| 40 | 1506857 | 9885817 | 1524261 | 65605538 | 10115501 | 66363293 | 20 |
| 41 | 1509733 | 9865378 | 1527238 | 65477672 | 10115950 | 66236890 | 19 |
| 42 | 1512608 | 9884938 | 1530215 | 65350293 | 10116400 | 66110973 | 18 |
| 43 | 1515484 | 9884498 | 1533192 | 65223396 | 10116851 | 65985540 | 17 |
| 44 | 1518359 | 9884057 | 1536189 | 65096981 | 10117303 | 65860587 | 16 |
| 45 | 1521234 | 9883615 | 1539147 | 64971043 | 10117756 | 65736112 | 15 |
| 46 | 1524109 | 9883172 | 1542125 | 64845581 | 10118209 | 65612113 | 14 |
| 47 | 1526984 | 9882728 | 1545103 | 64720591 | 10118663 | 65488586 | 13 |
| 48 | 1529858 | 9882283 | 1548082 | 64596070 | 10119118 | 65365528 | 12 |
| 49 | 1532733 | 9881838 | 1551061 | 64472017 | 10119574 | 65242938 | 11 |
| 50 | 1535607 | 9881392 | 1554040 | 64348428 | 10120031 | 65120812 | 10 |
| 51 | 1538482 | 9880945 | 1557019 | 64225301 | 10120489 | 64999148 | 9 |
| 52 | 1541356 | 9880497 | 1559998 | 64102633 | 10120948 | 64877944 | 8 |
| 53 | 1544230 | 9880048 | 1562978 | 63980422 | 10121408 | 64757195 | 7 |
| 54 | 1547104 | 9879598 | 1565958 | 63858665 | 10121869 | 64636901 | 6 |
| 55 | 1549978 | 9879148 | 1568938 | 63737359 | 10122331 | 64517059 | 5 |
| 56 | 1552851 | 9878697 | 1571919 | 63616502 | 10122793 | 64397666 | 4 |
| 57 | 1555725 | 9878245 | 1574900 | 63496092 | 10123256 | 64278719 | 3 |
| 58 | 1558598 | 9877792 | 1577881 | 63376126 | 10123720 | 64160216 | 2 |
| 59 | 1561472 | 9877338 | 1580862 | 63256601 | 10124185 | 64042154 | 1 |
| 60 | 1564345 | 9876883 | 1583844 | 63137515 | 10124651 | 63924532 | 0 |
| | N Co-Sine. | N. Sine. | N Co Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

81 DEGREES.

8 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co. Tang.* | *L. Secant.* | *L. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.1435553 | 9.9957528 | 9.1478025 | 10.8521975 | 10.0042472 | 10.8564447 | 60 |
| 1 | 9.1444532 | 9.9957350 | 9.1487182 | 10.8512818 | 10.0042650 | 10.8555468 | 59 |
| 2 | 9.1453493 | 9.9957172 | 9.1496321 | 10.8503679 | 10.0042828 | 10.8546507 | 58 |
| 3 | 9.1462435 | 9.9956993 | 9.1505441 | 10.8494559 | 10.0043007 | 10.8537565 | 57 |
| 4 | 9.1471358 | 9.9956815 | 9.1514543 | 10.8485457 | 10.0043185 | 10.8528642 | 56 |
| 5 | 9.1480262 | 9.9956635 | 9.1523627 | 10.8476373 | 10.0043365 | 10.8519738 | 55 |
| 6 | 9.1489148 | 9.9956456 | 9.1532692 | 10.8467308 | 10.0043544 | 10.8510852 | 54 |
| 7 | 9.1498015 | 9.9956276 | 9.1541739 | 10.8458261 | 10.0043724 | 10.8501985 | 53 |
| 8 | 9.1506864 | 9.9956095 | 9.1550769 | 11.8449231 | 10.0043905 | 10.8493136 | 52 |
| 9 | 9.1515694 | 9.9955915 | 9.1559780 | 10.8440220 | 10.0044085 | 10.8484306 | 51 |
| 10 | 9.1524507 | 9.9955734 | 9.1568773 | 10.8431227 | 10.0044266 | 10.8475493 | 50 |
| 11 | 9.1533301 | 9.9955552 | 9.1577748 | 10.8422252 | 10.0044448 | 10.8466699 | 49 |
| 12 | 9.1542076 | 9.9955370 | 9.1586706 | 10.8413294 | 10.0044630 | 10.8457924 | 48 |
| 13 | 9.1550834 | 9.9955188 | 9.1595646 | 10.8404354 | 10.0044812 | 10.8449166 | 47 |
| 14 | 9.1559574 | 9.9955005 | 9.1604569 | 10.8395431 | 10.0044995 | 10.8440426 | 46 |
| 15 | 9.1568296 | 9.9954822 | 9.1613473 | 10.8386527 | 10.0045178 | 10.8431704 | 45 |
| 16 | 9.1577000 | 9.9954639 | 9.1622361 | 10.8377639 | 10.0045361 | 10.8423000 | 44 |
| 17 | 9.1585686 | 9.9954455 | 9.1631231 | 10.8368769 | 10.0045545 | 10.8414314 | 43 |
| 18 | 9.1594354 | 9.9954272 | 9.1640083 | 10.8359917 | 10.0045729 | 10.8405646 | 42 |
| 19 | 9.1603005 | 9.9954087 | 9.1648919 | 10.8351081 | 10.0045913 | 10.8396995 | 41 |
| 20 | 9.1611639 | 9.9953902 | 9.1657737 | 10.8342263 | 10.0046098 | 10.8388361 | 40 |
| 21 | 9.1620254 | 9.9953717 | 9.1666538 | 10.8333462 | 10.0046283 | 10.8379745 | 39 |
| 22 | 9.1628853 | 9.9953531 | 9.1675322 | 10.8324678 | 10.0046469 | 10.8371147 | 38 |
| 23 | 9.1637434 | 9.9953345 | 9.1684089 | 10.8315911 | 10.0046655 | 10.8362566 | 37 |
| 24 | 9.1645998 | 9.9953159 | 9.1692839 | 10.8307161 | 10.0046841 | 10.8354002 | 36 |
| 25 | 9.1654544 | 9.9952972 | 9.1701572 | 10.8298428 | 10.0047028 | 10.8345456 | 35 |
| 26 | 9.1663074 | 9.9952785 | 9.1710289 | 10.8289711 | 10.0047215 | 10.8336926 | 34 |
| 27 | 9.1671586 | 9.9952597 | 9.1718989 | 10.8281011 | 10.0047403 | 10.8328414 | 33 |
| 28 | 9.1680081 | 9.9952409 | 9.1727672 | 10.8272328 | 10.0047591 | 10.8319919 | 32 |
| 29 | 9.1688559 | 9.9952221 | 9.1736338 | 10.8263662 | 10.0047779 | 10.8311441 | 31 |
| 30 | 9.1697021 | 9.9952033 | 9.1744988 | 10.8255012 | 10.0047967 | 10.8302979 | 30 |
| 31 | 9.1705465 | 9.9951844 | 9.1753622 | 10.8246378 | 10.0048156 | 10.8294534 | 29 |
| 32 | 9.1713893 | 9.9951654 | 9.1762239 | 10.8237761 | 10.0048346 | 10.8286107 | 28 |
| 33 | 9.1722305 | 9.9951464 | 9.1770840 | 10.8229160 | 10.0048536 | 10.8277695 | 27 |
| 34 | 9.1730699 | 9.9951274 | 9.1779425 | 10.8220575 | 10.0048726 | 10.8269301 | 26 |
| 35 | 9.1739077 | 9.9951084 | 9.1787993 | 10.8212007 | 10.0048916 | 10.8260923 | 25 |
| 36 | 9.1747439 | 9.9950893 | 9.1796546 | 10.8203454 | 10.0049107 | 10.8252561 | 24 |
| 37 | 9.1755784 | 9.9950702 | 9.1805082 | 10.8194918 | 10.0049298 | 10.8244216 | 23 |
| 38 | 9.1764112 | 9.9950510 | 9.1813602 | 10.8186398 | 10.0049490 | 10.8235888 | 22 |
| 39 | 9.1772425 | 9.9950318 | 9.1822106 | 10.8177894 | 10.0049682 | 10.8227575 | 21 |
| 40 | 9.1780721 | 9.9950126 | 9.1830595 | 10.8169405 | 10.0049874 | 10.8219279 | 20 |
| 41 | 9.1789001 | 9.9949933 | 9.1839068 | 10.8160932 | 10.0050067 | 10.8210999 | 19 |
| 42 | 9.1797265 | 9.9949740 | 9.1847525 | 10.8152475 | 10.0050260 | 10.8202735 | 18 |
| 43 | 9.1805512 | 9.9949546 | 9.1855966 | 10.8144034 | 10.0050454 | 10.8194888 | 17 |
| 44 | 9.1813744 | 9.9949352 | 9.1864392 | 10.8135608 | 10.0050648 | 10.8186256 | 16 |
| 45 | 9.1821960 | 9.9949158 | 9.1872802 | 10.8127198 | 10.0050842 | 10.8178040 | 15 |
| 46 | 9.1830160 | 9.9948964 | 9.1881196 | 10.8118804 | 10.0051036 | 10.8169840 | 14 |
| 47 | 9.1838344 | 9.9948769 | 9.1889575 | 10.8110425 | 10.0051231 | 10.8161656 | 13 |
| 48 | 9.1846512 | 9.9948573 | 9.1897939 | 10.8102061 | 10.0051427 | 10.8153488 | 12 |
| 49 | 9.1854665 | 9.9948377 | 9.1906287 | 10.8093713 | 10.0051623 | 10.8145335 | 11 |
| 50 | 9.1862802 | 9.9948181 | 9.1914621 | 10.8085379 | 10.0051819 | 10.8137199 | 10 |
| 51 | 9.1870923 | 9.9947985 | 9.1922939 | 10.8077061 | 10.0052015 | 10.8129077 | 9 |
| 52 | 9.1879029 | 9.9947788 | 9.1931241 | 10.8068759 | 10.0052212 | 10.8120971 | 8 |
| 53 | 9.1887120 | 9.9947591 | 9.1939529 | 10.8060471 | 10.0052409 | 10.8112880 | 7 |
| 54 | 9.1895195 | 9.9947393 | 9.1947802 | 10.8052198 | 10.0052607 | 10.8104805 | 6 |
| 55 | 9.1903254 | 9.9947195 | 9.1956059 | 10.8043941 | 10.0052805 | 10.8096746 | 5 |
| 56 | 9.1911299 | 9.9946997 | 9.1964302 | 10.8035698 | 10.0053003 | 10.8088701 | 4 |
| 57 | 9.1919328 | 9.9946798 | 9.1972530 | 10.8027470 | 10.0053202 | 10.8080672 | 3 |
| 58 | 9.1927342 | 9.9946599 | 9.1980743 | 10.8019257 | 10.0053401 | 10.8072658 | 2 |
| 59 | 9.1935341 | 9.9946399 | 9.1988941 | 10.8011059 | 10.0053601 | 10.8064659 | 1 |
| 60 | 9.1943324 | 9.9946199 | 9.1997125 | 10.8002875 | 10.0053801 | 10.8056676 | 0 |
| | *L. Co-Sine* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L. CoSecant.* | *L. Secant.* | M |

81 DEGREES.

9 DEGREES

| M | *N. Sine* | *N. Co-Sine* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant* | *N Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 1564345 | 9876883 | 1583844 | 63137515 | 10124651 | 63924522 | 60 |
| 1 | 1567218 | 9876428 | 1586826 | 63018866 | 10125118 | 63807347 | 59 |
| 2 | 1570091 | 9875972 | 1589808 | 62900651 | 10125586 | 63690595 | 58 |
| 3 | 1572963 | 9875515 | 1592791 | 62782868 | 10126055 | 63574276 | 57 |
| 4 | 1575836 | 9875057 | 1595774 | 62665514 | 10126525 | 63458386 | 56 |
| 5 | 1578708 | 9874598 | 1598757 | 62548588 | 10126996 | 63342923 | 55 |
| 6 | 1581581 | 9874138 | 1601740 | 62432086 | 10127467 | 63227884 | 54 |
| 7 | 1584453 | 9873677 | 1604724 | 62316007 | 10127939 | 63113269 | 53 |
| 8 | 1587325 | 9873216 | 1607708 | 62200347 | 10128412 | 62999073 | 52 |
| 9 | 1590197 | 9872754 | 1610692 | 62085106 | 10128886 | 62885295 | 51 |
| 10 | 1593069 | 9872291 | 1613677 | 61970279 | 10129361 | 62771933 | 50 |
| 11 | 1595940 | 9871827 | 1616662 | 61855867 | 10129837 | 62658984 | 49 |
| 12 | 1598812 | 9871362 | 1619647 | 61741865 | 10130314 | 62546446 | 48 |
| 13 | 1601683 | 9870897 | 1622632 | 61628272 | 10130792 | 62434316 | 47 |
| 14 | 1603555 | 9870431 | 1625617 | 61515085 | 10131271 | 62322594 | 46 |
| 15 | 1607426 | 9869964 | 1628603 | 61402303 | 10131751 | 62211275 | 45 |
| 16 | 1610297 | 9869496 | 1631589 | 61289923 | 10132231 | 62100359 | 44 |
| 17 | 1613167 | 9869027 | 1634576 | 61177943 | 10132712 | 61989843 | 43 |
| 18 | 1616038 | 9868557 | 1637563 | 61066360 | 10133194 | 61879725 | 42 |
| 19 | 1618909 | 9868086 | 1640550 | 60955174 | 10133677 | 61770003 | 41 |
| 20 | 1621779 | 9867615 | 1643537 | 60844381 | 10134161 | 61660674 | 40 |
| 21 | 1624650 | 9867143 | 1646525 | 60733979 | 10134646 | 61551736 | 39 |
| 22 | 1627520 | 9866670 | 1649513 | 60623967 | 10135132 | 61443189 | 38 |
| 23 | 1630390 | 9866196 | 1652501 | 60514343 | 10135619 | 61335028 | 37 |
| 24 | 1633260 | 9865721 | 1655489 | 60405103 | 10136107 | 61227253 | 36 |
| 25 | 1636129 | 9865246 | 1658478 | 60296247 | 10136595 | 61119861 | 35 |
| 26 | 1638999 | 9864770 | 1661467 | 60187772 | 10137084 | 61012850 | 34 |
| 27 | 1641868 | 9864293 | 1664456 | 60079676 | 10137574 | 60906219 | 33 |
| 28 | 1644738 | 9863815 | 1667446 | 59971957 | 10138065 | 60799964 | 32 |
| 29 | 1647607 | 9863336 | 1670436 | 59864614 | 10138557 | 60694085 | 31 |
| 30 | 1650476 | 9862856 | 1673426 | 59757644 | 10139050 | 60588580 | 30 |
| 31 | 1653345 | 9862375 | 1676416 | 59651045 | 10139544 | 60483445 | 29 |
| 32 | 1656214 | 9861894 | 1679407 | 59544815 | 10140039 | 60378680 | 28 |
| 33 | 1659082 | 9861412 | 1682398 | 59438952 | 10140535 | 60274282 | 27 |
| 34 | 1661951 | 9860929 | 1685389 | 59333455 | 10141032 | 60170250 | 26 |
| 35 | 1664819 | 9860445 | 1688381 | 59228322 | 10141530 | 60066581 | 25 |
| 36 | 1667687 | 9859960 | 1691373 | 59123550 | 10142029 | 59963274 | 24 |
| 37 | 1670555 | 9859474 | 1694365 | 59019138 | 10142529 | 59860326 | 23 |
| 38 | 1673423 | 9858988 | 1697358 | 58915084 | 10143029 | 59757737 | 22 |
| 39 | 1676291 | 9858501 | 1700351 | 58811386 | 10143530 | 59655504 | 21 |
| 40 | 1679159 | 9858013 | 1703344 | 58708042 | 10144032 | 59553625 | 20 |
| 41 | 1682026 | 9857524 | 1706337 | 58605051 | 10144535 | 59452098 | 19 |
| 42 | 1684894 | 9857034 | 1709331 | 58502410 | 10145039 | 59350922 | 18 |
| 43 | 1687761 | 9856544 | 1712325 | 58400117 | 10145544 | 59250095 | 17 |
| 44 | 1690628 | 9856053 | 1715310 | 58298172 | 10146050 | 59149614 | 16 |
| 45 | 1693495 | 9855561 | 1718314 | 58196572 | 10146557 | 59049479 | 15 |
| 46 | 1696362 | 9855068 | 1721309 | 58095315 | 10147064 | 58949688 | 14 |
| 47 | 1699228 | 9854574 | 1724304 | 57994400 | 10147572 | 58850238 | 13 |
| 48 | 1702095 | 9854079 | 1727300 | 57893825 | 10148081 | 58751128 | 12 |
| 49 | 1704961 | 9853583 | 1730296 | 57793588 | 10148591 | 58652356 | 11 |
| 50 | 1707828 | 9853087 | 1733292 | 57693688 | 10149102 | 58553920 | 10 |
| 51 | 1710694 | 9852590 | 1736288 | 57594122 | 10149614 | 58455820 | 9 |
| 52 | 1713560 | 9852092 | 1739285 | 57494889 | 10150127 | 58358053 | 8 |
| 53 | 1716425 | 9851593 | 1742282 | 57395988 | 10150641 | 58260617 | 7 |
| 54 | 1719291 | 9851093 | 1745279 | 57297416 | 10151156 | 58163510 | 6 |
| 55 | 1722156 | 9850592 | 1748277 | 57199173 | 10151672 | 58066732 | 5 |
| 56 | 1725022 | 9850091 | 1751275 | 57101256 | 10152189 | 57970280 | 4 |
| 57 | 1727887 | 9849589 | 1754273 | 57003663 | 10152707 | 57874153 | 3 |
| 58 | 1730752 | 9849086 | 1757272 | 56906394 | 10153226 | 57778350 | 2 |
| 59 | 1733617 | 9848582 | 1760271 | 56809446 | 10153746 | 57682867 | 1 |
| 60 | 1736482 | 9848077 | 1763270 | 56712818 | 10154267 | 57587705 | 0 |
| | *N Co-Sine.* | *N. Sine* | *N. Co Tang.* | *N. Tangent.* | *N Co-Secant* | *N. Secant* | *M* |

80 DEGREES.

9 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.1943324 | 9.9946199 | 9.1997125 | 10.8002875 | 10.0053801 | 10.8056676 | 60 |
| 1 | 9.1951293 | 9.9945999 | 9.2005294 | 10.7994706 | 10.0054001 | 10.8048707 | 59 |
| 2 | 9.1959247 | 9.9945798 | 9.2013449 | 10.7986551 | 10.0054202 | 10.8040753 | 58 |
| 3 | 9.1967186 | 9.9945597 | 9.2021588 | 10.7978411 | 10.0054403 | 10.8032814 | 57 |
| 4 | 9.1975110 | 9.9945396 | 9.2029714 | 10.7970286 | 10.0054604 | 10.8024890 | 56 |
| 5 | 9.1983019 | 9.9945194 | 9.2037825 | 10.7962175 | 10.0054806 | 10.8016981 | 55 |
| 6 | 9.1990913 | 9.9944992 | 9.2045922 | 10.7954078 | 10.0055008 | 10.8009087 | 54 |
| 7 | 9.1998793 | 9.9944789 | 9.2054004 | 10.7945996 | 10.0055211 | 10.8001207 | 53 |
| 8 | 9.2006658 | 9.9944587 | 9.2062072 | 10.7937928 | 10.0055413 | 10.7993342 | 52 |
| 9 | 9.2014509 | 9.9944383 | 9.2070126 | 10.7929874 | 10.0055617 | 10.7985491 | 51 |
| 10 | 9.2022345 | 9.9944180 | 9.2078165 | 10.7921835 | 10.0055820 | 10.7977655 | 50 |
| 11 | 9.2030167 | 9.9943975 | 9.2086191 | 10.7913809 | 10.0056025 | 10.7969833 | 49 |
| 12 | 9.2037974 | 9.9943771 | 9.2094203 | 10.7905797 | 10.0056229 | 10.7962026 | 48 |
| 13 | 9.2045766 | 9.9943566 | 9.2102200 | 10.7897800 | 10.0056434 | 10.7954234 | 47 |
| 14 | 9.2053545 | 9.9943361 | 9.2110184 | 10.7889816 | 10.0056639 | 10.7946455 | 46 |
| 15 | 9.2061309 | 9.9943156 | 9.2118153 | 10.7881847 | 10.0056844 | 10.7938691 | 45 |
| 16 | 9.2069059 | 9.9942950 | 9.2126109 | 10.7873891 | 10.0057050 | 10.7930941 | 44 |
| 17 | 9.2076795 | 9.9942743 | 9.2134051 | 10.7865949 | 10.0057257 | 10.7923205 | 43 |
| 18 | 9.2084516 | 9.9942537 | 9.2141980 | 10.7858020 | 10.0057463 | 10.7915484 | 42 |
| 19 | 9.2092224 | 9.9942330 | 9.2149894 | 10.7850106 | 10.0057670 | 10.7907776 | 41 |
| 20 | 9.2099917 | 9.9942122 | 9.2157795 | 10.7842205 | 10.0057878 | 10.7900083 | 40 |
| 21 | 9.2107597 | 9.9941914 | 9.2165683 | 10.7834317 | 10.0058086 | 10.7892403 | 39 |
| 22 | 9.2115263 | 9.9941706 | 9.2173556 | 10.7826444 | 10.0058294 | 10.7884737 | 38 |
| 23 | 9.2122914 | 9.9941498 | 9.2181417 | 10.7818583 | 10.0058502 | 10.7877586 | 37 |
| 24 | 9.2130552 | 9.9941289 | 9.2189264 | 10.7810736 | 10.0058711 | 10.7869448 | 36 |
| 25 | 9.2138176 | 9.9941079 | 9.2197097 | 10.7802903 | 10.0058921 | 10.7861824 | 35 |
| 26 | 9.2145787 | 9.9940870 | 9.2204917 | 10.7795083 | 10.0059130 | 10.7854213 | 34 |
| 27 | 9.2153384 | 9.9940659 | 9.2212724 | 10.7787276 | 10.0059341 | 10.7846616 | 33 |
| 28 | 9.2160967 | 9.9940449 | 9.2220518 | 10.7779482 | 10.0059551 | 10.7839033 | 32 |
| 29 | 9.2168536 | 9.9940238 | 9.2228298 | 10.7771702 | 10.0059762 | 10.7831464 | 31 |
| 30 | 9.2176092 | 9.9940027 | 9.2236065 | 10.7763935 | 10.0059973 | 10.7823908 | 30 |
| 31 | 9.2183635 | 9.9939815 | 9.2243819 | 10.7756181 | 10.0060185 | 10.7816365 | 29 |
| 32 | 9.2191164 | 9.9939603 | 9.2251561 | 10.7748439 | 10.0060397 | 10.7808836 | 28 |
| 33 | 9.2198680 | 9.9939391 | 9.2259289 | 10.7740711 | 10.0060609 | 10.7801320 | 27 |
| 34 | 9.2206182 | 9.9939178 | 9.2267004 | 10.7732996 | 10.0060822 | 10.7793818 | 26 |
| 35 | 9.2213671 | 9.9938965 | 9.2274706 | 10.7725294 | 10.0061035 | 10.7786329 | 25 |
| 36 | 9.2221147 | 9.9938752 | 9.2282395 | 10.7717605 | 10.0061248 | 10.7778853 | 24 |
| 37 | 9.2228609 | 9.9938538 | 9.2290071 | 10.7709929 | 10.0061462 | 10.7771391 | 23 |
| 38 | 9.2236059 | 9.9938324 | 9.2297735 | 10.7702265 | 10.0061676 | 10.7763941 | 22 |
| 39 | 9.2243495 | 9.9938109 | 9.2305386 | 10.7694614 | 10.0061891 | 10.7756505 | 21 |
| 40 | 9.2250918 | 9.9937894 | 9.2313024 | 10.7686976 | 10.0062106 | 10.7749082 | 20 |
| 41 | 9.2258328 | 9.9937679 | 9.2320650 | 10.7679350 | 10.0062321 | 10.7741672 | 19 |
| 42 | 9.2265725 | 9.9937463 | 9.2328262 | 10.7671738 | 10.0062537 | 10.7734275 | 18 |
| 43 | 9.2273110 | 9.9937247 | 9.2335863 | 10.7664137 | 10.0062753 | 10.7726890 | 17 |
| 44 | 9.2280481 | 9.9937030 | 9.2343451 | 10.7656549 | 10.0062970 | 10.7719519 | 16 |
| 45 | 9.2287839 | 9.9936813 | 9.2351026 | 10.7648974 | 10.0063187 | 10.7712161 | 15 |
| 46 | 9.2295185 | 9.9936596 | 9.2358589 | 10.7641411 | 10.0063404 | 10.7704815 | 14 |
| 47 | 9.2302518 | 9.9936378 | 9.2366139 | 10.7633861 | 10.0063622 | 10.7697482 | 13 |
| 48 | 9.2309838 | 9.9936160 | 9.2373678 | 10.7626322 | 10.0063840 | 10.7690162 | 12 |
| 49 | 9.2317145 | 9.9935942 | 9.2381203 | 10.7618797 | 10.0064058 | 10.7682855 | 11 |
| 50 | 9.2324440 | 9.9935723 | 9.2388717 | 10.7611283 | 10.0064277 | 10.7675560 | 10 |
| 51 | 9.2331722 | 9.9935504 | 9.2396218 | 10.7603782 | 10.0064495 | 10.7668278 | 9 |
| 52 | 9.2338992 | 9.9935285 | 9.2403708 | 10.7596292 | 10.0064715 | 10.7661008 | 8 |
| 53 | 9.2346249 | 9.9935065 | 9.2411185 | 10.7588815 | 10.0064935 | 10.7653751 | 7 |
| 54 | 9.2353494 | 9.9934844 | 9.2418650 | 10.7581350 | 10.0065156 | 10.7646506 | 6 |
| 55 | 9.2360726 | 9.9934624 | 9.2426103 | 10.7573897 | 10.0065376 | 10.7639274 | 5 |
| 56 | 9.2367946 | 9.9934403 | 9.2433543 | 10.7566457 | 10.0065597 | 10.7632054 | 4 |
| 57 | 9.2375153 | 9.9934181 | 9.2440972 | 10.7559028 | 10.0065819 | 10.7624847 | 3 |
| 58 | 9.2382349 | 9.9933959 | 9.2448389 | 10.7551611 | 10.0066041 | 10.7617651 | 2 |
| 59 | 9.2389532 | 9.9933737 | 9.2455794 | 10.7544206 | 10.0066263 | 10.7610468 | 1 |
| 60 | 9.2396702 | 9.9933515 | 9.2463188 | 10.7536812 | 10.0066485 | 10.7603298 | 0 |
| | L. Co-Sine. | L. Sine. | L. Co Tang. | L. Tangent | L. Co Secant | L. Secant | M |

80 DEGREES.

10 DEGREES.

| M | N Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 1736482 | 9848077 | 1763270 | 56712818 | 10154267 | 57587705 | 60 |
| 1 | 1739346 | 9847571 | 1766269 | 56616509 | 10154788 | 57492861 | 59 |
| 2 | 1742211 | 9847065 | 1769269 | 56520516 | 10155310 | 57398333 | 58 |
| 3 | 1745075 | 9846558 | 1772269 | 56424838 | 10155833 | 57304121 | 57 |
| 4 | 1747939 | 9846050 | 1775269 | 56329474 | 10156357 | 57210223 | 56 |
| 5 | 1750803 | 9845541 | 1778270 | 56234421 | 10156882 | 57116636 | 55 |
| 6 | 1753667 | 9845031 | 1781271 | 56139680 | 10157408 | 57023360 | 54 |
| 7 | 1756531 | 9844521 | 1784272 | 56045247 | 10157935 | 56930393 | 53 |
| 8 | 1759395 | 9844010 | 1787274 | 55951121 | 10158463 | 56837734 | 52 |
| 9 | 1762258 | 9843498 | 1790276 | 55857302 | 10158992 | 56745380 | 51 |
| 10 | 1765121 | 9842985 | 1793278 | 55763786 | 10159521 | 56653331 | 50 |
| 11 | 1767984 | 9842471 | 1796281 | 55670574 | 10160051 | 56561584 | 49 |
| 12 | 1770847 | 9841956 | 1799284 | 55577663 | 10160582 | 56470140 | 48 |
| 13 | 1773710 | 9841440 | 1802287 | 55485052 | 10161114 | 56378995 | 47 |
| 14 | 1776573 | 9840924 | 1805291 | 55392740 | 10161647 | 56288148 | 46 |
| 15 | 1779435 | 9840407 | 1808295 | 55300724 | 10162181 | 56197599 | 45 |
| 16 | 1782298 | 9839889 | 1811299 | 55209005 | 10162716 | 56107345 | 44 |
| 17 | 1785160 | 9839370 | 1814303 | 55117579 | 10163252 | 56017386 | 43 |
| 18 | 1788022 | 9838850 | 1817308 | 55026446 | 10163789 | 55927719 | 42 |
| 19 | 1790884 | 9838329 | 1820313 | 54935604 | 10164327 | 55838343 | 41 |
| 20 | 1793746 | 9837808 | 1823318 | 54845052 | 10164866 | 55749258 | 40 |
| 21 | 1796607 | 9837286 | 1826324 | 54754788 | 10165406 | 55660460 | 39 |
| 22 | 1799469 | 9836763 | 1829330 | 54664812 | 10165946 | 55571950 | 38 |
| 23 | 1802330 | 9836239 | 1832336 | 54575121 | 10166487 | 55483726 | 37 |
| 24 | 1805191 | 9835714 | 1835343 | 54485715 | 10167029 | 55395786 | 36 |
| 25 | 1808052 | 9835189 | 1838350 | 54396592 | 10167572 | 55308129 | 35 |
| 26 | 1810913 | 9834663 | 1841357 | 54307750 | 10168116 | 55220754 | 34 |
| 27 | 1813774 | 9834136 | 1844365 | 54219188 | 10168661 | 55133659 | 33 |
| 28 | 1816635 | 9833608 | 1847373 | 54130906 | 10169207 | 55046843 | 32 |
| 29 | 1819495 | 9833079 | 1850381 | 54042901 | 10169754 | 54960305 | 31 |
| 30 | 1822355 | 9832549 | 1853390 | 53955172 | 10170302 | 54874043 | 30 |
| 31 | 1825215 | 9832018 | 1856390 | 53867718 | 10170851 | 54788055 | 29 |
| 32 | 1828075 | 9831487 | 1859408 | 53780538 | 10171401 | 54702342 | 28 |
| 33 | 1830935 | 9830955 | 1862418 | 53693630 | 10171952 | 54616901 | 27 |
| 34 | 1833795 | 9830422 | 1865428 | 53606993 | 10172504 | 54531731 | 26 |
| 35 | 1836654 | 9829888 | 1868438 | 53520626 | 10173056 | 54446831 | 25 |
| 36 | 1839513 | 9829353 | 1871449 | 53434527 | 10173609 | 54362199 | 24 |
| 37 | 1842373 | 9828817 | 1874460 | 53348696 | 10174163 | 54277835 | 23 |
| 38 | 1845232 | 9828281 | 1877471 | 53263131 | 10174718 | 54193737 | 22 |
| 39 | 1848091 | 9827744 | 1880483 | 53177830 | 10175274 | 54109903 | 21 |
| 40 | 1850949 | 9827206 | 1883495 | 53092793 | 10175831 | 54026333 | 20 |
| 41 | 1853808 | 9826667 | 1886507 | 53008018 | 10176389 | 53943026 | 19 |
| 42 | 1856666 | 9826127 | 1889520 | 52923505 | 10176948 | 53859979 | 18 |
| 43 | 1859524 | 9825587 | 1892533 | 52839251 | 10177508 | 53777192 | 17 |
| 44 | 1862382 | 9825046 | 1895546 | 52755255 | 10178069 | 53694664 | 16 |
| 45 | 1865240 | 9824504 | 1898559 | 52671517 | 10178631 | 53612393 | 15 |
| 46 | 1868098 | 9823961 | 1901573 | 52588035 | 10179194 | 53530379 | 14 |
| 47 | 1870956 | 9823417 | 1904587 | 52504809 | 10179758 | 53448620 | 13 |
| 48 | 1873813 | 9822872 | 1907602 | 52421836 | 10180322 | 53367114 | 12 |
| 49 | 1876670 | 9822327 | 1910617 | 52339116 | 10180887 | 53285861 | 11 |
| 50 | 1879527 | 9821781 | 1913632 | 52256647 | 10181453 | 53204860 | 10 |
| 51 | 1882384 | 9821234 | 1916648 | 52174428 | 10182020 | 53124109 | 9 |
| 52 | 1885241 | 9820686 | 1919664 | 52092459 | 10182588 | 53043608 | 8 |
| 53 | 1888098 | 9820137 | 1922680 | 52010738 | 10183157 | 52963354 | 7 |
| 54 | 1890954 | 9819587 | 1925696 | 51929264 | 10183727 | 52883347 | 6 |
| 55 | 1893811 | 9819036 | 1928713 | 51848035 | 10184298 | 52803587 | 5 |
| 56 | 1896667 | 9818485 | 1931730 | 51767051 | 10184870 | 52724070 | 4 |
| 57 | 1899523 | 9817933 | 1934748 | 51686311 | 10185443 | 52644798 | 3 |
| 58 | 1902379 | 9817380 | 1937766 | 51605813 | 10186017 | 52565768 | 2 |
| 59 | 1905234 | 9816826 | 1940784 | 51525557 | 10186592 | 52486979 | 1 |
| 60 | 1908090 | 9816271 | 1943803 | 51445540 | 10187168 | 52408431 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

79 DEGREES.

10 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co-Tang.* | *L. Secant.* | *L. Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.2396702 | 9.9933515 | 9.2463188 | 10.7536812 | 10.0066485 | 10.7603298 | 60 |
| 1 | 9.2403861 | 9.9933292 | 9.2470569 | 10.7529431 | 10.0066708 | 10.7596139 | 59 |
| 2 | 9.2411007 | 9.9933068 | 9.2477939 | 10.7522061 | 10.0066532 | 10.7588993 | 58 |
| 3 | 9.2418141 | 9.9933845 | 9.2485297 | 10.7514703 | 10.0067155 | 10.7581859 | 57 |
| 4 | 9.2425264 | 9.9932621 | 9.2492643 | 10.7507357 | 10.0067379 | 10.7574736 | 56 |
| 5 | 9.2432374 | 9.9932396 | 9.2499978 | 10.7500022 | 10.0067604 | 10.7567626 | 55 |
| 6 | 9.2439472 | 9.9932171 | 9.2507301 | 10.7492699 | 10.0067829 | 10.7560528 | 54 |
| 7 | 9.2446558 | 9.9931946 | 9.2514612 | 10.7485388 | 10.0068054 | 10.7553442 | 53 |
| 8 | 9.2453632 | 9.9931720 | 9.2521912 | 10.7478088 | 10.0068280 | 10.7546368 | 52 |
| 9 | 9.2460695 | 9.9931494 | 9.2529200 | 10.7470800 | 10.0068506 | 10.7539305 | 51 |
| 10 | 9.2467746 | 9.9931268 | 9.2536477 | 10.7463523 | 10.0068732 | 10.7532254 | 50 |
| 11 | 9.2474784 | 9.9931041 | 9.2543743 | 10.7456257 | 10.0068959 | 10.7525216 | 49 |
| 12 | 9.2481811 | 9.9930814 | 9.2550996 | 10.7449003 | 10.0069186 | 10.7518189 | 48 |
| 13 | 9.2488827 | 9.9930587 | 9.2558240 | 10.7441760 | 10.0069413 | 10.7511173 | 47 |
| 14 | 9.2495830 | 9.9930359 | 9.2565472 | 10.7434528 | 10.0069641 | 10.7504170 | 46 |
| 15 | 9.2502822 | 9.9930131 | 9.2572691 | 10.7427308 | 10.0069869 | 10.7497178 | 45 |
| 16 | 9.2509803 | 9.9929902 | 9.2579901 | 10.7420099 | 10.0070098 | 10.7490197 | 44 |
| 17 | 9.2516772 | 9.9929673 | 9.2587099 | 10.7412901 | 10.0070327 | 10.7483228 | 43 |
| 18 | 9.2523729 | 9.9929444 | 9.2594285 | 10.7405715 | 10.0070556 | 10.7476271 | 42 |
| 19 | 9.2530675 | 9.9929214 | 9.2601461 | 10.7398539 | 10.0070786 | 10.7469325 | 41 |
| 20 | 9.2537609 | 9.9928984 | 9.2608625 | 10.7391375 | 10.0071016 | 10.7462391 | 40 |
| 21 | 9.2544532 | 9.9928753 | 9.2615779 | 10.7384221 | 10.0071247 | 10.7455468 | 39 |
| 22 | 9.2551444 | 9.9928522 | 9.2622921 | 10.7377079 | 10.0071478 | 10.7448556 | 38 |
| 23 | 9.2558344 | 9.9928291 | 9.2630053 | 10.7369947 | 10.0071709 | 10.7441656 | 37 |
| 24 | 9.2565233 | 9.9928059 | 9.2637173 | 10.7362827 | 10.0071941 | 10.7434767 | 36 |
| 25 | 9.2572110 | 9.9927827 | 9.2644283 | 10.7355717 | 10.0072173 | 10.7427890 | 35 |
| 26 | 9.2578977 | 9.9927595 | 9.2651382 | 10.7348618 | 10.0072405 | 10.7421023 | 34 |
| 27 | 9.2585832 | 9.9927362 | 9.2658470 | 10.7341530 | 10.0072638 | 10.7414168 | 33 |
| 28 | 9.2592676 | 9.9927129 | 9.2665547 | 10.7334453 | 10.0072871 | 10.7407324 | 32 |
| 29 | 9.2599509 | 9.9926895 | 9.2672613 | 10.7327387 | 10.0073105 | 10.7400491 | 31 |
| 30 | 9.2606330 | 9.9926661 | 9.2679669 | 10.7320331 | 10.0073339 | 10.7393670 | 30 |
| 31 | 9.2613141 | 9.9926427 | 9.2686714 | 10.7313286 | 10.0073573 | 10.7386859 | 29 |
| 32 | 9.2619941 | 9.9926192 | 9.2693749 | 10.7306251 | 10.0073808 | 10.7380059 | 28 |
| 33 | 9.2626729 | 9.9925957 | 9.2700772 | 10.7299228 | 10.0074043 | 10.7373271 | 27 |
| 34 | 9.2633507 | 9.9925722 | 9.2707786 | 10.7292214 | 10.0074278 | 10.7366493 | 26 |
| 35 | 9.2640274 | 9.9925486 | 9.2714788 | 10.7285212 | 10.0074514 | 10.7359729 | 25 |
| 36 | 9.2647030 | 9.9925250 | 9.2721780 | 10.7278220 | 10.0074750 | 10.7352970 | 24 |
| 37 | 9.2653775 | 9.9925013 | 9.2728762 | 10.7271238 | 10.0074987 | 10.7346225 | 23 |
| 38 | 9.2660509 | 9.9924776 | 9.2735733 | 10.7264267 | 10.0075224 | 10.7339491 | 22 |
| 39 | 9.2667232 | 9.9924539 | 9.2742693 | 10.7257306 | 10.0075461 | 10.7332768 | 21 |
| 40 | 9.2673945 | 9.9924301 | 9.2749644 | 10.7250356 | 10.0075699 | 10.7326055 | 20 |
| 41 | 9.2680647 | 9.9924063 | 9.2756584 | 10.7243416 | 10.0075937 | 10.7319353 | 19 |
| 42 | 9.2687338 | 9.9923824 | 9.2763514 | 10.7236486 | 10.0076176 | 10.7312662 | 18 |
| 43 | 9.2694019 | 9.9923585 | 9.2770434 | 10.7229566 | 10.0076415 | 10.7305981 | 17 |
| 44 | 9.2700689 | 9.9923346 | 9.2777343 | 10.7222657 | 10.0076654 | 10.7299311 | 16 |
| 45 | 9.2707348 | 9.9923106 | 9.2784242 | 10.7215758 | 10.0076894 | 10.7292652 | 15 |
| 46 | 9.2713997 | 9.9922866 | 9.2791131 | 10.7208869 | 10.0077134 | 10.7286003 | 14 |
| 47 | 9.2720635 | 9.9922626 | 9.2798009 | 10.7201991 | 10.0077374 | 10.7279365 | 13 |
| 48 | 9.2727263 | 9.9922385 | 9.2804878 | 10.7195122 | 10.0077615 | 10.7272737 | 12 |
| 49 | 9.2733880 | 9.9922144 | 9.2811736 | 10.7188264 | 10.0077856 | 10.7266120 | 11 |
| 50 | 9.2740487 | 9.9921902 | 9.2818585 | 10.7181415 | 10.0078098 | 10.7259513 | 10 |
| 51 | 9.2747083 | 9.9921660 | 9.2825423 | 10.7174577 | 10.0078340 | 10.7252917 | 9 |
| 52 | 9.2753669 | 9.9921418 | 9.2832251 | 10.7167749 | 10.0078582 | 10.7246331 | 8 |
| 53 | 9.2760245 | 9.9921175 | 9.2839070 | 10.7160930 | 10.0078825 | 10.7239755 | 7 |
| 54 | 9.2766811 | 9.9920932 | 9.2845878 | 10.7154122 | 10.0079068 | 10.7233189 | 6 |
| 55 | 9.2773366 | 9.9920689 | 9.2852677 | 10.7147323 | 10.0079311 | 10.7226634 | 5 |
| 56 | 9.2779911 | 9.9920445 | 9.2859466 | 10.7140534 | 10.0079555 | 10.7220089 | 4 |
| 57 | 9.2786445 | 9.9920201 | 9.2866245 | 10.7133755 | 10.0079799 | 10.7213555 | 3 |
| 58 | 9.2792970 | 9.9919956 | 9.2873014 | 10.7126986 | 10.0080044 | 10.7207030 | 2 |
| 59 | 9.2799484 | 9.9919711 | 9.2879773 | 10.7120227 | 10.0080289 | 10.7200516 | 1 |
| 60 | 9.2805988 | 9.9919466 | 9.2886523 | 10.7113477 | 10.0080534 | 10.7194012 | 0 |
| | *L. Co-Sine.* | *L. Sine.* | *L. Co Tang.* | *L. Tangent* | *L. Co-Secant* | *L. Secant.* | M |

79 DEGREES.

11 DEGREES.

| M | *N. Sine.* | *N. Co-Sine.* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant.* | *N. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 1908090 | 9816271 | 1943803 | 51445540 | 10187168 | 52408431 | 60 |
| 1 | 1910945 | 9815716 | 1946822 | 51365763 | 10187744 | 52330121 | 59 |
| 2 | 1913800 | 9815160 | 1949841 | 51286224 | 10188321 | 52252050 | 58 |
| 3 | 1916655 | 9814603 | 1952861 | 51206921 | 10188899 | 52174216 | 57 |
| 4 | 1919510 | 9814045 | 1955881 | 51127855 | 10189478 | 52096618 | 56 |
| 5 | 1922365 | 9813486 | 1958901 | 51049024 | 10190058 | 52019254 | 55 |
| 6 | 1925220 | 9812926 | 1961922 | 50970426 | 10190639 | 51942125 | 54 |
| 7 | 1928074 | 9812366 | 1964943 | 50892061 | 10191221 | 51865228 | 53 |
| 8 | 1930928 | 9811805 | 1967964 | 50813928 | 10191804 | 51788563 | 52 |
| 9 | 1933782 | 9811243 | 1970986 | 50736025 | 10192388 | 51712128 | 51 |
| 10 | 1936636 | 9810680 | 1974008 | 50658352 | 10192973 | 51635924 | 50 |
| 11 | 1939490 | 9810116 | 1977030 | 50580907 | 10193559 | 51559948 | 49 |
| 12 | 1942344 | 9809551 | 1980053 | 50503690 | 10194146 | 51484199 | 48 |
| 13 | 1945197 | 9808986 | 1983076 | 50426700 | 10194734 | 51408677 | 47 |
| 14 | 1948050 | 9808420 | 1986100 | 50349935 | 10195323 | 51333381 | 46 |
| 15 | 1950903 | 9807853 | 1989124 | 50273395 | 10195912 | 51258309 | 45 |
| 16 | 1953756 | 9807285 | 1992148 | 50197078 | 10196502 | 51183461 | 44 |
| 17 | 1956609 | 9806716 | 1995172 | 50120984 | 10197093 | 51108835 | 43 |
| 18 | 1959461 | 9806146 | 1998197 | 50045111 | 10197685 | 51034431 | 42 |
| 19 | 1962314 | 9805576 | 2001222 | 49969459 | 10198278 | 50960248 | 41 |
| 20 | 1965166 | 9805005 | 2004248 | 49894027 | 10198872 | 50886284 | 40 |
| 21 | 1968018 | 9804433 | 2007274 | 49818813 | 10199467 | 50812539 | 39 |
| 22 | 1970870 | 9803860 | 2010300 | 49743817 | 10200063 | 50739012 | 38 |
| 23 | 1973722 | 9803286 | 2013327 | 49669037 | 10200660 | 50665701 | 37 |
| 24 | 1976573 | 9802711 | 2016354 | 49594474 | 10201258 | 50592606 | 36 |
| 25 | 1979425 | 9802136 | 2019381 | 49520125 | 10201857 | 50519726 | 35 |
| 26 | 1982276 | 9801560 | 2022409 | 49445590 | 10202457 | 50447060 | 34 |
| 27 | 1985127 | 9800983 | 2025437 | 49372068 | 10203058 | 50374607 | 33 |
| 28 | 1987978 | 9800405 | 2028465 | 49298358 | 10203660 | 50302367 | 32 |
| 29 | 1990829 | 9799826 | 2031494 | 49224859 | 10204263 | 50230337 | 31 |
| 30 | 1993679 | 9799247 | 2034523 | 49151570 | 10204867 | 50158517 | 30 |
| 31 | 1996530 | 9798667 | 2037552 | 49078491 | 10205471 | 50086907 | 29 |
| 32 | 1999380 | 9798086 | 2040582 | 49005620 | 10206076 | 50015505 | 28 |
| 33 | 2002230 | 9797504 | 2043612 | 48932956 | 10206682 | 49944311 | 27 |
| 34 | 2005080 | 9796921 | 2046643 | 48860499 | 10207289 | 49873323 | 26 |
| 35 | 2007930 | 9796337 | 2049674 | 48788248 | 10207897 | 49802541 | 25 |
| 36 | 2010779 | 9795752 | 2052705 | 48716201 | 10208506 | 49731964 | 24 |
| 37 | 2013629 | 9795167 | 2055737 | 48644359 | 10209116 | 49661591 | 23 |
| 38 | 2016478 | 9794581 | 2058769 | 48572719 | 10209727 | 49591421 | 22 |
| 39 | 2019327 | 9793994 | 2061801 | 48501282 | 10210339 | 49521453 | 21 |
| 40 | 2022176 | 9793406 | 2064834 | 48430045 | 10210952 | 49451687 | 20 |
| 41 | 2025024 | 9792817 | 2067867 | 48359010 | 10211566 | 49382120 | 19 |
| 42 | 2027873 | 9792228 | 2070900 | 48288174 | 10212181 | 49312754 | 18 |
| 43 | 2030721 | 9791638 | 2073934 | 48217536 | 10212797 | 49243586 | 17 |
| 44 | 2033569 | 9791047 | 2076968 | 48147096 | 10213414 | 49174616 | 16 |
| 45 | 2036417 | 9790455 | 2080003 | 48076854 | 10214032 | 49105844 | 15 |
| 46 | 2039265 | 9789862 | 2083038 | 48006808 | 10214650 | 49037267 | 14 |
| 47 | 2042113 | 9789268 | 2086073 | 47936957 | 10215269 | 48968886 | 13 |
| 48 | 2044961 | 9788674 | 2089109 | 47867300 | 10215889 | 48900700 | 12 |
| 49 | 2047808 | 9788079 | 2092145 | 47797837 | 10216510 | 48372707 | 11 |
| 50 | 2050655 | 9787483 | 2095181 | 47728567 | 10217132 | 48764907 | 10 |
| 51 | 2053502 | 9786886 | 2098218 | 47659490 | 10217755 | 48697299 | 9 |
| 52 | 2056349 | 9786288 | 2101255 | 47590603 | 10218379 | 48629883 | 8 |
| 53 | 2059195 | 9785689 | 2104293 | 47521907 | 10219004 | 48562657 | 7 |
| 54 | 2062042 | 9785090 | 2107331 | 47453401 | 10219630 | 48495621 | 6 |
| 55 | 2064888 | 9784498 | 2110369 | 47385083 | 10220257 | 48428774 | 5 |
| 56 | 2067734 | 6783889 | 2113407 | 47316954 | 10220885 | 48362114 | 4 |
| 57 | 2070580 | 9783287 | 2116446 | 47249012 | 10221514 | 48295643 | 3 |
| 58 | 2073426 | 9782684 | 2119485 | 47181256 | 10222144 | 48229357 | 2 |
| 59 | 2076271 | 9782080 | 2122525 | 47113686 | 10222775 | 48163258 | 1 |
| 60 | 2079117 | 9781476 | 2125565 | 47046301 | 10223407 | 48097343 | 0 |
| | *N. Co-Sine.* | *N. Sine.* | *N. Co-Tang.* | *N. Tangent.* | *N. Co-Secant.* | *N. Secant.* | M |

78 DEGREES.

11 DEGREES.

| M | L. Sine. | L. Co.Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.2805988 | 9.9919466 | 9.2886523 | 10.7113477 | 10.0080534 | 10.7194012 | 60 |
| 1 | 9.2812483 | 9.9919220 | 9.2893263 | 10.7106737 | 10.0080780 | 10.7187517 | 59 |
| 2 | 9.2818967 | 9.9918974 | 9.2899993 | 10.7100007 | 10.0081026 | 10.7181033 | 58 |
| 3 | 9.2825441 | 9.9918727 | 9.2906713 | 10.7093287 | 10.0081273 | 10.7174559 | 57 |
| 4 | 9.2831905 | 9.9918480 | 9.2913424 | 10.7086576 | 10.0081526 | 10.7168095 | 56 |
| 5 | 9.2838359 | 9.9918233 | 9.2920126 | 10.7079874 | 10.0081767 | 10.7161641 | 55 |
| 6 | 9.2844803 | 9.9917986 | 9.2926817 | 10.7073183 | 10.0082014 | 10.7155197 | 54 |
| 7 | 9.2851237 | 9.9917737 | 9.2933500 | 10.7066500 | 10.0082263 | 10.7148763 | 53 |
| 8 | 9.2857661 | 9.9917489 | 9.2940172 | 10.7059828 | 10.0082511 | 10.7142339 | 52 |
| 9 | 9.2864076 | 9.9917240 | 9.2946836 | 10.7053164 | 10.0082760 | 10.7135924 | 51 |
| 10 | 9.2870480 | 9.9916991 | 9.2953489 | 10.7046511 | 10.0083009 | 10.7129520 | 50 |
| 11 | 9.2876875 | 9.9916741 | 9.2960134 | 10.7039866 | 10.0083259 | 10.7123125 | 49 |
| 12 | 9.2883260 | 9.9916492 | 9.2966769 | 10.7033231 | 10.0083508 | 10.7116840 | 48 |
| 13 | 9.2889636 | 9.9916241 | 9.2973395 | 10.7026605 | 10.0083759 | 10.7110364 | 47 |
| 14 | 9.2896001 | 9.9915990 | 9.2980011 | 10.7019989 | 10.0084010 | 10.7103999 | 46 |
| 15 | 9.2902357 | 9.9915739 | 9.2986618 | 10.7013382 | 10.0084261 | 10.7097643 | 45 |
| 16 | 9.2908704 | 9.9915488 | 9.2993216 | 10.7006784 | 10.0084512 | 10.7091296 | 44 |
| 17 | 9.2915040 | 9.9915236 | 9.2999804 | 10.7000196 | 10.0084764 | 10.7084960 | 43 |
| 18 | 9.2921367 | 9.9914984 | 9.3006383 | 10.6993617 | 10.0085016 | 10.7078633 | 42 |
| 19 | 9.2927685 | 9.9914731 | 9.3012954 | 10.6987046 | 10.0085269 | 10.7072315 | 41 |
| 20 | 9.2933993 | 9.9914478 | 9.3019514 | 10.6980486 | 10.0085522 | 10.7066007 | 40 |
| 21 | 9.2940291 | 9.9914225 | 9.3026066 | 10.6973934 | 10.0085775 | 10.7059709 | 39 |
| 22 | 9.2946580 | 9.9913971 | 9.3032609 | 10.6967391 | 10.0086029 | 10.7053420 | 38 |
| 23 | 9.2952859 | 9.9913717 | 9.3039143 | 10.6960857 | 10.0086283 | 10.7047141 | 37 |
| 24 | 9.2959129 | 9.9913462 | 9.3045667 | 10.6954333 | 10.0086538 | 10.7040871 | 36 |
| 25 | 9.2965390 | 9.9913207 | 9.3052183 | 10.6947817 | 10.0086793 | 10.7034610 | 35 |
| 26 | 9.2971641 | 9.9912952 | 9.3058689 | 10.6941311 | 10.0087048 | 10.7028359 | 34 |
| 27 | 9.2977883 | 9.9912696 | 9.3065187 | 10.6934813 | 10.0087304 | 10.7022117 | 33 |
| 28 | 9.2984116 | 9.9912440 | 9.3071674 | 10.6928325 | 10.0087560 | 10.7015884 | 32 |
| 29 | 9.2990339 | 9.9912184 | 9.3078155 | 10.6921845 | 10.0087816 | 10.7009661 | 31 |
| 30 | 9.2996553 | 9.9911927 | 9.3084626 | 10.6915374 | 10.0088073 | 10.7003447 | 30 |
| 31 | 9.3002758 | 9.9911670 | 9.3091088 | 10.6908912 | 10.0088330 | 10.6997242 | 29 |
| 32 | 9.3008953 | 9.9911412 | 9.3097541 | 10.6902459 | 10.0088588 | 10.6991047 | 28 |
| 33 | 9.3015140 | 9.9911154 | 9.3103985 | 10.6896015 | 10.0088846 | 10.6984860 | 27 |
| 34 | 9.3021317 | 9.9910986 | 9.3110421 | 10.6889579 | 10.0089104 | 10.6978683 | 26 |
| 35 | 9.3027485 | 9.9910637 | 9.3116848 | 10.6883152 | 10.0089363 | 10.6972515 | 25 |
| 36 | 9.3033644 | 9.9910378 | 9.3123266 | 10.6876734 | 10.0089622 | 10.6966356 | 24 |
| 37 | 9.3039794 | 9.9910119 | 9.3129675 | 10.6870325 | 10.0089881 | 10.6960206 | 23 |
| 38 | 9.3045934 | 9.9909859 | 9.3136076 | 10.6863924 | 10.0090141 | 10.6954066 | 22 |
| 39 | 9.3052066 | 9.9909598 | 9.3142468 | 10.6857532 | 10.0090402 | 10.6947934 | 21 |
| 40 | 9.3058189 | 9.9909338 | 9.3148851 | 10.6851149 | 10.0090662 | 10.6941811 | 20 |
| 41 | 9.3064303 | 9.9909077 | 9.3155226 | 10.6844774 | 10.0090923 | 10.6935697 | 19 |
| 42 | 9.3070407 | 9.9908815 | 9.3161592 | 10.6838408 | 10.0091185 | 10.6929593 | 18 |
| 43 | 9.3076503 | 9.9908553 | 9.3167950 | 10.6832050 | 10.0091447 | 10.6923497 | 17 |
| 44 | 9.3082590 | 9.9908291 | 9.3174299 | 10.6825701 | 10.0091709 | 10.6917410 | 16 |
| 45 | 9.3088668 | 9.9908029 | 9.3180640 | 10.6819360 | 10.0091971 | 10.6911332 | 15 |
| 46 | 9.3094737 | 9.9907766 | 9.3186972 | 10.6813028 | 10.0092234 | 10.6905263 | 14 |
| 47 | 9.3100798 | 9.9907502 | 9.3193295 | 10.6806705 | 10.0092498 | 10.6899202 | 13 |
| 48 | 9.3106849 | 9.9907239 | 9.3199611 | 10.6800389 | 10.0092761 | 10.6893151 | 12 |
| 49 | 9.3112892 | 9.9906974 | 9.3205918 | 10.6794082 | 10.0093026 | 10.6887108 | 11 |
| 50 | 9.3118926 | 9.9906710 | 9.3212216 | 10.6787784 | 10.0093290 | 10.6881074 | 10 |
| 51 | 9.3124951 | 9.9906445 | 9.3218506 | 10.6781494 | 10.0093555 | 10.6875049 | 9 |
| 52 | 9.3130968 | 9.9906180 | 9.3224788 | 10.6775212 | 10.0093820 | 10.6869032 | 8 |
| 53 | 9.3136976 | 9.9905914 | 9.3231061 | 10.6768939 | 10.0094086 | 10.6863024 | 7 |
| 54 | 9.3142975 | 9.9905648 | 9.3237327 | 10.6762673 | 10.0094352 | 10.6857025 | 6 |
| 55 | 9.3148965 | 9.9905382 | 9.3243584 | 10.6756416 | 10.0094618 | 10.6851035 | 5 |
| 56 | 9.3154947 | 9.9905115 | 9.3249832 | 10.6750168 | 10.0094885 | 10.6845053 | 4 |
| 57 | 9.3160921 | 9.9904848 | 9.3256073 | 10.6743927 | 10.0095152 | 10.6839079 | 3 |
| 58 | 9.3166885 | 9.9904580 | 9.3262305 | 10.6737695 | 10.0095420 | 10.6833115 | 2 |
| 59 | 9.3172841 | 9.9904312 | 9.3268529 | 10.6731471 | 10.0095688 | 10.6827159 | 1 |
| 60 | 9.3178788 | 9.9904044 | 9.3274745 | 10.6725255 | 10.0095956 | 10.6821211 | 0 |
| | L. Co-Sine. | L. Sine. | L. CoTang. | L. Tangent | L. Co-Secant | L. Secant. | M |

78 DEGREES.

12 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 2079117 | 9781476 | 2125565 | 47046301 | 10223407 | 48097343 | 60 |
| 1 | 2081962 | 9780871 | 2128606 | 46979100 | 10224040 | 48031613 | 59 |
| 2 | 2084807 | 9780265 | 2131647 | 46912083 | 10224673 | 47966066 | 58 |
| 3 | 2087652 | 9779658 | 2134688 | 46845248 | 10225307 | 47900702 | 57 |
| 4 | 2090497 | 9779050 | 2137730 | 46778595 | 10225942 | 47835520 | 56 |
| 5 | 2093341 | 9778441 | 2140772 | 46712124 | 10226578 | 47770519 | 55 |
| 6 | 2096186 | 9777832 | 2143814 | 46645832 | 10227215 | 47705699 | 54 |
| 7 | 2099030 | 9777222 | 2146857 | 46579721 | 10227853 | 47641058 | 53 |
| 8 | 2101874 | 9776611 | 2149900 | 46513788 | 10228492 | 47576596 | 52 |
| 9 | 2104718 | 9775999 | 2152944 | 46448034 | 10229132 | 47512312 | 51 |
| 10 | 2107561 | 9775386 | 2155988 | 46382457 | 10229773 | 47438206 | 50 |
| 11 | 2110405 | 9774773 | 2159032 | 46317056 | 10230415 | 47384277 | 49 |
| 12 | 2113248 | 9774159 | 2162077 | 46251832 | 10231058 | 47320523 | 48 |
| 13 | 2116091 | 9773544 | 2165122 | 46186783 | 10231702 | 47256945 | 47 |
| 14 | 2118934 | 9772928 | 2168167 | 46121908 | 10232347 | 47193542 | 46 |
| 15 | 2121777 | 9772311 | 2171213 | 46057207 | 10232993 | 47130313 | 45 |
| 16 | 2124619 | 9771693 | 2174259 | 45992680 | 10233640 | 47067256 | 44 |
| 17 | 2127462 | 9771075 | 2177306 | 45928325 | 10234288 | 47004372 | 43 |
| 18 | 2130304 | 9770456 | 2180353 | 45864141 | 10234937 | 46941660 | 42 |
| 19 | 2133146 | 9769836 | 2183400 | 45800129 | 10235587 | 46879119 | 41 |
| 20 | 2135988 | 9769215 | 2186448 | 45736287 | 10236238 | 46816748 | 40 |
| 21 | 2138829 | 9768593 | 2189496 | 45672614 | 10236890 | 46754548 | 39 |
| 22 | 2141671 | 9767970 | 2192544 | 45609111 | 10237543 | 46692516 | 38 |
| 23 | 2144512 | 9767347 | 2195593 | 45545776 | 10238196 | 46630652 | 37 |
| 24 | 2147353 | 9766723 | 2198642 | 45482608 | 10238850 | 46568956 | 36 |
| 25 | 2150194 | 9766098 | 2201692 | 45419608 | 10239505 | 46507427 | 35 |
| 26 | 2153035 | 9765472 | 2204742 | 45356773 | 10240161 | 46446064 | 34 |
| 27 | 2155876 | 9764845 | 2207793 | 45294105 | 10240818 | 46384867 | 33 |
| 28 | 2158716 | 9764217 | 2210844 | 45231601 | 10241476 | 46323835 | 32 |
| 29 | 2161556 | 9763589 | 2213895 | 45169261 | 10242135 | 46262967 | 31 |
| 30 | 2164396 | 9762960 | 2216947 | 45107085 | 10242795 | 46202263 | 30 |
| 31 | 2167236 | 9762330 | 2219999 | 45045072 | 10243456 | 46141722 | 29 |
| 32 | 2170076 | 9761699 | 2223051 | 44983221 | 10244118 | 46081343 | 28 |
| 33 | 2172915 | 9761067 | 2226104 | 44921532 | 10244781 | 46021126 | 27 |
| 34 | 2175754 | 9760435 | 2229157 | 44860004 | 10245445 | 45961070 | 26 |
| 35 | 2178593 | 9759802 | 2232211 | 44798636 | 10246110 | 45901174 | 25 |
| 36 | 2181432 | 9759168 | 2235265 | 44737428 | 10246776 | 45841439 | 24 |
| 37 | 2184271 | 9758533 | 2238319 | 44676379 | 10247443 | 45781862 | 23 |
| 38 | 2187110 | 9757897 | 2241374 | 44615489 | 10248111 | 45722444 | 22 |
| 39 | 2189948 | 9757260 | 2244429 | 44554756 | 10248780 | 45663183 | 21 |
| 40 | 2192786 | 9756623 | 2247485 | 44494181 | 10249449 | 45604080 | 20 |
| 41 | 2195624 | 9755985 | 2250541 | 44433762 | 10250119 | 45545134 | 19 |
| 42 | 2198462 | 9755346 | 2253597 | 44373495 | 10250790 | 45486344 | 18 |
| 43 | 2201300 | 9754706 | 2256654 | 44313392 | 10251462 | 45427709 | 17 |
| 44 | 2204137 | 9754065 | 2259711 | 44253439 | 10252135 | 45369229 | 16 |
| 45 | 2206974 | 9753423 | 2262769 | 44193641 | 10252809 | 45310903 | 15 |
| 46 | 2209811 | 9752781 | 2265827 | 44133996 | 10253484 | 45252730 | 14 |
| 47 | 2212648 | 9752138 | 2268885 | 44074504 | 10254160 | 45194711 | 13 |
| 48 | 2215485 | 9751494 | 2271944 | 44015164 | 10254837 | 45136844 | 12 |
| 49 | 2218321 | 9750849 | 2271003 | 43955976 | 10255515 | 45079129 | 11 |
| 50 | 2221158 | 9750203 | 2278063 | 43896940 | 10256194 | 45021565 | 10 |
| 51 | 2223994 | 9749556 | 2281123 | 43838054 | 10256874 | 44964152 | 9 |
| 52 | 2226830 | 9748909 | 2284183 | 43779317 | 10257555 | 44906889 | 8 |
| 53 | 2229666 | 9748261 | 2287244 | 43720731 | 10258237 | 44849775 | 7 |
| 54 | 2232501 | 9747612 | 2290305 | 43662293 | 10258920 | 44792810 | 6 |
| 55 | 2235337 | 9746962 | 2293367 | 43604003 | 102596 | 44735993 | 5 |
| 56 | 2238172 | 9746311 | 2296429 | 43545861 | 1026028 | 44679324 | 4 |
| 57 | 2241007 | 9745660 | 2299492 | 43487866 | 1026097 | 44622802 | 3 |
| 58 | 2243841 | 9745008 | 2302555 | 43430018 | 10261662 | 44566428 | 2 |
| 59 | 2246676 | 9744355 | 2305618 | 43372316 | 10262350 | 44510198 | 1 |
| 60 | 2249511 | 9743701 | 2308682 | 43314759 | 10263039 | 44454115 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant. | M |

77 DEGREES.

12 DEGREES.

| M. | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.3178789 | 9.9904044 | 9.3274745 | 10.6725255 | 10.0095956 | 10.6821211 | 60 |
| 1 | 9.3184728 | 9.9903775 | 9.3280953 | 10.6719047 | 10.0096225 | 10.6815272 | 59 |
| 2 | 9.3190659 | 9.9903506 | 9.3287153 | 10.6712847 | 10.0096494 | 10.6809341 | 58 |
| 3 | 9.3196581 | 9.9908237 | 9.3293345 | 10.6706655 | 10.0096763 | 10.6803419 | 57 |
| 4 | 9.3202495 | 9.9902967 | 9.3299528 | 10.6700472 | 10.0097033 | 10.6797505 | 56 |
| 5 | 9.3208400 | 9.9902697 | 9.3305704 | 10.6694296 | 10.0097303 | 10.6791600 | 55 |
| 6 | 9.3214297 | 9.9902426 | 9.3311872 | 10.6688128 | 10.0097574 | 10.6785703 | 54 |
| 7 | 9.3220186 | 9.9902155 | 9.3318031 | 10.6681969 | 10.0097845 | 10.6779814 | 53 |
| 8 | 9.3226066 | 9.9901883 | 9.3324183 | 10.6675817 | 10.0098117 | 10.6773934 | 52 |
| 9 | 9.3231938 | 9.9901612 | 9.3330327 | 10.6669673 | 10.0098388 | 10.6768062 | 51 |
| 10 | 9.3237802 | 9.9901339 | 9.3336463 | 10.6663537 | 10.0098661 | 10.6762198 | 50 |
| 11 | 9.3243657 | 9.9901067 | 9.3342591 | 10.6657409 | 10.0098933 | 10.6756383 | 49 |
| 12 | 9.3249505 | 9.9900794 | 9.3348711 | 10.6651289 | 10.0099206 | 10.6750495 | 48 |
| 13 | 9.3255344 | 9.9900521 | 9.3354823 | 10.6645177 | 10.0099479 | 10.6744656 | 47 |
| 14 | 9.3261174 | 9.9900247 | 9.3360927 | 10.6639073 | 10.0099753 | 10.6738826 | 46 |
| 15 | 9.3266997 | 9.9899973 | 9.3367024 | 10.6632976 | 10.0100027 | 10.6733003 | 45 |
| 16 | 9.3272811 | 9.9899698 | 9.3373113 | 10.6526887 | 10.0100302 | 10.6727189 | 44 |
| 17 | 9.3278617 | 9.9899423 | 9.3379194 | 10.6620806 | 10.0100577 | 10.6721383 | 43 |
| 18 | 9.3284416 | 9.9899148 | 9.3385267 | 10.6614733 | 10.0100852 | 10.6715584 | 42 |
| 19 | 9.3290206 | 9.9898873 | 9.3391333 | 10.6608667 | 10.0101127 | 10.6709794 | 41 |
| 20 | 9.3295988 | 9.9898597 | 9.3397391 | 10.6602609 | 10.0101403 | 10.6704012 | 40 |
| 21 | 9.3301771 | 9.9898320 | 9.3403441 | 10.6596559 | 10.0101690 | 10.6698239 | 39 |
| 22 | 9.3307527 | 9.9898043 | 9.3409484 | 10.6590516 | 10.0101957 | 10.6692473 | 38 |
| 23 | 9.3313285 | 9.9897766 | 9.3415519 | 10.6584481 | 10.0102234 | 10.6686715 | 37 |
| 24 | 9.3319035 | 9.9897489 | 9.3421546 | 10.6578454 | 10.0102511 | 10.6680965 | 36 |
| 25 | 9.3324777 | 9.9897211 | 9.3427566 | 10.6572434 | 10.0102789 | 10.6675223 | 35 |
| 26 | 9.3330511 | 9.9896932 | 9.3433578 | 10.6566422 | 10.0103068 | 10.6669489 | 34 |
| 27 | 9.3336237 | 9.9896654 | 9.3439583 | 10.6560417 | 10.0103346 | 10.6667763 | 33 |
| 28 | 9.3341955 | 9.9896374 | 9.3445580 | 10.6554420 | 10.0103626 | 10.6658045 | 32 |
| 29 | 9.3347665 | 9.9896095 | 9.3451570 | 10.6548430 | 10.0103905 | 10.6652335 | 31 |
| 30 | 9.3353368 | 9.9895815 | 9.3457552 | 10.6542448 | 10.0104185 | 10.6646632 | 30 |
| 31 | 9.3359062 | 9.9895535 | 9.3463527 | 10.6536473 | 10.0104465 | 10.6640938 | 29 |
| 32 | 9.3364749 | 9.9895254 | 9.3469494 | 10.6530506 | 10.0104746 | 10.6635251 | 28 |
| 33 | 9.3370428 | 9.9894973 | 9.3475454 | 10.6524546 | 10.0105027 | 10.6629572 | 27 |
| 34 | 9.3376099 | 9.9894692 | 9.3481407 | 10.6518593 | 10.0105308 | 10.6623901 | 26 |
| 35 | 9.3381762 | 9.9894410 | 9.3487352 | 10.6512648 | 10.0105590 | 10.6618274 | 25 |
| 36 | 9.3387418 | 9.9894128 | 9.3493290 | 10.6506710 | 10.0105872 | 10.6612582 | 24 |
| 37 | 9.3393065 | 9.9893845 | 9.3499220 | 10.6500780 | 10.0106155 | 10.6606935 | 23 |
| 38 | 9.3398706 | 9.9893562 | 9.3505143 | 10.6494857 | 10.0106438 | 10.6601293 | 22 |
| 39 | 9.3404338 | 9.9893279 | 9.3511059 | 10.6488941 | 10.0106721 | 10.6595662 | 21 |
| 40 | 9.3409963 | 9.9892995 | 9.3516968 | 10.6483032 | 10.0107005 | 10.6590037 | 20 |
| 41 | 9.3415580 | 9.9892711 | 9.3522869 | 10.6477131 | 10.0107289 | 10.6584420 | 19 |
| 42 | 9.3421190 | 9.9892427 | 9.3528763 | 10.6471237 | 10.0107573 | 10.6578810 | 18 |
| 43 | 9.3426792 | 9.9892142 | 9.3534650 | 10.6465350 | 10.0107858 | 10.6573208 | 17 |
| 44 | 9.3432386 | 9.9891856 | 9.3540530 | 10.6459470 | 10.0108144 | 10.6567614 | 16 |
| 45 | 9.3437973 | 9.9891571 | 9.3546402 | 10.6453598 | 10.0108429 | 10.6562027 | 15 |
| 46 | 9.3443552 | 9.9891285 | 9.3552267 | 10.6446733 | 10.0108716 | 10.6556448 | 14 |
| 47 | 9.3449124 | 9.9890998 | 9.3558126 | 10.6441874 | 10.0109002 | 10.6550876 | 13 |
| 48 | 9.3454688 | 9.9890711 | 9.3563977 | 10.6436023 | 10.0109289 | 10.6545312 | 12 |
| 49 | 9.3460245 | 9.9890424 | 9.3569821 | 10.6430179 | 10.0109576 | 10.6539755 | 11 |
| 50 | 9.3465794 | 9.9890137 | 9.3575658 | 10.6424342 | 10.0109863 | 10.6534206 | 10 |
| 51 | 9.3471336 | 9.9889849 | 9.3581487 | 10.6418513 | 10.0110151 | 10.6528664 | 9 |
| 52 | 9.3476870 | 9.9889560 | 9.3587310 | 10.6412690 | 10.0110440 | 10.6523130 | 8 |
| 53 | 9.3482397 | 9.9889271 | 9.3595126 | 10.6406874 | 10.0110729 | 10.6517603 | 7 |
| 54 | 9.3487917 | 9.9888982 | 9.3598935 | 10.6401065 | 10.0111018 | 10.6512083 | 6 |
| 55 | 9.3493429 | 9.9888693 | 9.3604736 | 10.6395264 | 10.0111307 | 10.6506561 | 5 |
| 56 | 9.3498934 | 9.9888403 | 9.3610531 | 10.6389469 | 10.0111597 | 10.6501066 | 4 |
| 57 | 9.3504432 | 9.9888113 | 9.3616319 | 10.6383681 | 10.0111887 | 10.6495568 | 3 |
| 58 | 9.3509922 | 9.9887822 | 9.3622100 | 10.6377900 | 10.0112178 | 10.6490078 | 2 |
| 59 | 9.3515405 | 9.9887531 | 9.3627874 | 10.6372126 | 10.0112469 | 10.6484595 | 1 |
| 60 | 9.3520880 | 9.9887239 | 9.3633641 | 10.6366359 | 10.0112761 | 10.6479120 | 0 |
| | L. Co-Sine. | L. Sine | L. Co-Tang. | L. Tangent | L. Co-Secant. | L. Secant. | M |

77 DEGREES.

13 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 2249511 | 9743701 | 2308682 | 43314759 | 10263039 | 44454115 | 60 |
| 1 | 2252345 | 9743046 | 2311746 | 43257347 | 10263729 | 44398176 | 59 |
| 2 | 2255179 | 9742390 | 2314811 | 43200079 | 10264420 | 44342382 | 58 |
| 3 | 2258013 | 9741734 | 2317876 | 43142955 | 10265112 | 44286731 | 57 |
| 4 | 2260846 | 9741077 | 2320941 | 43085974 | 10265805 | 44231224 | 56 |
| 5 | 2263680 | 9740419 | 2324007 | 43029136 | 10266499 | 44175859 | 55 |
| 6 | 2266513 | 9739760 | 2327073 | 42972440 | 10267194 | 44120637 | 54 |
| 7 | 2269346 | 9739100 | 2330140 | 42915885 | 10267890 | 44065556 | 53 |
| 8 | 2272179 | 9738439 | 2333207 | 42859472 | 10268587 | 44010616 | 52 |
| 9 | 2275012 | 9737778 | 2336274 | 42803199 | 10269284 | 43955817 | 51 |
| 10 | 2277844 | 9737116 | 2339342 | 42747066 | 10269982 | 43901158 | 50 |
| 11 | 2280677 | 9736453 | 2342410 | 42691072 | 10270681 | 43846638 | 49 |
| 12 | 2283509 | 9735789 | 2345479 | 42635218 | 10271381 | 43792257 | 48 |
| 13 | 2286341 | 9735124 | 2348548 | 42579501 | 10272082 | 43738015 | 47 |
| 14 | 2289172 | 9734458 | 2351617 | 42523923 | 10272784 | 43683910 | 46 |
| 15 | 2292004 | 9733792 | 2354687 | 42468482 | 10273487 | 43629943 | 45 |
| 16 | 2294835 | 9733125 | 2357758 | 42413177 | 10274191 | 43576113 | 44 |
| 17 | 2297666 | 9732457 | 2360829 | 42358009 | 10274896 | 43522419 | 43 |
| 18 | 2300497 | 9731788 | 2363900 | 42302977 | 10275602 | 43468861 | 42 |
| 19 | 2303328 | 9731118 | 2366972 | 42248080 | 10276309 | 43415438 | 41 |
| 20 | 2306159 | 9730448 | 2370044 | 42193318 | 10277017 | 43362150 | 40 |
| 21 | 2308989 | 9729777 | 2373116 | 42138690 | 10277726 | 43308996 | 39 |
| 22 | 2311819 | 9729105 | 2376189 | 42084196 | 10278436 | 43255977 | 38 |
| 23 | 2314649 | 9728432 | 2379262 | 42029835 | 10279147 | 43203090 | 37 |
| 24 | 2317479 | 9727758 | 2382336 | 41975606 | 10279859 | 43150336 | 36 |
| 25 | 2320309 | 9727084 | 2385410 | 41921510 | 10280572 | 43097715 | 35 |
| 26 | 2323138 | 9726409 | 2388485 | 41867546 | 10281286 | 43045225 | 34 |
| 27 | 2325967 | 9725733 | 2391560 | 41813713 | 10282001 | 42992867 | 33 |
| 28 | 2328796 | 9725056 | 2394635 | 41760011 | 10282717 | 42940640 | 32 |
| 29 | 2331625 | 9724378 | 2397711 | 41706440 | 10283434 | 42888543 | 31 |
| 30 | 2334454 | 9723699 | 2400787 | 41652998 | 10284152 | 42836576 | 30 |
| 31 | 2337282 | 9723019 | 2403864 | 41599685 | 10284871 | 42784738 | 29 |
| 32 | 2340110 | 9722339 | 2406941 | 41546501 | 10285591 | 42733029 | 28 |
| 33 | 2342938 | 9721658 | 2410019 | 41493446 | 10286312 | 42681449 | 27 |
| 34 | 2345766 | 9720976 | 2413097 | 41440519 | 10287034 | 42629996 | 26 |
| 35 | 2348594 | 9720293 | 2416176 | 41387719 | 10287757 | 42578671 | 25 |
| 36 | 2351421 | 9719609 | 2419255 | 41335046 | 10288481 | 42527474 | 24 |
| 37 | 2354248 | 9718925 | 2422334 | 41282499 | 10289206 | 42476402 | 23 |
| 38 | 2357075 | 9718240 | 2425414 | 41230079 | 10289932 | 42425457 | 22 |
| 39 | 2359902 | 9717554 | 2428494 | 41177784 | 10290658 | 42374637 | 21 |
| 40 | 2362729 | 9716867 | 2431575 | 41125614 | 10291385 | 42323943 | 20 |
| 41 | 2365555 | 9716179 | 2434656 | 41073569 | 10292113 | 42273373 | 19 |
| 42 | 2368381 | 9715491 | 2437737 | 41021649 | 10292842 | 42222928 | 18 |
| 43 | 2371207 | 9714802 | 2440819 | 40969852 | 10293572 | 42172606 | 17 |
| 44 | 2374033 | 9714112 | 2443901 | 40918178 | 10294303 | 42122408 | 16 |
| 45 | 2376859 | 9713421 | 2446984 | 40866627 | 10295035 | 42072333 | 15 |
| 46 | 2379684 | 9712729 | 2450067 | 40815199 | 10295768 | 42022380 | 14 |
| 47 | 2382510 | 9712036 | 2453151 | 40763892 | 10296502 | 41972549 | 13 |
| 48 | 2385335 | 9711343 | 2456235 | 40712707 | 10297237 | 41922840 | 12 |
| 49 | 2388159 | 9710649 | 2459320 | 40661643 | 10297973 | 41873252 | 11 |
| 50 | 2390984 | 9709954 | 2462405 | 40610700 | 10298710 | 41823785 | 10 |
| 51 | 2393808 | 9709258 | 2465491 | 40559877 | 10299448 | 41774438 | 9 |
| 52 | 2396633 | 9708561 | 2468577 | 40509174 | 10300187 | 41725210 | 8 |
| 53 | 2399457 | 9707863 | 2471663 | 40458590 | 10300927 | 41676102 | 7 |
| 54 | 2402280 | 9707165 | 2474750 | 40408125 | 10301668 | 41627114 | 6 |
| 55 | 2405104 | 9706466 | 2477837 | 40357779 | 10302410 | 41578243 | 5 |
| 56 | 2407927 | 9705766 | 2480925 | 40307550 | 10303153 | 41529491 | 4 |
| 57 | 2410751 | 9705065 | 2484013 | 40257440 | 10303897 | 41480856 | 3 |
| 58 | 2413574 | 9704363 | 2487102 | 40207446 | 10304642 | 41432339 | 2 |
| 59 | 2416396 | 9703660 | 2490191 | 40157570 | 10305388 | 41383939 | 1 |
| 60 | 2419219 | 9702957 | 2493280 | 40107809 | 10306135 | 41335655 | 0 |
| | N Co-Sine. | N. Sine. | N .Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

76 DEGREES.

13 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co.Tang.* | *L. Secant.* | *L Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.3520880 | 9.9887239 | 9.3633641 | 10.6366359 | 10.0112761 | 10.6479120 | 60 |
| 1 | 9.3526349 | 9.9886947 | 9.3639401 | 10.6360599 | 10.0113053 | 10.6473651 | 59 |
| 2 | 9.3531810 | 9.9886655 | 9.3645155 | 10.6354845 | 10.0113345 | 10.6468190 | 58 |
| 3 | 9.3537264 | 9.9886363 | 9.3650901 | 10.6349099 | 10.0113637 | 10.6462636 | 57 |
| 4 | 9.3542710 | 9.9886070 | 9.3656641 | 10.6343359 | 10.0113930 | 10.6457290 | 56 |
| 5 | 9.3548150 | 9.9885776 | 9.3662374 | 10.6337626 | 10.0114224 | 10.6451850 | 55 |
| 6 | 9.3553582 | 9.9885482 | 9.3668100 | 10.6337900 | 10.0114518 | 10.6446418 | 54 |
| 7 | 9.3559149 | 9.9885188 | 9.3673819 | 10.6326181 | 10.0114812 | 10.6440993 | 53 |
| 8 | 9.3564426 | 9.9884894 | 9.3679532 | 10.6320468 | 10.0115106 | 10.6435574 | 52 |
| 9 | 9.3569836 | 9.9884599 | 9.3685238 | 10.6314762 | 10.0115401 | 10.6430164 | 51 |
| 10 | 9.3575240 | 9.9884303 | 9.3690937 | 10.6309063 | 10.0115697 | 10.6424760 | 50 |
| 11 | 9.3580637 | 9.9884008 | 9.3696629 | 10.6303371 | 10.0115992 | 10.6419363 | 49 |
| 12 | 9.3586027 | 9.9883712 | 9.3702315 | 10.6297685 | 10.0116288 | 10.6413973 | 48 |
| 13 | 9.3591409 | 9.9883415 | 9.3707994 | 10.6292006 | 10.0116585 | 10.6408591 | 47 |
| 14 | 9.3596785 | 9.9883118 | 9.3713657 | 10.6286333 | 10.0116882 | 10.6403215 | 46 |
| 15 | 9.3602154 | 9.9882821 | 9.3719333 | 10.6280667 | 10.0117179 | 10.6397846 | 45 |
| 16 | 9.3607515 | 9.9882523 | 9.3724992 | 10.6275008 | 10.0117477 | 10.6392485 | 44 |
| 17 | 9.3612870 | 9.9882225 | 9.3730645 | 10.6269355 | 10.0117775 | 10.6387130 | 43 |
| 18 | 9.3618217 | 9.9881927 | 9.3736291 | 10.6263709 | 10.0118073 | 10.6381783 | 42 |
| 19 | 9.3623558 | 9.9881628 | 9.3741930 | 10.6258070 | 10.0118372 | 10.6376442 | 41 |
| 20 | 9.3628892 | 9.9881329 | 9.3747563 | 10.6252437 | 10.0118671 | 10.6371108 | 40 |
| 21 | 9.3634219 | 9.9881029 | 9.3753190 | 10.6246810 | 10.0118971 | 10.6365781 | 39 |
| 22 | 9.3639539 | 9.9880729 | 9.3758810 | 10.6241190 | 10.0119271 | 10.6360461 | 38 |
| 23 | 9.3644852 | 9.9880429 | 9.3764423 | 10.6235577 | 10.0119571 | 10.6355148 | 37 |
| 24 | 9.3650158 | 9.9880128 | 9.3770030 | 10.6229970 | 10.0119872 | 10.6349842 | 36 |
| 25 | 9.3655458 | 9.9879826 | 9.3775631 | 10.6224369 | 10.0120173 | 10.6341542 | 35 |
| 26 | 9.3660750 | 9.9879525 | 9.3781225 | 10.6218775 | 10.0120475 | 10.6339250 | 34 |
| 27 | 9.3666036 | 9.9879223 | 9.3786813 | 10.6213187 | 10.0120777 | 10.6333964 | 33 |
| 28 | 9.3671315 | 9.9878921 | 9.3792394 | 10.6207606 | 10.0121079 | 10.6328685 | 32 |
| 29 | 9.3676587 | 9.9878618 | 9.3797969 | 10.6202031 | 10.0121382 | 10.6323413 | 31 |
| 30 | 9.3681853 | 9.9878315 | 9.3803537 | 10.6196463 | 10.0121685 | 10.6318147 | 30 |
| 31 | 9.3687111 | 9.9878012 | 9.3809100 | 10.6190900 | 10.0121988 | 10.6312889 | 29 |
| 32 | 9.3692363 | 9.9877708 | 9.3814655 | 10.6185345 | 10.0122292 | 10.6307637 | 28 |
| 33 | 9.3697608 | 9.9877404 | 9.3820205 | 10.6179795 | 10.0122596 | 10.6302392 | 27 |
| 34 | 9.3702847 | 9.9877099 | 9.3825748 | 10.6174252 | 10.0122901 | 10.6297153 | 26 |
| 35 | 9.3708079 | 9.9876794 | 9.3831285 | 10.6168715 | 10.0123206 | 10.6291921 | 25 |
| 36 | 9.3713304 | 9.9876488 | 9.3836816 | 10.6163184 | 10.0123512 | 10.6286696 | 24 |
| 37 | 9.3718523 | 9.9876183 | 9.3842340 | 10.6157660 | 10.0123817 | 10.6281477 | 23 |
| 38 | 9.3723735 | 9.9875876 | 9.3847858 | 10.6152142 | 10.0124124 | 10.6276265 | 22 |
| 39 | 9.3728940 | 9.9875570 | 9.3853370 | 10.6146630 | 10.0124430 | 10.6271060 | 21 |
| 40 | 9.3734139 | 9.9875263 | 9.3858876 | 10.6141124 | 10.0124737 | 10.6265861 | 20 |
| 41 | 9.3739331 | 9.9874955 | 9.3864376 | 10.6135624 | 10.0125045 | 10.6260669 | 19 |
| 42 | 9.3744517 | 9.9874648 | 9.3869869 | 10.6130131 | 10.0125352 | 10.6255483 | 18 |
| 43 | 9.3749696 | 9.9874339 | 9.3875356 | 10.6124644 | 10.0125661 | 10.6250304 | 17 |
| 44 | 9.3754868 | 9.9874031 | 9.3880837 | 10.6119163 | 10.0125969 | 10.6245132 | 16 |
| 45 | 9.3760034 | 9.9873722 | 9.3886312 | 10.6113688 | 10.0126278 | 10.6239966 | 15 |
| 46 | 9.3765194 | 9.9873413 | 9.3891781 | 10.6108219 | 10.0126587 | 10.6234806 | 14 |
| 47 | 9.3770347 | 9.9873103 | 9.3897244 | 10.6102756 | 10.0126897 | 10.6229653 | 13 |
| 48 | 9.3775493 | 9.9872793 | 9.3902700 | 10.6097300 | 10.0127207 | 10.6224507 | 12 |
| 49 | 9.3780633 | 9.9872482 | 9.3908151 | 10.6091849 | 10.0127518 | 10.6219367 | 11 |
| 50 | 9.3785767 | 9.9872171 | 9.3913595 | 10.6086405 | 10.0127829 | 10.6214233 | 10 |
| 51 | 9.3790894 | 9.9871860 | 9.3919034 | 10.6080966 | 10.0128140 | 10.6209106 | 9 |
| 52 | 9.3796015 | 9.9871549 | 9.3924466 | 10.6075534 | 10.0128451 | 10.6203985 | 8 |
| 53 | 9.3801129 | 9.9871236 | 9.3929893 | 10.6070107 | 10.0128764 | 10.6198871 | 7 |
| 54 | 9.3806237 | 9.9870924 | 9.3935313 | 10.6064687 | 10.0129076 | 10.6193763 | 6 |
| 55 | 9.3811339 | 9.9870611 | 9.3940727 | 10.6059273 | 10.0129389 | 10.6188661 | 5 |
| 56 | 9.3816434 | 9.9870298 | 9.3946136 | 10.6053864 | 10.0129702 | 10.6185366 | 4 |
| 57 | 9.3821523 | 9.9869984 | 9.3951538 | 10.6048462 | 10.0130016 | 10.6178477 | 3 |
| 58 | 9.3826605 | 9.9869670 | 9.3956935 | 10.6043065 | 10.0130330 | 10.6173395 | 2 |
| 59 | 9.3831682 | 9.9869356 | 9.3962326 | 10.6037674 | 10.0130644 | 10.6168318 | 1 |
| 60 | 9.3836752 | 9.9869041 | 9.3967711 | 10.6032289 | 10.0130959 | 10.6163248 | 0 |
| | *L. Co-Sine* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant.* | *L. Secant.* | M |

76 DEGREES.

14 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N. Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 2419219 | 9702957 | 2493280 | 40107809 | 10306135 | 41335655 | 60 |
| 1 | 2422041 | 9702253 | 2496370 | 40058165 | 10306583 | 41287487 | 59 |
| 2 | 2424863 | 9701548 | 2499460 | 40008636 | 10307632 | 41239435 | 58 |
| 3 | 2427685 | 9700842 | 2502551 | 39959243 | 10308382 | 41191498 | 57 |
| 4 | 2430507 | 9700135 | 2505642 | 39909924 | 10309133 | 41143675 | 56 |
| 5 | 2433329 | 9699428 | 2508734 | 39860739 | 10309885 | 41095967 | 55 |
| 6 | 2436150 | 9698720 | 2511826 | 39811669 | 10310638 | 41048374 | 54 |
| 7 | 2438971 | 9698011 | 2514919 | 39762712 | 10311392 | 41000893 | 53 |
| 8 | 2441792 | 9697301 | 2518012 | 39713868 | 10312147 | 40953526 | 52 |
| 9 | 2444613 | 9696590 | 2521106 | 39665137 | 10312903 | 40906272 | 51 |
| 10 | 2447433 | 9695879 | 2524200 | 39616518 | 10313660 | 40859130 | 50 |
| 11 | 2450254 | 9695167 | 2527294 | 39568011 | 10314418 | 40812100 | 49 |
| 12 | 2453074 | 9694454 | 2530589 | 39519615 | 10315177 | 40765281 | 48 |
| 13 | 2455894 | 9693740 | 2533484 | 39471331 | 10315936 | 40718374 | 47 |
| 14 | 2458713 | 9693025 | 2536580 | 39423157 | 10316697 | 40671677 | 46 |
| 15 | 2461533 | 9692309 | 2539676 | 39375084 | 10317459 | 40625091 | 45 |
| 16 | 2464352 | 9691592 | 2542733 | 39327141 | 10318222 | 40578615 | 44 |
| 17 | 2467171 | 9690875 | 2545870 | 39279297 | 10318985 | 40532249 | 43 |
| 18 | 2469990 | 9690157 | 2548968 | 39281563 | 10319750 | 40485992 | 42 |
| 19 | 2172809 | 9689438 | 2552066 | 39183937 | 10320516 | 40439844 | 41 |
| 20 | 2475627 | 9688718 | 2555165 | 39136420 | 10321282 | 40393804 | 40 |
| 21 | 2478445 | 9687998 | 2558264 | 39089011 | 10322050 | 40347872 | 39 |
| 22 | 2481263 | 9687277 | 2561363 | 39041710 | 10322818 | 40302048 | 38 |
| 23 | 2484087 | 9686555 | 2564463 | 38994516 | 10323588 | 40256332 | 37 |
| 24 | 2487899 | 9685832 | 2567563 | 38947429 | 10324359 | 40210722 | 36 |
| 25 | 2489716 | 9685108 | 2570664 | 38900448 | 10325130 | 40165219 | 35 |
| 26 | 2492533 | 9684383 | 2573766 | 38853574 | 10325903 | 40119823 | 34 |
| 27 | 2495350 | 9683657 | 2576868 | 38806805 | 10326676 | 40074532 | 33 |
| 28 | 2498167 | 9682931 | 2579970 | 38760142 | 10327451 | 40029347 | 32 |
| 29 | 2500984 | 9682204 | 2583073 | 38713584 | 10328227 | 39984267 | 31 |
| 30 | 2503800 | 9681476 | 2586176 | 38667131 | 10329003 | 39939292 | 30 |
| 31 | 2506616 | 9680747 | 2589280 | 38620782 | 10329781 | 39894421 | 29 |
| 32 | 2509432 | 9680018 | 2592384 | 38574537 | 10330559 | 39849654 | 28 |
| 33 | 2512248 | 9679288 | 2595488 | 38528396 | 10331339 | 39804991 | 27 |
| 34 | 2515063 | 9678557 | 2598593 | 38482358 | 10332119 | 39760431 | 26 |
| 35 | 2517879 | 9677825 | 2601699 | 38436424 | 10332901 | 39715975 | 25 |
| 36 | 2520694 | 9677092 | 2604805 | 38390591 | 10333683 | 39671621 | 24 |
| 37 | 2523508 | 9676358 | 2607911 | 38344861 | 10334467 | 39627369 | 23 |
| 38 | 2526323 | 9675623 | 2611018 | 38299233 | 10335251 | 39583219 | 22 |
| 39 | 2529137 | 9674888 | 2614126 | 38253707 | 10336037 | 39539171 | 21 |
| 40 | 2531952 | 9674152 | 2617234 | 38208281 | 10336823 | 39495224 | 20 |
| 41 | 2534766 | 9673415 | 2620342 | 38162957 | 10337611 | 39451379 | 19 |
| 42 | 2537579 | 9672677 | 2623451 | 38127733 | 10338399 | 39407633 | 18 |
| 43 | 2540393 | 9671938 | 2626560 | 38072609 | 10339188 | 39363988 | 17 |
| 44 | 2543206 | 9671199 | 2629670 | 38027585 | 10339979 | 39320443 | 16 |
| 45 | 2546019 | 9670459 | 2632780 | 37982661 | 10340770 | 39276997 | 15 |
| 46 | 2548832 | 9669718 | 2635891 | 37937835 | 10341563 | 39233651 | 14 |
| 47 | 2551645 | 9668976 | 2639002 | 37893109 | 10342356 | 39190403 | 13 |
| 48 | 2554458 | 9668233 | 2642114 | 37848481 | 10343151 | 39147254 | 12 |
| 49 | 2557270 | 9667490 | 2645226 | 37803951 | 10343946 | 39104203 | 11 |
| 50 | 2560082 | 9666746 | 2648339 | 37759519 | 10344743 | 39061250 | 10 |
| 51 | 2562894 | 9666001 | 2651452 | 37715185 | 10345540 | 39018395 | 9 |
| 52 | 2565705 | 9665255 | 2654566 | 37670947 | 10346338 | 38975637 | 8 |
| 53 | 2568517 | 9664508 | 2657680 | 37626807 | 10347138 | 38932976 | 7 |
| 54 | 2571328 | 9663760 | 2660794 | 37582763 | 10347938 | 38890411 | 6 |
| 55 | 2574139 | 9663012 | 2663909 | 37538815 | 10348740 | 38847943 | 5 |
| 56 | 2576950 | 9662263 | 2667025 | 37494963 | 10349542 | 38805570 | 4 |
| 57 | 2579760 | 9661513 | 2670141 | 37451207 | 10350346 | 38763293 | 3 |
| 58 | 2582570 | 9660762 | 2673257 | 37407546 | 10351150 | 38721112 | 2 |
| 59 | 2585381 | 9660010 | 2676374 | 37363980 | 10351955 | 38679025 | 1 |
| 60 | 2588190 | 9659258 | 2679492 | 37320508 | 10352762 | 38637033 | 0 |
| | N Co-Sine. | N. Sine. | N Co Tang. | N. Tangent. | N Co-Secant. | N. Secant | M |

75 DEGREES.

14 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co. Tang.* | *L. Secant.* | *L. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.3836752 | 9.9869041 | 9.3967711 | 10.6032289 | 10.0130959 | 10.6163248 | 60 |
| 1 | 9.3841815 | 9.9868726 | 9.3973089 | 10.6026911 | 10.0131274 | 10.6158185 | 59 |
| 2 | 9.3846872 | 9.9868410 | 9.3978463 | 10.6021537 | 10.0131590 | 10.6153127 | 58 |
| 3 | 9.3851924 | 9.9868094 | 9.3983830 | 10.6016170 | 10.0131906 | 10.6148076 | 57 |
| 4 | 9.3856969 | 9.9867778 | 9 3989191 | 10.6010809 | 10.0132222 | 10.6143031 | 56 |
| 5 | 9.3862008 | 9.9867461 | 9.3994547 | 10.6005453 | 10.0132539 | 10.6137992 | 55 |
| 6 | 9.3867040 | 9.9867144 | 9.3999896 | 10.6000104 | 10.0132856 | 10.6132960 | 54 |
| 7 | 9.3872067 | 9.9866827 | 9.4005240 | 10.5994760 | 10.0133173 | 10.6127933 | 53 |
| 8 | 9.3877087 | 9.9866509 | 9.4010578 | 10.5989422 | 10.0133491 | 10.6122913 | 52 |
| 9 | 9.3882101 | 9.9866191 | 9.4015910 | 10.5984090 | 10.0133809 | 10.6117898 | 51 |
| 10 | 9.3887109 | 9.9865872 | 9.4021237 | 10.5978763 | 10.0134128 | 10.6112891 | 50 |
| 11 | 9.3892111 | 9.9865553 | 9.4026558 | 10.5973442 | 10.0134447 | 10.6107889 | 49 |
| 12 | 9.3897106 | 9.9865233 | 9.4031873 | 10.5968127 | 10.0134767 | 10.6102894 | 48 |
| 13 | 9.3902096 | 9.9864913 | 9.4037182 | 10.5962818 | 10.0135087 | 10.6097904 | 47 |
| 14 | 9.3907079 | 9.9864593 | 9.4042486 | 10.5957514 | 10.0135407 | 10.6092921 | 46 |
| 15 | 9.3912057 | 9.9864273 | 9.4047784 | 10.5952216 | 10.0135727 | 10.6087943 | 45 |
| 16 | 9.3917028 | 9.9863952 | 9.4053076 | 10.5946924 | 10.0136048 | 10.6082972 | 44 |
| 17 | 9.3921993 | 9.9863630 | 9.4058363 | 10.5941637 | 10.0136370 | 10.6078007 | 43 |
| 18 | 9.3926952 | 9.9863308 | 9.4063644 | 10.5936356 | 10.0136692 | 10.6073048 | 42 |
| 19 | 9.3931905 | 9.9862986 | 9.4068919 | 10.5931081 | 10.0137014 | 10.6068005 | 41 |
| 20 | 9.3936852 | 9.9862663 | 9.4074189 | 10.5925811 | 10.0137337 | 10.6063148 | 40 |
| 21 | 9.3941794 | 9.9862340 | 9.4079453 | 10.5920547 | 10.0137660 | 10.6058206 | 39 |
| 22 | 9.3946729 | 9.9862017 | 9.4084712 | 10.5915288 | 10.0137983 | 10.6053271 | 38 |
| 23 | 9.3951658 | 9.9861693 | 9.4089965 | 10.5910035 | 10.0138307 | 10.6048342 | 37 |
| 24 | 9.3956581 | 9.9861369 | 9.4095212 | 10.5914788 | 10.0138631 | 10.6043419 | 36 |
| 25 | 9.3961499 | 9.9861045 | 9.4100054 | 10.5899546 | 10.0138955 | 10.6038501 | 35 |
| 26 | 9.3966410 | 9.9860720 | 9.4105690 | 10.5894310 | 10.0139280 | 10.6033590 | 34 |
| 27 | 9.3971315 | 9.9860394 | 9.4110921 | 10.5889079 | 10.0139606 | 10.6028685 | 33 |
| 28 | 9.3976215 | 9.9860069 | 9 4116146 | 10.5883854 | 10.0139931 | 10.6023785 | 32 |
| 29 | 9.3981109 | 9.9859742 | 9.4121366 | 10.5878634 | 10.0140258 | 10.6018891 | 31 |
| 30 | 9.3985996 | 9.9859416 | 9.4126581 | 10.5873419 | 10.0140584 | 10.6014004 | 30 |
| 31 | 9.3990878 | 9.9859089 | 9.4131789 | 10.5868211 | 10.0140911 | 10.6009122 | 29 |
| 32 | 9.3995754 | 9.9858762 | 9.4136993 | 10.5863007 | 10.0141238 | 10.6004246 | 28 |
| 33 | 9.4000625 | 9.9858434 | 9.4142191 | 10.5857809 | 10.0141566 | 10.5999375 | 27 |
| 34 | 9.4005489 | 9.9858106 | 9.4147383 | 10.5852617 | 10.0141894 | 10.5994511 | 26 |
| 35 | 9.4010348 | 9.9857777 | 9.4152570 | 10.5847430 | 10.0142223 | 10.5989652 | 25 |
| 36 | 9.4015201 | 9.9857449 | 9.4157752 | 10.5842248 | 10.0142551 | 10.5984799 | 24 |
| 37 | 9.4020048 | 9.9857119 | 9.4162928 | 10.5837072 | 10.0142881 | 10.5979952 | 23 |
| 38 | 9.4024889 | 9.9856790 | 9.4168099 | 10.5831901 | 10.0143210 | 10.5975111 | 22 |
| 39 | 9.4029734 | 9.9856460 | 9.4173265 | 10.5826735 | 10.0143540 | 10.5970276 | 21 |
| 40 | 9.4034554 | 9.9856129 | 9.4178425 | 10.5821575 | 10.0143871 | 10.5965446 | 20 |
| 41 | 9.4039378 | 9.9855798 | 9.4183580 | 10.5816420 | 10.0144202 | 10.5960622 | 19 |
| 42 | 9.4044196 | 9.9855467 | 9.4188729 | 10.5811271 | 10.0144533 | 10.5955804 | 18 |
| 43 | 9.4049009 | 9.9855135 | 9.4193874 | 10.5806126 | 10.0144865 | 10.5950991 | 17 |
| 44 | 9.4053816 | 9.9854803 | 9.4199013 | 10.5800987 | 10.0145197 | 10.5946184 | 16 |
| 45 | 9.4058617 | 9.9854471 | 9.4204146 | 10.5795854 | 10.0145529 | 10.5941383 | 15 |
| 46 | 9.4063413 | 9.9854138 | 9.4209275 | 10.5790725 | 10.0145862 | 10.5936587 | 14 |
| 47 | 9 4068203 | 9.9853805 | 9.4213398 | 10.5785602 | 10.0146195 | 10.5931797 | 13 |
| 48 | 9.4072987 | 9.9853471 | 9.4219515 | 10.5780485 | 10.0146529 | 10.5927013 | 12 |
| 49 | 9.4077766 | 9.9853138 | 9.4224628 | 10.5775372 | 10.0146862 | 10.5922234 | 11 |
| 50 | 9.4082539 | 9.9852803 | 9.4229735 | 10.5770265 | 10.0147196 | 10.5917461 | 10 |
| 51 | 9.4087306 | 9.9852468 | 9.4234838 | 10.5765162 | 10.0147532 | 10.5912694 | 9 |
| 52 | 9.4092068 | 9.9852133 | 9.4239935 | 10.5760065 | 10.0147867 | 10.5907932 | 8 |
| 53 | 9.4096824 | 9.9851798 | 9.4245026 | 10.5754974 | 10.0148202 | 10.5903176 | 7 |
| 54 | 9.4101575 | 9.9851462 | 9.4250113 | 10.5749887 | 10.0148538 | 10.5898425 | 6 |
| 55 | 9.4106320 | 9.9851125 | 9.4255194 | 10.5744806 | 10.0148875 | 10.5893680 | 5 |
| 56 | 9.4111059 | 9.9850789 | 9.4260271 | 10.5739729 | 10.0149211 | 10.5888941 | 4 |
| 57 | 9.4115793 | 9.9850452 | 9.4265342 | 10.5734658 | 10.0149548 | 10.5884207 | 3 |
| 58 | 9.4120522 | 9.9850114 | 9.4270408 | 10.5729592 | 10.0149886 | 10.5879478 | 2 |
| 59 | 9.4125245 | 9.9849776 | 9.4275469 | 10.5724531 | 10.0150224 | 10.5874755 | 1 |
| 60 | 9.4129962 | 9.9849438 | 9.4280525 | 10.5719475 | 10.0150562 | 10.5870038 | 0 |
| | *L. Co-Sine* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant.* | *L. Secant.* | M |

75 DEGREES.

15 DEGREES

| M. | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 2588190 | 9659258 | 2679492 | 37320580 | 10352762 | 38637033 | 60 |
| 1 | 2591000 | 9658505 | 2682610 | 37277131 | 10353569 | 38595135 | 59 |
| 2 | 2593810 | 9557751 | 2685728 | 37233847 | 10354378 | 38553332 | 58 |
| 3 | 2596619 | 9656996 | 2688847 | 37190658 | 10355187 | 38511622 | 57 |
| 4 | 2599428 | 9656240 | 2691967 | 37147561 | 10355998 | 38470005 | 56 |
| 5 | 2602237 | 9655483 | 2695087 | 37104558 | 10356809 | 38428482 | 55 |
| 6 | 2605045 | 9654726 | 2698207 | 37061648 | 10357621 | 38387051 | 54 |
| 7 | 2607853 | 9653968 | 2701328 | 37018830 | 10358435 | 38345713 | 53 |
| 8 | 2610661 | 9653209 | 2704449 | 36976103 | 10359249 | 38304467 | 52 |
| 9 | 2613469 | 9652449 | 2707571 | 36933469 | 10360065 | 38263313 | 51 |
| 10 | 2616277 | 9651688 | 2710693 | 36890927 | 10360881 | 38222251 | 50 |
| 11 | 2619085 | 9650927 | 2713816 | 36848475 | 10361699 | 38181280 | 49 |
| 12 | 2621892 | 9650165 | 2716940 | 36806115 | 10362517 | 38140399 | 48 |
| 13 | 2624699 | 9649402 | 2720064 | 36763845 | 10363337 | 38099610 | 47 |
| 14 | 2627506 | 9648638 | 2723188 | 36721665 | 10364157 | 38058911 | 46 |
| 15 | 2630312 | 9647873 | 2726313 | 36679575 | 10364979 | 38018301 | 45 |
| 16 | 2633118 | 9647107 | 2729438 | 36637575 | 10365801 | 37977782 | 44 |
| 17 | 2635924 | 9646341 | 2732564 | 36595565 | 10366625 | 37937352 | 43 |
| 18 | 2638730 | 9645574 | 2735690 | 36553844 | 10367449 | 37897011 | 42 |
| 19 | 2641536 | 9644806 | 2738817 | 36512111 | 10368275 | 37856760 | 41 |
| 20 | 2644342 | 9644037 | 2741944 | 36470467 | 10369101 | 37816596 | 40 |
| 21 | 2647147 | 9643257 | 2745072 | 36428911 | 10369929 | 37776522 | 39 |
| 22 | 2649952 | 9642497 | 2748201 | 36387444 | 10370757 | 37736535 | 38 |
| 23 | 2652757 | 9641726 | 2751330 | 36346064 | 10371587 | 37696636 | 37 |
| 24 | 2655561 | 9640954 | 2754459 | 36304771 | 10372417 | 37656824 | 36 |
| 25 | 2658365 | 9640181 | 2757589 | 36263566 | 10373249 | 37617100 | 35 |
| 26 | 2661169 | 9639407 | 2760719 | 36222447 | 10374082 | 37577462 | 34 |
| 27 | 2663973 | 9638633 | 2763850 | 36181415 | 10374915 | 37537911 | 33 |
| 28 | 2666777 | 9637858 | 2766981 | 36140469 | 10375750 | 37498447 | 32 |
| 29 | 2669581 | 9637082 | 2770113 | 36099609 | 10376585 | 37459068 | 31 |
| 30 | 2672384 | 9636305 | 2773245 | 36058835 | 10377422 | 37419775 | 30 |
| 31 | 2675187 | 9635527 | 2776378 | 36018146 | 10378260 | 37380568 | 29 |
| 32 | 2677989 | 9634748 | 2779512 | 35977543 | 10379098 | 37341446 | 28 |
| 33 | 2680792 | 9633969 | 2782646 | 35937024 | 10379938 | 37302409 | 27 |
| 34 | 2683594 | 9633189 | 2785780 | 35896590 | 10380779 | 37263457 | 26 |
| 35 | 2686396 | 9632408 | 2788915 | 35856241 | 10381621 | 37224589 | 25 |
| 36 | 2689198 | 9631626 | 2792050 | 35815975 | 10382463 | 37185805 | 24 |
| 37 | 2692000 | 9630843 | 2795186 | 35775794 | 10383307 | 37147105 | 23 |
| 38 | 2694801 | 9630059 | 2798322 | 35735696 | 10384152 | 37108489 | 22 |
| 39 | 2697602 | 9629275 | 2801459 | 35695681 | 10384998 | 37069956 | 21 |
| 40 | 2700403 | 9628490 | 2804597 | 35655749 | 10385844 | 37031506 | 20 |
| 41 | 2703204 | 9627704 | 2807735 | 35615900 | 10386692 | 36993139 | 19 |
| 42 | 2706004 | 9626917 | 2810873 | 35576133 | 10387541 | 36954854 | 18 |
| 43 | 2708805 | 9626130 | 2814012 | 35536449 | 10388391 | 36916652 | 17 |
| 44 | 2711605 | 9625342 | 2817152 | 35496846 | 10389242 | 36878532 | 16 |
| 45 | 2714404 | 9624553 | 2820292 | 35457325 | 10390094 | 36840493 | 15 |
| 46 | 2717204 | 9623763 | 2823432 | 35417886 | 10390947 | 36802536 | 14 |
| 47 | 2720003 | 9622972 | 2826573 | 35378528 | 10391800 | 36764660 | 13 |
| 48 | 2722802 | 9622180 | 2829715 | 35339251 | 10392655 | 36726865 | 12 |
| 49 | 2725601 | 9621387 | 2832857 | 35300054 | 10393511 | 36689151 | 11 |
| 50 | 2728400 | 9620594 | 2835999 | 35260938 | 10394368 | 36651518 | 10 |
| 51 | 2731198 | 9619800 | 2839142 | 35221902 | 10395226 | 36613964 | 9 |
| 52 | 2733996 | 9619005 | 2842286 | 35182946 | 10396085 | 36576491 | 8 |
| 53 | 2736794 | 9618209 | 2845430 | 35144070 | 10396945 | 36539097 | 7 |
| 54 | 2739592 | 9617413 | 2848575 | 35105273 | 10397806 | 36501783 | 6 |
| 55 | 2742390 | 9616616 | 2851720 | 35066555 | 10398669 | 36464548 | 5 |
| 56 | 2745187 | 9615818 | 2854866 | 35027916 | 10399532 | 36427392 | 4 |
| 57 | 2747984 | 9615019 | 2858012 | 34989356 | 10400396 | 36390315 | 3 |
| 58 | 2750781 | 9614219 | 2861159 | 34950874 | 10401261 | 36353316 | 2 |
| 59 | 2753578 | 9613418 | 2864306 | 34912470 | 10402127 | 36316395 | 1 |
| 60 | 2756374 | 9612617 | 2867454 | 34874144 | 10402994 | 36279553 | 0 |
| | N Co-Sine. | N. Sine. | N Co Tang. | N. Tangent. | N. Co-Secant. | N. Secant | M |

74 DEGREES.

15 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.4129962 | 9.9849438 | 9.4280525 | 10.5719475 | 10.0150562 | 10.5870038 | 60 |
| 1 | 9.4134674 | 9.9849099 | 9.4285575 | 10.5714425 | 10.0150901 | 10.5865326 | 59 |
| 2 | 9.4139381 | 9.9848760 | 9.4290621 | 10.5709379 | 10.0151240 | 10.5860619 | 58 |
| 3 | 9.4144082 | 9.9848420 | 9.4295661 | 10.5704339 | 10.0151580 | 10.5855918 | 57 |
| 4 | 9.4148778 | 9.9848081 | 9 4300697 | 10.5699303 | 10.0151919 | 10.5851222 | 56 |
| 5 | 9.4153468 | 9.9847740 | 9 4305727 | 10.5694273 | 10.0152260 | 10.5846532 | 55 |
| 6 | 9.4158152 | 9.9847400 | 9.4310753 | 10.5689247 | 10.0152600 | 10.5841848 | 54 |
| 7 | 9.4162832 | 9.9847059 | 9.4315773 | 10.5684227 | 10.0152941 | 10.5837168 | 53 |
| 8 | 9.4167506 | 9 9846717 | 9.4320789 | 10.5679211 | 10.0153283 | 10.5832494 | 52 |
| 9 | 9.4172174 | 9.9846375 | 9.4325799 | 10.5674201 | 10.0153625 | 10.5827826 | 51 |
| 10 | 9.4176837 | 9.9846033 | 9.4330804 | 10.5669196 | 10.0153967 | 10.5823163 | 50 |
| 11 | 9.4181495 | 9.9845690 | 9.2335805 | 10.5664195 | 10.0154310 | 10.5818505 | 49 |
| 12 | 9.4186148 | 9 9845347 | 9.4340800 | 10.5659200 | 10.0154653 | 10.5813852 | 48 |
| 13 | 9.4190795 | 9.9845004 | 9.4345791 | 10.5654209 | 10.0154996 | 10.5809205 | 47 |
| 14 | 9.4195436 | 9.9844660 | 9.4350776 | 10.5649224 | 10.0155340 | 10.5804564 | 46 |
| 15 | 9.4200073 | 9.9844316 | 9.4355757 | 10.5644243 | 10.0155684 | 10.5799927 | 45 |
| 16 | 9.4204704 | 9.9843971 | 9.4360733 | 10.5639267 | 10.0156029 | 10.5795296 | 44 |
| 17 | 9.4209330 | 9.9843626 | 9.4365704 | 10.5634296 | 10.0156374 | 10.5790670 | 43 |
| 18 | 9.4213950 | 9.9843281 | 9.4370670 | 10.5629330 | 10.0156719 | 10.5786050 | 42 |
| 19 | 9.4218566 | 9.9842935 | 9.4375631 | 10.5624369 | 10.0157065 | 10.5781434 | 41 |
| 20 | 9.4223176 | 9.9842589 | 9.4380587 | 10.5619413 | 10.0157411 | 10.5776824 | 40 |
| 21 | 9.4227780 | 9.9842242 | 9.4385538 | 10.5614462 | 10 0157758 | 10.5772220 | 39 |
| 22 | 9.4232380 | 9.9841895 | 9.4390485 | 10.5609515 | 10.0158105 | 10.5767620 | 38 |
| 23 | 9.4236974 | 9.9841548 | 9.4395426 | 10.5604574 | 10.0158452 | 10.5763026 | 37 |
| 24 | 9.4241563 | 9.9841200 | 9.4400363 | 10.5599637 | 10.0158800 | 10.5758437 | 36 |
| 25 | 9.4246147 | 9.9840852 | 9.4405295 | 10.5594705 | 10.0159148 | 10.5753853 | 35 |
| 26 | 9.4250726 | 9.9840503 | 9.4410222 | 10.5589778 | 10.0159497 | 10.5749274 | 34 |
| 27 | 9.4255299 | 9.9840154 | 9.4415145 | 10.5584855 | 10.0159846 | 10.5744701 | 33 |
| 28 | 9.4259867 | 9.9839805 | 9.4420062 | 10.5579938 | 10.0160195 | 10.5740133 | 32 |
| 29 | 9.4264430 | 9.9839455 | 9.4424975 | 10.5575025 | 10.0160545 | 10.5735570 | 31 |
| 30 | 9.4268988 | 9.9839105 | 9.4429883 | 10.5570117 | 10.0160895 | 10.5731012 | 30 |
| 31 | 9.4273541 | 9.9838755 | 9.4434786 | 10.5565214 | 10.0161245 | 10.5726459 | 29 |
| 32 | 9.4278089 | 9.9838404 | 9.4439685 | 10.5560315 | 10.0161596 | 10.5721911 | 28 |
| 33 | 9.4282631 | 9.9838052 | 9.4444579 | 10.5555421 | 10.0161948 | 10.5717369 | 27 |
| 34 | 9.4287169 | 9.9837701 | 9.4449468 | 10.5550532 | 10.0162299 | 10.5712831 | 26 |
| 35 | 9.4291701 | 9.9837348 | 9.4454352 | 10.5545648 | 10.0162652 | 10.5708299 | 25 |
| 36 | 9.4296228 | 9.9836996 | 9.4459232 | 10.5540768 | 10.0163004 | 10.5703772 | 24 |
| 37 | 9.4300750 | 9 9836643 | 9.4464107 | 10.5535893 | 10.0163357 | 10.5699250 | 23 |
| 38 | 9.4305267 | 9.9836290 | 9.4468978 | 10.5531022 | 10.0163710 | 10.5694733 | 22 |
| 39 | 9.4309779 | 9.9835936 | 9.4473843 | 10.5526157 | 10.0164064 | 10.5690221 | 21 |
| 40 | 9.4314286 | 9.9835582 | 9.4478704 | 10.5521296 | 10 0164418 | 10.5685714 | 20 |
| 41 | 9.4318788 | 9.9835227 | 9.4483561 | 10.5516439 | 10.0164773 | 10.5681212 | 19 |
| 42 | 9.4323285 | 9.9834872 | 9.4488413 | 10.5511587 | 10.0165128 | 10.5676715 | 18 |
| 43 | 9.4327777 | 9.9834517 | 9.4493260 | 10.5506740 | 10.0165483 | 10.5672223 | 17 |
| 44 | 9.4332264 | 9.9834161 | 9.4498102 | 10.5501898 | 10.0165839 | 10.5667736 | 16 |
| 45 | 9.4336746 | 9.9833805 | 9.4502940 | 10.5497060 | 10.0166195 | 10.5663254 | 15 |
| 46 | 9.4341223 | 9.9833449 | 9.4507774 | 10.5492226 | 10.0166551 | 10.5658777 | 14 |
| 47 | 9.4345694 | 9.9833092 | 9.4512602 | 10.5487398 | 10.0166908 | 10.5654306 | 13 |
| 48 | 9.4350161 | 9.9832735 | 9.4517427 | 10.5482573 | 10.0167265 | 10.5649839 | 12 |
| 49 | 9.4354623 | 9.9832377 | 9.4522246 | 10.5477754 | 10.0167623 | 10.5645377 | 11 |
| 50 | 9.4359080 | 9.9832019 | 9.4527061 | 10.5472939 | 10.0167981 | 10.5640920 | 10 |
| 51 | 9.4363532 | 9.9831661 | 9.4531872 | 10.5468128 | 10.0168339 | 10.5636468 | 9 |
| 52 | 9.4367980 | 9.9831302 | 9.4536678 | 10.5463322 | 10.0168698 | 10.5632020 | 8 |
| 53 | 9.4372422 | 9.9830942 | 9.4541479 | 10.5458521 | 10.0169058 | 10.5627578 | 7 |
| 54 | 9.4376850 | 9.9830583 | 9.4546276 | 10.5453724 | 10.0169417 | 10.5623141 | 6 |
| 55 | 9.4381292 | 9.9830223 | 9.4551069 | 10.5448931 | 10.0169777 | 10.5618708 | 5 |
| 56 | 9.4385719 | 9.9829862 | 9.4555857 | 10.5444143 | 10.0170138 | 10.5614281 | 4 |
| 57 | 9.8390142 | 9.9829501 | 9.4560641 | 10.5439359 | 10.0170499 | 10.5609858 | 3 |
| 58 | 9.4394560 | 9.9829140 | 9.4565420 | 10.5434580 | 10.0170860 | 10.5605440 | 2 |
| 59 | 9.4398973 | 9.9828778 | 9.4570194 | 10.5429806 | 10.0171222 | 10.5601027 | 1 |
| 60 | 9.4403381 | 9.9828416 | 9.4574964 | 10.5425036 | 10.0171586 | 10.5596619 | 0 |
| | *LCo-Sine.* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant.* | *L. Secant.* | M |

74 DEGREES.

16 DEGREES.

| M | N Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 2756374 | 9612617 | 2867454 | 34874144 | 10402994 | 36279553 | 60 |
| 1 | 2759170 | 9611815 | 2870602 | 34835896 | 10403863 | 36242788 | 59 |
| 2 | 2761965 | 9611012 | 2873751 | 34797726 | 10404732 | 36206101 | 58 |
| 3 | 2764761 | 9610208 | 2876900 | 34759632 | 10405602 | 36169490 | 57 |
| 4 | 2767556 | 9609403 | 2880050 | 34721616 | 10406473 | 36132957 | 56 |
| 5 | 2770352 | 9608598 | 2883201 | 34683676 | 10407346 | 36096501 | 55 |
| 6 | 2773147 | 9607792 | 2886352 | 34645813 | 10408219 | 36060121 | 54 |
| 7 | 2775941 | 9606985 | 2889503 | 34608026 | 10409094 | 36023818 | 53 |
| 8 | 2778736 | 9606177 | 2892655 | 34570315 | 10409969 | 35987590 | 52 |
| 9 | 2781530 | 9605368 | 2895808 | 34532679 | 10410845 | 35951439 | 51 |
| 10 | 2784324 | 9604558 | 2898961 | 34495120 | 10411723 | 35915363 | 50 |
| 11 | 2787118 | 9603748 | 2902114 | 34457635 | 10412601 | 35879362 | 49 |
| 12 | 2789911 | 9602937 | 2905268 | 34420226 | 10413481 | 35843437 | 48 |
| 13 | 2792704 | 9602125 | 2908423 | 34382891 | 10414362 | 35807586 | 47 |
| 14 | 2795497 | 9601312 | 2911578 | 34345631 | 10415243 | 35771810 | 46 |
| 15 | 2798290 | 9600498 | 2914734 | 34308446 | 10416126 | 35736108 | 45 |
| 16 | 2801083 | 9599684 | 2917890 | 34271334 | 10417009 | 35700481 | 44 |
| 17 | 2803875 | 9598869 | 2921047 | 34234297 | 10417894 | 35664928 | 43 |
| 18 | 2806667 | 9598053 | 2924205 | 34197333 | 10418780 | 35629448 | 42 |
| 19 | 2809459 | 9597236 | 2927363 | 34160443 | 10419667 | 35594042 | 41 |
| 20 | 2812251 | 9596418 | 2930521 | 34123626 | 10420554 | 35558710 | 40 |
| 21 | 2815042 | 9595600 | 2933680 | 34086882 | 10421443 | 35523450 | 39 |
| 22 | 2817833 | 9594781 | 2936839 | 34050210 | 10422333 | 35488263 | 38 |
| 23 | 2820624 | 9593961 | 2939999 | 34013612 | 10423224 | 35453149 | 37 |
| 24 | 2823415 | 9593140 | 2943160 | 33977085 | 10424116 | 35418107 | 36 |
| 25 | 2826205 | 9592318 | 2946321 | 33940631 | 10425009 | 35383138 | 35 |
| 26 | 2828995 | 9591495 | 2949483 | 33904249 | 10425903 | 35348240 | 34 |
| 27 | 2831785 | 9590672 | 2952645 | 33867938 | 10426798 | 35313414 | 33 |
| 28 | 2834575 | 9589848 | 2955808 | 33831699 | 10427694 | 35278660 | 32 |
| 29 | 2837364 | 9589023 | 2958971 | 33795531 | 10428591 | 35243977 | 31 |
| 30 | 2840153 | 9588197 | 2962135 | 33759434 | 10429489 | 35209365 | 30 |
| 31 | 2842942 | 9587370 | 2965299 | 33723403 | 10430388 | 35174824 | 29 |
| 32 | 2845731 | 9586543 | 2968464 | 33687453 | 10431289 | 35140354 | 28 |
| 33 | 2848520 | 9585715 | 2971630 | 33651568 | 10432190 | 35105954 | 27 |
| 34 | 2851308 | 9584886 | 2974796 | 33615753 | 10433092 | 35071625 | 26 |
| 35 | 2854096 | 9584056 | 2977962 | 33580008 | 10433995 | 35037365 | 25 |
| 36 | 2856884 | 9583225 | 2981129 | 33544333 | 10434900 | 35003175 | 24 |
| 37 | 2859671 | 9582394 | 2984297 | 33508728 | 10435805 | 34969055 | 23 |
| 38 | 2862458 | 9581562 | 2987465 | 33473191 | 10436712 | 34935004 | 22 |
| 39 | 2865245 | 9580729 | 2990634 | 33437724 | 10437619 | 34901023 | 21 |
| 40 | 2868032 | 9579895 | 2993803 | 33402326 | 10438528 | 34867110 | 20 |
| 41 | 2870819 | 9579060 | 2996973 | 33366997 | 10439437 | 34833267 | 19 |
| 42 | 2873605 | 9578225 | 3000144 | 33331736 | 10440348 | 34799392 | 18 |
| 43 | 2876391 | 9577389 | 3003315 | 33296543 | 10441259 | 34765785 | 17 |
| 44 | 2879177 | 9576552 | 3006486 | 33261419 | 10442172 | 34732146 | 16 |
| 45 | 2881963 | 9575714 | 3009658 | 33226362 | 10443086 | 34698576 | 15 |
| 46 | 2884748 | 9574875 | 3012831 | 33191373 | 10444001 | 34665037 | 14 |
| 47 | 2887533 | 9574035 | 3016004 | 33156452 | 10444917 | 34631673 | 13 |
| 48 | 2890318 | 9573195 | 3019178 | 33121598 | 10445833 | 34598269 | 12 |
| 49 | 2893103 | 9572354 | 3022352 | 33086811 | 10446751 | 34564969 | 11 |
| 50 | 2895887 | 9571512 | 3025527 | 33052091 | 10447670 | 34531735 | 10 |
| 51 | 2898671 | 9570669 | 3028703 | 33017438 | 10448590 | 34498568 | 9 |
| 52 | 2901455 | 9569825 | 3031879 | 32982851 | 10449511 | 34465467 | 8 |
| 53 | 2904239 | 9568981 | 3035055 | 32948330 | 10450433 | 34432433 | 7 |
| 54 | 2907022 | 9568136 | 3038232 | 32913876 | 10451257 | 34399465 | 6 |
| 55 | 2909805 | 9567290 | 3041410 | 32879487 | 10452281 | 34366563 | 5 |
| 56 | 2912588 | 9566443 | 3044588 | 32845164 | 10453206 | 34333727 | 4 |
| 57 | 2915371 | 9565595 | 3047767 | 32810907 | 10454132 | 34300956 | 3 |
| 58 | 2918153 | 9564747 | 3050946 | 32776715 | 10455060 | 34268251 | 2 |
| 59 | 2920935 | 9563898 | 3054126 | 32742588 | 10455988 | 34235611 | 1 |
| 60 | 2923717 | 9563048 | 3057307 | 32708526 | 10456918 | 34203036 | 0 |
| | N. Co-Sine. | N. Sine. | N .Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

73 DEGREES.

16 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.4403381 | 9.9828416 | 9.4574964 | 10.5425036 | 10.0171584 | 10.5596619 | 60 |
| 1 | 9.4407784 | 9.9828054 | 9.4579730 | 10.5420270 | 10.0171946 | 10.5592216 | 59 |
| 2 | 9.4412182 | 9.9827691 | 9.4584491 | 10.5415509 | 10.0172309 | 10.5587818 | 58 |
| 3 | 9.4416576 | 9.9827328 | 9.4589248 | 10.5410752 | 10.0172672 | 10.5583424 | 57 |
| 4 | 9.4420965 | 9.9826964 | 9.4594001 | 10.5405999 | 10.0173036 | 10.5579035 | 56 |
| 5 | 9.4425349 | 9.9826600 | 9.4598749 | 10.5401251 | 10.0173400 | 10.5574651 | 55 |
| 6 | 9.4429728 | 9.9826236 | 9.4603492 | 10.5396508 | 10.0173764 | 10.5570272 | 54 |
| 7 | 9.4434103 | 9.9825871 | 9.4608232 | 10.5391768 | 10.0174129 | 10.5565897 | 53 |
| 8 | 9.4438472 | 9.9825506 | 9.4612967 | 10.5387033 | 10.0174494 | 10.5561528 | 52 |
| 9 | 9.4442837 | 9.9825140 | 9.4617697 | 10.5382303 | 10.0174860 | 10.5557163 | 51 |
| 10 | 9.4447197 | 9.9824774 | 9.4622423 | 10.5377557 | 10.0175226 | 10.5552803 | 50 |
| 11 | 9.4451553 | 9.9824408 | 9.4627145 | 10.5372855 | 10.0175592 | 10.5548447 | 49 |
| 12 | 9.4455904 | 9.9824041 | 9.4631863 | 10.5368137 | 10.0175959 | 10.5544096 | 48 |
| 13 | 9.4460250 | 9.9823674 | 9.4636576 | 10.5363424 | 10.0176326 | 10.5539750 | 47 |
| 14 | 9.4464591 | 9.9823306 | 9.4641285 | 10.5358715 | 10.0176694 | 10.5535409 | 46 |
| 15 | 9.4468927 | 9.9822938 | 9.4645990 | 10.5354010 | 10.0177062 | 10.5531073 | 45 |
| 16 | 9.4473259 | 9.9822569 | 9.4650690 | 10.5349310 | 10.0177431 | 10.5526741 | 44 |
| 17 | 9.4477586 | 9.9822201 | 9.4655386 | 10.5344614 | 10.0177799 | 10.5522414 | 43 |
| 18 | 9.4481909 | 9.9821831 | 9.4660078 | 10.5339922 | 10.0178169 | 10.5518091 | 42 |
| 19 | 9.4486227 | 9.9821462 | 9.4664765 | 10.5335235 | 10.0178538 | 10.5513773 | 41 |
| 20 | 9.4490540 | 9.9821092 | 9.4669448 | 10.5330552 | 10.0178908 | 10.5509460 | 40 |
| 21 | 9.4494849 | 9.9820721 | 9.4674127 | 10.5325873 | 10.0179279 | 10.5505151 | 39 |
| 22 | 9.4499153 | 9.9820351 | 9.4678802 | 10.5321198 | 10.0179649 | 10.5500847 | 38 |
| 23 | 9.4503452 | 9.9819979 | 9.4683473 | 10.5316527 | 10.0180021 | 10.5496548 | 37 |
| 24 | 9.4507747 | 9.9819608 | 9.4688139 | 10.5311861 | 10.0180392 | 10.5492253 | 36 |
| 25 | 9.4512037 | 9.9819236 | 9.4692801 | 10.5307199 | 10.0180764 | 10.5487963 | 35 |
| 26 | 9.4516322 | 9.9818863 | 9.4697459 | 10.5302541 | 10.0181137 | 10.5483678 | 34 |
| 27 | 9.4520603 | 9.9818490 | 9.4702112 | 10.5297888 | 10.0181510 | 10.5479397 | 33 |
| 28 | 9.4524879 | 9.9818117 | 9.4706762 | 10.5293238 | 10.0181883 | 10.5475121 | 32 |
| 29 | 9.4529151 | 9.9817744 | 9.4711407 | 10.5288503 | 10.0182256 | 10.5470849 | 31 |
| 30 | 9.4533418 | 9.9817370 | 9.4716048 | 10.5283952 | 10.0182630 | 10.5466582 | 30 |
| 31 | 9.4537681 | 9.9816995 | 9.4720685 | 10.5279315 | 10.0183005 | 10.5462319 | 29 |
| 32 | 9.4541939 | 9.9816620 | 9.4725318 | 10.5274682 | 10.0183380 | 10.5458061 | 28 |
| 33 | 9.4546192 | 9.9816245 | 9.4729947 | 10.5270053 | 10.0183755 | 10.5453808 | 27 |
| 34 | 9.4550441 | 9.9815870 | 9.4734571 | 10.5265428 | 10.0184130 | 10.5449559 | 26 |
| 35 | 9.4554686 | 9.9815494 | 9.4739192 | 10.5260808 | 10.0184506 | 10.5445314 | 25 |
| 36 | 9.4558926 | 9.9815117 | 9.4743808 | 10.5256192 | 10.0184883 | 10.5441074 | 24 |
| 37 | 9.4563161 | 9.9814740 | 9.4748421 | 10.5251579 | 10.0185260 | 10.5436839 | 23 |
| 38 | 9.4567392 | 9.9814363 | 9.4753029 | 10.5246971 | 10.0185637 | 10.5432608 | 22 |
| 39 | 9.4571618 | 9.9813986 | 9.4757633 | 10.5242367 | 10.0186014 | 10.5428382 | 21 |
| 40 | 9.4575840 | 9.9813608 | 9.4762233 | 10.5237767 | 10.0186392 | 10.5424160 | 20 |
| 41 | 9.4580058 | 9.9813229 | 9.4766829 | 10.5233171 | 10.0186771 | 10.5419942 | 19 |
| 42 | 9.4584271 | 9.9812850 | 9.4771421 | 10.5228579 | 10.0187150 | 10.5415729 | 18 |
| 43 | 9.4588480 | 9.9812471 | 9.4776009 | 10.5223991 | 10.0187529 | 10.5411520 | 17 |
| 44 | 9.4592684 | 9.9812091 | 9.4780592 | 10.5219408 | 10.0187909 | 10.5407316 | 16 |
| 45 | 9.4596884 | 9.9811711 | 9.4785172 | 10.5214828 | 10.0188289 | 10.5403116 | 15 |
| 46 | 9.4601079 | 9.9811331 | 9.4789748 | 10.5210252 | 10.0188669 | 10.5398921 | 14 |
| 47 | 9.4605270 | 9.9810950 | 9.4794319 | 10.5205681 | 10.0189050 | 10.5394730 | 13 |
| 48 | 9.4609456 | 9.9810569 | 9.4798887 | 10.5201113 | 10.0189431 | 10.5390541 | 12 |
| 49 | 9.4613638 | 9.9810187 | 9.4803451 | 10.5196549 | 10.0189813 | 10.5386362 | 11 |
| 50 | 9.4617816 | 9.9809805 | 9.4808011 | 10.5191989 | 10.0190195 | 10.5382184 | 10 |
| 51 | 9.4621989 | 9.9809423 | 9.4812566 | 10.5187434 | 10.0190577 | 10.5378011 | 9 |
| 52 | 9.4626158 | 9.9809040 | 9.4817118 | 10.5182882 | 10.0190960 | 10.5373842 | 8 |
| 53 | 9.4630323 | 9.9808657 | 9.4821666 | 10.5178334 | 10.0191343 | 10.5369677 | 7 |
| 54 | 9.4634483 | 9.9808273 | 9.4826210 | 10.5173790 | 10.0191727 | 10.5365517 | 6 |
| 55 | 9.4638639 | 9.9807889 | 9.4830750 | 10.5169250 | 10.0192111 | 10.5361361 | 5 |
| 56 | 9.4642790 | 9.9807505 | 9.4835286 | 10.5164714 | 10.0192495 | 10.5357210 | 4 |
| 57 | 9.4646938 | 9.9807120 | 9.4839818 | 10.5160182 | 10.0192880 | 10.5353062 | 3 |
| 58 | 9.4651081 | 9.9806735 | 9.4844346 | 10.5155654 | 10.0193265 | 10.5348919 | 2 |
| 59 | 9.4655219 | 9.9806349 | 9.4848870 | 10.5151130 | 10.0193651 | 10.5344781 | 1 |
| 60 | 9.4659353 | 9.9805963 | 9.4853390 | 10.5146610 | 10.0194037 | 10.5340647 | 0 |
| | L. Co-Sine. | L. Sine | L. Co-Tang. | L. Tangent | L. Co-Secant. | L. Secant. | M |

73 DEGREES.

17 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 2923717 | 9563048 | 3057307 | 32708526 | 10456918 | 34202036 | 60 |
| 1 | 2926499 | 9562197 | 3060488 | 32674529 | 10457848 | 34170526 | 59 |
| 2 | 2929280 | 9561345 | 3063669 | 32640596 | 10458780 | 34138080 | 58 |
| 3 | 2932061 | 9560492 | 3066851 | 32606728 | 10459712 | 34105699 | 57 |
| 4 | 2934842 | 9559639 | 3070034 | 32572924 | 10460646 | 34073382 | 56 |
| 5 | 2937623 | 9558785 | 3073218 | 32539184 | 10461581 | 34041130 | 55 |
| 6 | 2940403 | 9557930 | 3076402 | 32505508 | 10462516 | 34008941 | 54 |
| 7 | 2943183 | 9557074 | 3079586 | 32471895 | 10463453 | 33976816 | 53 |
| 8 | 2945963 | 9556217 | 3082771 | 32438346 | 10464391 | 33944754 | 52 |
| 9 | 2948743 | 9555360 | 3085957 | 32404860 | 10465330 | 33912755 | 51 |
| 10 | 2951522 | 9554502 | 3089143 | 32371438 | 10466270 | 33880820 | 50 |
| 11 | 2954301 | 9553643 | 3092330 | 32338078 | 10467211 | 33848948 | 49 |
| 12 | 2957080 | 9552783 | 3095517 | 32304780 | 10468153 | 33817138 | 48 |
| 13 | 2959859 | 9551922 | 3098705 | 32271546 | 10469096 | 33785391 | 47 |
| 14 | 2962638 | 9551061 | 3101893 | 32238373 | 10470040 | 33753707 | 46 |
| 15 | 2965416 | 9550199 | 3105082 | 32205263 | 10470986 | 33722084 | 45 |
| 16 | 2968194 | 9549336 | 3108272 | 32172215 | 10471932 | 33690524 | 44 |
| 17 | 2970971 | 9548472 | 3111462 | 32139228 | 10472879 | 33659026 | 43 |
| 18 | 2973749 | 9547607 | 3114653 | 32106304 | 10473828 | 33627589 | 42 |
| 19 | 2976526 | 9546742 | 3117844 | 32073440 | 10474777 | 33596214 | 41 |
| 20 | 2979303 | 9545876 | 3121036 | 32040638 | 10475728 | 33564900 | 40 |
| 21 | 2982079 | 9545009 | 3124229 | 32007897 | 10476679 | 33533647 | 39 |
| 22 | 2984856 | 9544141 | 3127422 | 31975217 | 10477632 | 33502455 | 38 |
| 23 | 2987632 | 9543272 | 3130616 | 31942598 | 10478586 | 33471324 | 37 |
| 24 | 2990408 | 9542403 | 3133810 | 31910039 | 10479540 | 33440254 | 36 |
| 25 | 2993184 | 9541533 | 3137005 | 31877540 | 10480496 | 33409244 | 35 |
| 26 | 2995959 | 9540662 | 3140200 | 31845102 | 10481453 | 33379294 | 34 |
| 27 | 2998734 | 9539790 | 3143396 | 31812724 | 10482411 | 33347405 | 33 |
| 28 | 3001509 | 9538917 | 3146593 | 31780406 | 10483370 | 33316575 | 32 |
| 29 | 3004284 | 9538043 | 3149790 | 31748147 | 10484330 | 33285805 | 31 |
| 30 | 3007058 | 9537169 | 3152988 | 31715948 | 10485291 | 33255095 | 30 |
| 31 | 3009832 | 9536294 | 3156186 | 31683808 | 10486253 | 33224444 | 29 |
| 32 | 3012606 | 9535418 | 3159385 | 31651728 | 10487217 | 33193853 | 28 |
| 33 | 3015380 | 9534541 | 3162585 | 31619706 | 10488181 | 33163320 | 27 |
| 34 | 3018153 | 9533664 | 3165785 | 31587744 | 10489146 | 33132847 | 26 |
| 35 | 3020926 | 9532786 | 3168986 | 31555840 | 10490113 | 33102432 | 25 |
| 36 | 3023699 | 9531907 | 3172187 | 31523994 | 10491080 | 33072076 | 24 |
| 37 | 3026471 | 9531027 | 3175389 | 31492207 | 10492049 | 33041778 | 23 |
| 38 | 3029244 | 9530146 | 3178591 | 31460478 | 10493019 | 33011539 | 22 |
| 39 | 3032016 | 9529264 | 3181794 | 31428807 | 10493989 | 32981357 | 21 |
| 40 | 3034788 | 9528382 | 3184998 | 31397194 | 10494961 | 32951234 | 20 |
| 41 | 3037559 | 9527499 | 3188202 | 31365639 | 10495934 | 32921168 | 19 |
| 42 | 3040331 | 9526615 | 3191407 | 31334141 | 10496908 | 32891160 | 18 |
| 43 | 3043102 | 9525730 | 3194613 | 31302701 | 10497883 | 32861209 | 17 |
| 44 | 3045872 | 9524844 | 3197819 | 31271317 | 10498859 | 32831316 | 16 |
| 45 | 3048643 | 9523958 | 3201025 | 31239991 | 10499836 | 32801479 | 15 |
| 46 | 3051413 | 9523071 | 3204232 | 31208722 | 10500815 | 32771700 | 14 |
| 47 | 3054183 | 9522183 | 3207440 | 31177509 | 10501794 | 32741977 | 13 |
| 48 | 3056953 | 9521294 | 3210649 | 31146353 | 10502774 | 32712311 | 12 |
| 49 | 3059723 | 9520404 | 3213858 | 31115254 | 10503756 | 32682702 | 11 |
| 50 | 3062492 | 9519514 | 3217067 | 31084210 | 10504738 | 32653149 | 10 |
| 51 | 3065261 | 9518623 | 3220277 | 31053223 | 10505722 | 32623652 | 9 |
| 52 | 3068029 | 9517731 | 3223488 | 31022291 | 10506706 | 32594211 | 8 |
| 53 | 3070798 | 9516838 | 3226700 | 30991416 | 10507692 | 32564825 | 7 |
| 54 | 3073566 | 9515944 | 3229912 | 30960596 | 10508679 | 32535496 | 6 |
| 55 | 3076334 | 9515049 | 3233125 | 30929831 | 10509667 | 32506222 | 5 |
| 56 | 3079102 | 9514154 | 3236338 | 30899122 | 10510656 | 32477003 | 4 |
| 57 | 3081869 | 9513258 | 3239552 | 30868468 | 10511646 | 32447840 | 3 |
| 58 | 3084636 | 9512361 | 3242766 | 30837869 | 10512637 | 32418732 | 2 |
| 59 | 3087403 | 9511463 | 3245981 | 30807325 | 10513629 | 323896 8 | 1 |
| 60 | 3090170 | 9510565 | 3249197 | 30776835 | 10514622 | 32360680 | 0 |
| | N Co-Sine. | N. Sine. | N Co Tang. | N. Tangent. | N. Co-Secant. | N. Secant | M |

72 DEGREES.

17 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co-Tang.* | *L. Secant.* | *L. Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.4659353 | 9.9805963 | 9.4853390 | 10.5146610 | 10.0194037 | 10.5340647 | 60 |
| 1 | 9.4663483 | 9.9805577 | 9.4857907 | 10.5142093 | 10.0194423 | 10.5336517 | 59 |
| 2 | 9.4667609 | 9.9805190 | 9.4862419 | 10.5137581 | 10.0194810 | 10.5332391 | 58 |
| 3 | 9.4671730 | 9.9804803 | 9.4866928 | 10.5133072 | 10.0195197 | 10.5328270 | 57 |
| 4 | 9.4675848 | 9.9804415 | 9.4871433 | 10.5128567 | 10.0195585 | 10.5324152 | 56 |
| 5 | 9.4679960 | 9.9804027 | 9.4875933 | 10.5124067 | 10.0195973 | 10.5320040 | 55 |
| 6 | 9.4684069 | 9.9803639 | 9.4880430 | 10.5119570 | 10.0196361 | 10.5315931 | 54 |
| 7 | 9.4688173 | 9.9803250 | 9.4884924 | 10.5115076 | 10.0196750 | 10.5311827 | 53 |
| 8 | 9.4692273 | 9.9802860 | 9.4889413 | 10.5110587 | 10.0197140 | 10.5307727 | 52 |
| 9 | 9.4696369 | 9.9802471 | 9.4893898 | 10.5106102 | 10.0197529 | 10.5303631 | 51 |
| 10 | 9.4700461 | 9.9802081 | 9.4898380 | 10.5101620 | 10.0197919 | 10.5299539 | 50 |
| 11 | 9.4704548 | 9.9801690 | 9.4902858 | 10.5097142 | 10.0198310 | 10.5295452 | 49 |
| 12 | 9.4708631 | 9.9801299 | 9.4907332 | 10.5092668 | 10.0198701 | 10.5291369 | 48 |
| 13 | 9.4712710 | 9.9800908 | 9.4911802 | 10.5088198 | 10.0199092 | 10.5287290 | 47 |
| 14 | 9.4716785 | 9.9800516 | 9.4916269 | 10.5083731 | 10.0199484 | 10.5283215 | 46 |
| 15 | 9.4720856 | 9.9800124 | 9.4920731 | 10.5079269 | 10.0199876 | 10.5279144 | 45 |
| 16 | 9.4724922 | 9.9799732 | 9.4925190 | 10.5074810 | 10.0200268 | 10.5275078 | 44 |
| 17 | 9.4728985 | 9.9799339 | 9.4929646 | 10.5070354 | 10.0200661 | 10.5271015 | 43 |
| 18 | 9.4733043 | 9.9798946 | 9.4938097 | 10.5065903 | 10.0201054 | 10.5266957 | 42 |
| 19 | 9.4737097 | 9.9798552 | 9.4938545 | 10.5061455 | 10.0201448 | 10.5262903 | 41 |
| 20 | 9.4741146 | 9.9798158 | 9.4942988 | 10.5057012 | 10.0201842 | 10.5258854 | 40 |
| 21 | 9.4745192 | 9.9797764 | 9.4947429 | 10.5052571 | 10.0202236 | 10.5254808 | 39 |
| 22 | 9.4749234 | 9.9797369 | 9.4951865 | 10.5048135 | 10.0202631 | 10.5250766 | 38 |
| 23 | 9.4753271 | 9.9796973 | 9.4956298 | 10.5043702 | 10.0203027 | 10.5246729 | 37 |
| 24 | 9.4757304 | 9.9796574 | 9.4960727 | 10.5039273 | 10.0203422 | 10.5242696 | 36 |
| 25 | 9.4761334 | 9.9796182 | 9.4965152 | 10.5034848 | 10.0203818 | 10.5238666 | 35 |
| 26 | 9.4765359 | 9.9795785 | 9.4969574 | 10.5030426 | 10.0204215 | 10.5234641 | 34 |
| 27 | 9.4769380 | 9.9795388 | 9.4973991 | 10.5026009 | 10.0204612 | 10.5230620 | 33 |
| 28 | 9.4773396 | 9.9794991 | 9.4978406 | 10.5021594 | 10.0205009 | 10.5226604 | 32 |
| 29 | 9.4777409 | 9.9794593 | 9.4982816 | 10.5017184 | 10.0205407 | 10.5222591 | 31 |
| 30 | 9.4781418 | 9.9794195 | 9.4987223 | 10.5012777 | 10.0205805 | 10.5218582 | 30 |
| 31 | 9.4785423 | 9.9793796 | 9.4991626 | 10.5008374 | 10.0206204 | 10.5214577 | 29 |
| 32 | 9.4789423 | 9.9793398 | 9.4996026 | 10.5003974 | 10.0206602 | 10.5210577 | 28 |
| 33 | 9.4793420 | 9.9792998 | 9.5000422 | 10.4999578 | 10.0207002 | 10.5206580 | 27 |
| 34 | 9.4797412 | 9.9792599 | 9.5004814 | 10.4995186 | 10.0207402 | 10.5202588 | 26 |
| 35 | 9.4801401 | 9.9792198 | 9.5009203 | 10.4990797 | 10.0207802 | 10.5198599 | 25 |
| 36 | 9.4805385 | 9.9791798 | 9.5013588 | 10.4986412 | 10.0208202 | 10.5194615 | 24 |
| 37 | 9.4809366 | 9.9791397 | 9.5017969 | 10.4982031 | 10.0208603 | 10.5190634 | 23 |
| 38 | 9.4813342 | 9.9790996 | 9.5022347 | 10.4977653 | 10.0209004 | 10.5186658 | 22 |
| 39 | 9.4817315 | 9.9790594 | 9.5026721 | 10.4973279 | 10.0209406 | 10.5182685 | 21 |
| 40 | 9.4821283 | 9.9790192 | 9.5031092 | 10.4968908 | 10.0209808 | 10.5178717 | 20 |
| 41 | 9.4825248 | 9.9789789 | 9.5035459 | 10.4964541 | 10.0210211 | 10.5174752 | 19 |
| 42 | 9.4829208 | 9.9789386 | 9.5039822 | 10.4960178 | 10.0210614 | 10.5170792 | 18 |
| 43 | 9.4833165 | 9.9788983 | 9.5044182 | 10.4955818 | 10.0211017 | 10.5166835 | 17 |
| 44 | 9.4837117 | 9.9788579 | 9.5048538 | 10.4951462 | 10.0211421 | 10.5162883 | 16 |
| 45 | 9.4841066 | 9.9788175 | 9.5052891 | 10.4947109 | 10.0211825 | 10.5158934 | 15 |
| 46 | 9.4845010 | 9.9787770 | 9.5057240 | 10.4942760 | 10.0212230 | 10.5154990 | 14 |
| 47 | 9.4848951 | 9.9787365 | 9.5061586 | 10.4938414 | 10.0212635 | 10.5151049 | 13 |
| 48 | 9.4852888 | 9.9786960 | 9.5065928 | 10.4934072 | 10.0213040 | 10.5147112 | 12 |
| 49 | 9.4856820 | 9.9786554 | 9.5070267 | 10.4929733 | 10.0213446 | 10.5143180 | 11 |
| 50 | 9.4860749 | 9.9786148 | 9.5074602 | 10.4925398 | 10.0213852 | 10.5139251 | 10 |
| 51 | 9.4864674 | 9.9785741 | 9.5078933 | 10.4921067 | 10.0214259 | 10.5135326 | 9 |
| 52 | 9.4868595 | 9.9785334 | 9.5083261 | 10.4916739 | 10.0214666 | 10.5131405 | 8 |
| 53 | 9.4872512 | 9.9784927 | 9.5087586 | 10.4912414 | 10.0215073 | 10.5127488 | 7 |
| 54 | 9.4876426 | 9.9784519 | 9.5091907 | 10.4908093 | 10.0215481 | 10.5123574 | 6 |
| 55 | 9.4880335 | 9.9784111 | 9.5096224 | 10.4903776 | 10.0215889 | 10.5119665 | 5 |
| 56 | 9.4884240 | 9.9783702 | 9.5100539 | 10.4899461 | 10.0216298 | 10.5115760 | 4 |
| 57 | 9.4888142 | 9.9783293 | 9.5104849 | 10.4895151 | 10.0216707 | 10.5111858 | 3 |
| 58 | 9.4892040 | 9.9782883 | 9.5109156 | 10.4890844 | 10.0217117 | 10.5107960 | 2 |
| 59 | 9.4895934 | 9.9782474 | 9.5113460 | 10.4886540 | 10.0217526 | 10.5104066 | 1 |
| 60 | 9.4899824 | 9.9782063 | 9.5117760 | 10.4882240 | 10.0217937 | 10.5100176 | 0 |
| | *L. Co-Sine.* | *L. Sine* | *L. Co-Tang.* | *L. Tangent* | *L. Co-Secant.* | *L. Secant.* | M |

72 DEGREES.

18 DEGREES

| M | N. Sine | N. Co-Sine | V. Tangent. | N. Co-Tang. | N. Secant | N Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 3090170 | 9510565 | 3249197 | 30776835 | 10514622 | 32260680 | 60 |
| 1 | 3092936 | 9509666 | 3252413 | 30746400 | 10515627 | 32331736 | 59 |
| 2 | 3095702 | 9508766 | 3255630 | 30716020 | 10516612 | 32302846 | 58 |
| 3 | 3098468 | 9507865 | 3258848 | 30685698 | 10517608 | 32274011 | 57 |
| 4 | 3101234 | 9506763 | 3262066 | 30655421 | 10518606 | 32245230 | 56 |
| 5 | 3103999 | 9506060 | 3265285 | 30625203 | 10519605 | 32216503 | 55 |
| 6 | 3106764 | 9505157 | 3268504 | 30595038 | 10520604 | 32187830 | 54 |
| 7 | 3109529 | 9504253 | 3271724 | 30564928 | 10521605 | 32159210 | 53 |
| 8 | 3112294 | 9503348 | 3274944 | 30534870 | 10522607 | 32130644 | 52 |
| 9 | 3115058 | 9502442 | 3278165 | 30504866 | 10523610 | 32102132 | 51 |
| 10 | 3117822 | 9501536 | 3281387 | 30474915 | 10524614 | 32073673 | 50 |
| 11 | 3120586 | 9500629 | 3284610 | 30445018 | 10525619 | 32045266 | 49 |
| 12 | 3123349 | 9499721 | 3287833 | 30415173 | 10526625 | 32016913 | 48 |
| 13 | 3126112 | 9498812 | 3291056 | 30385381 | 10527633 | 31988613 | 47 |
| 14 | 3128875 | 9497902 | 3294280 | 30355641 | 10528641 | 31960365 | 46 |
| 15 | 3131638 | 9496991 | 3297505 | 30325954 | 10529651 | 31932170 | 45 |
| 16 | 3134400 | 9496080 | 3300731 | 38296320 | 10530661 | 31904028 | 44 |
| 17 | 3137163 | 9495168 | 3303957 | 30266737 | 10531673 | 31875937 | 43 |
| 18 | 3139925 | 9494255 | 3307184 | 30237207 | 10532686 | 31847899 | 42 |
| 19 | 3142686 | 9493341 | 3310411 | 30207728 | 10533699 | 31819913 | 41 |
| 20 | 3145448 | 9492426 | 3313639 | 30178301 | 10534714 | 31791978 | 40 |
| 21 | 3148209 | 9491511 | 3316868 | 30148926 | 10535730 | 31764095 | 39 |
| 22 | 3150969 | 9490595 | 3320097 | 30119602 | 10536747 | 31736264 | 38 |
| 23 | 3153730 | 9489678 | 3323327 | 30090330 | 10537765 | 31708484 | 37 |
| 24 | 3156490 | 9488760 | 3326557 | 30061109 | 10538785 | 31680756 | 36 |
| 25 | 3159250 | 9487841 | 3329788 | 30031939 | 10539805 | 31653078 | 35 |
| 26 | 3162010 | 9486922 | 3333020 | 30002820 | 10540826 | 31625452 | 34 |
| 27 | 3164770 | 9486002 | 3336252 | 29973751 | 10541849 | 31597876 | 33 |
| 28 | 3167529 | 9485081 | 3339485 | 29944734 | 10542873 | 31570351 | 32 |
| 29 | 3170544 | 9484159 | 3342719 | 29915766 | 10543897 | 31542847 | 31 |
| 30 | 3173047 | 9483236 | 3345953 | 29886850 | 10544923 | 31515453 | 30 |
| 31 | 3175805 | 9482313 | 3349188 | 29857983 | 10545950 | 31488079 | 29 |
| 32 | 3178563 | 9481389 | 3352424 | 29829166 | 10546978 | 31460756 | 28 |
| 33 | 3181321 | 9480464 | 3355660 | 29800400 | 10548007 | 31433483 | 27 |
| 34 | 3184079 | 9479538 | 3358897 | 29771683 | 10549037 | 31406259 | 26 |
| 35 | 3186836 | 9478611 | 3362134 | 29743016 | 10550068 | 31379086 | 25 |
| 36 | 3189593 | 9477684 | 3365372 | 29714399 | 10551101 | 31351962 | 24 |
| 37 | 3192350 | 9476756 | 3368511 | 29685831 | 10552134 | 31324887 | 23 |
| 38 | 3195106 | 9475827 | 3371850 | 29657312 | 10553169 | 31297862 | 22 |
| 39 | 3197863 | 9474897 | 3375090 | 29628842 | 10554204 | 31270886 | 21 |
| 40 | 3200619 | 9473966 | 3378330 | 29600422 | 10555241 | 31243959 | 20 |
| 41 | 3203374 | 9473035 | 3381571 | 29572050 | 10556279 | 31217081 | 19 |
| 42 | 3206130 | 9472103 | 3384813 | 20543727 | 10557318 | 31190252 | 18 |
| 43 | 3208885 | 9471170 | 3388056 | 29515453 | 10558358 | 31163472 | 17 |
| 44 | 3211640 | 9470236 | 3391299 | 29487227 | 10559399 | 31136740 | 16 |
| 45 | 3214395 | 9469301 | 3394543 | 29459050 | 10560441 | 31110057 | 15 |
| 46 | 3217149 | 9468366 | 3397787 | 29430921 | 10561485 | 31083422 | 14 |
| 47 | 3219903 | 9467430 | 3401032 | 29402840 | 10562529 | 31056825 | 13 |
| 48 | 3222657 | 9466493 | 3404278 | 29374807 | 10563575 | 31030296 | 12 |
| 49 | 3225410 | 9465555 | 3407524 | 29346822 | 10564621 | 31003805 | 11 |
| 50 | 3228164 | 9464616 | 3410771 | 29318885 | 10565669 | 30977363 | 10 |
| 51 | 3230917 | 9463676 | 3414019 | 29290995 | 10566718 | 30950967 | 9 |
| 52 | 3233670 | 9462730 | 3417267 | 29263152 | 10567768 | 30924620 | 8 |
| 53 | 3236422 | 9461765 | 3420516 | 29235358 | 10568819 | 30898319 | 7 |
| 54 | 3239174 | 9460853 | 3423765 | 29207610 | 10569871 | 30872066 | 6 |
| 55 | 3241926 | 9459910 | 3427015 | 29179909 | 10570924 | 30845860 | 5 |
| 56 | 3244678 | 9458967 | 3430266 | 29152256 | 10571978 | 30819702 | 4 |
| 57 | 3247429 | 9458023 | 3433518 | 29124649 | 10573034 | 30793590 | 3 |
| 58 | 3250180 | 9457078 | 3436770 | 29097089 | 10574090 | 30767525 | 2 |
| 59 | 3252931 | 9456132 | 3440023 | 29069576 | 10575148 | 30741507 | 1 |
| 60 | 3255682 | 9455185 | 3443276 | 29042109 | 10576207 | 30715535 | 0 |
| | N Co-Sine. | N. Sine. | N Co-Tang. | N. Tangent. | N. Co-Secant. | N. Secant | M |

71 DEGREES.

18 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.4899824 | 9.9782063 | 9.5117760 | 10.4882240 | 10.0217937 | 10.5100176 | 60 |
| 1 | 9.4903710 | 9.9781653 | 9.5122057 | 10.4877943 | 10.0218347 | 10.5096290 | 59 |
| 2 | 9.4907592 | 9.9781241 | 9.5126351 | 10.4873649 | 10.0218759 | 10.5092408 | 58 |
| 3 | 9.4911471 | 9.9780830 | 9.5130641 | 10.4869359 | 10.0219170 | 10.5088529 | 57 |
| 4 | 9.4915345 | 9.9780418 | 9.5134927 | 10.4865073 | 10.0219582 | 10.5084655 | 56 |
| 5 | 9.4919216 | 9.9780006 | 9.5139210 | 10.4860790 | 10.0219994 | 10.5080784 | 55 |
| 6 | 9.4923083 | 9.9779593 | 9.5143490 | 10.4856510 | 10.0220407 | 10.5076917 | 54 |
| 7 | 9.4926946 | 9.9779180 | 9.5147766 | 10.4852234 | 10.0220820 | 10.5073054 | 53 |
| 8 | 9.4930806 | 9.9778766 | 9.5152039 | 10.4847961 | 10.0221233 | 10.5069194 | 52 |
| 9 | 9.4934661 | 9.9778353 | 9.5156309 | 10.4843691 | 10.0221647 | 10.5065339 | 51 |
| 10 | 9.4938513 | 9.9777938 | 9.5160575 | 10.4839425 | 10.0222062 | 10.5061487 | 50 |
| 11 | 9.4942361 | 9.9777523 | 9.5164838 | 10.4835162 | 10.0222477 | 10.5057639 | 49 |
| 12 | 9.4946205 | 9.9777108 | 9.5169097 | 10.4830903 | 10.0222892 | 10.5053795 | 48 |
| 13 | 9.4950046 | 9.9776693 | 9.5173353 | 10.4826647 | 10.0223307 | 10.5049954 | 47 |
| 14 | 9.4953883 | 9.9776277 | 9.5177606 | 10.4822394 | 10.0223723 | 10.5046117 | 46 |
| 15 | 9.4957716 | 9.9775860 | 9.5181855 | 10.4818145 | 10.0224140 | 10.5042284 | 45 |
| 16 | 9.4961545 | 9.9775444 | 9.5186101 | 10.4813899 | 10.0224556 | 10.5038455 | 44 |
| 17 | 9.4965370 | 9.9775026 | 9.5190344 | 10.4809656 | 10.0224974 | 10.5034630 | 43 |
| 18 | 9.4969192 | 9.9774609 | 9.5194583 | 10.4805417 | 10.0225391 | 10.5030808 | 42 |
| 19 | 9.4973010 | 9.9774191 | 9.5198819 | 10.4801181 | 10.0225809 | 10.5026990 | 41 |
| 20 | 9.4976824 | 9.9773772 | 9.5203052 | 10.4796948 | 10.0226228 | 10.5023176 | 40 |
| 21 | 9.4980635 | 9.9773354 | 9.5207282 | 10.4792718 | 10.0226646 | 10.5019365 | 39 |
| 22 | 9.4984442 | 9.9772934 | 9.5211508 | 10.4788492 | 10.0227066 | 10.5015558 | 38 |
| 23 | 9.4988245 | 9.9772515 | 9.5215730 | 10.4784270 | 10.0227485 | 10.5011755 | 37 |
| 24 | 9.4992045 | 9.9772095 | 9.5219950 | 10.4780050 | 10.0227905 | 10.5007955 | 36 |
| 25 | 9.4995840 | 9.9771674 | 9.5224166 | 10.4775834 | 10.0228326 | 10.5004160 | 35 |
| 26 | 9.4999633 | 9.9771253 | 9.5228379 | 10.4771621 | 10.0228747 | 10.5000367 | 34 |
| 27 | 9.5003421 | 9.9770832 | 9.5231589 | 10.4767411 | 10.0229168 | 10.4996579 | 33 |
| 28 | 9.5007206 | 9.9770410 | 9.5236795 | 10.4763205 | 10.0229590 | 10.4992794 | 32 |
| 29 | 9.5010987 | 9.9769988 | 9.5240999 | 10.4759001 | 10.0230012 | 10.4989013 | 31 |
| 30 | 9.5014764 | 9.9769566 | 9.5245199 | 10.4754801 | 10.0230434 | 10.4985236 | 30 |
| 31 | 9.5018538 | 9.9769143 | 9.5249395 | 10.4750605 | 10.0230857 | 10.4981462 | 29 |
| 32 | 9.5022308 | 9.9768720 | 9.5253589 | 10.4746411 | 10.0231280 | 10.4977692 | 28 |
| 33 | 9.5026075 | 9.9768296 | 9.5257779 | 10.4742221 | 10.0231704 | 10.4973925 | 27 |
| 34 | 9.5029838 | 9.9767872 | 9.5261966 | 10.4738034 | 10.0232128 | 10.4970162 | 26 |
| 35 | 9.5033597 | 9.9767447 | 9.5266150 | 10.4733850 | 10.0232553 | 10.4966403 | 25 |
| 36 | 9.5037353 | 9.9767022 | 9.5270331 | 10.4729669 | 10.0232978 | 10.4962647 | 24 |
| 37 | 9.5041105 | 9.9766597 | 9.5274508 | 10.4725492 | 10.0233403 | 10.4958895 | 23 |
| 38 | 9.5044853 | 9.9766171 | 9.5278682 | 10.4721318 | 10.0233829 | 10.4955147 | 22 |
| 39 | 9.5048598 | 9.9765745 | 9.5282853 | 10.4717147 | 10.0234255 | 10.4951402 | 21 |
| 40 | 9.5052339 | 9.9765318 | 9.5287021 | 10.4712979 | 10.0234682 | 10.4947661 | 20 |
| 41 | 9.5056077 | 9.9764891 | 9.5291186 | 10.4708814 | 10.0235109 | 10.4943923 | 19 |
| 42 | 9.5059811 | 9.9764464 | 9.5295347 | 10.4704653 | 10.0235536 | 10.4940189 | 18 |
| 43 | 9.5063542 | 9.9764036 | 9.5299505 | 10.4700495 | 10.0235964 | 10.4936458 | 17 |
| 44 | 9.5067268 | 9.9763608 | 9.5303661 | 10.4696339 | 10.0236392 | 10.4932731 | 16 |
| 45 | 9.5070992 | 9.9763179 | 9.5307813 | 10.4692187 | 10.0236821 | 10.4929008 | 15 |
| 46 | 9.5074712 | 9.9762750 | 9.5311961 | 10.4688039 | 10.0237250 | 10.4925288 | 14 |
| 47 | 9.5078428 | 9.9762321 | 9.5316107 | 10.4683893 | 10.0237679 | 10.4921572 | 13 |
| 48 | 9.5082141 | 9.9761891 | 9.5320250 | 10.4679750 | 10.0238109 | 10.4917859 | 12 |
| 49 | 9.5085850 | 9.9761461 | 9.5324389 | 10.4675611 | 10.0238539 | 10.4914150 | 11 |
| 50 | 9.5089556 | 9.9761030 | 9.5328526 | 10.4661474 | 10.0238970 | 10.4910444 | 10 |
| 51 | 9.5093258 | 9.9760599 | 9.5332659 | 10.4667341 | 10.0239401 | 10.4906742 | 9 |
| 52 | 9.5096956 | 9.9760167 | 9.5336789 | 10.4663211 | 10.0239833 | 10.4903044 | 8 |
| 53 | 9.5100651 | 9.9759736 | 9.5340916 | 10.4659084 | 10.0240264 | 10.4899349 | 7 |
| 54 | 9.5104343 | 9.9759303 | 9.5345040 | 10.4654960 | 10.0240697 | 10.4895657 | 6 |
| 55 | 9.5108031 | 9.9758870 | 9.5342161 | 10.4650839 | 10.0241130 | 10.4891969 | 5 |
| 56 | 9.5111716 | 9.9758437 | 9.5353278 | 10.4646722 | 10.0241563 | 10.4888284 | 4 |
| 57 | 9.5115397 | 9.9758004 | 9.5357393 | 10.4642607 | 10.0241996 | 10.4884603 | 3 |
| 58 | 9.5119074 | 9.9757570 | 9.5361505 | 10.4638495 | 10.0242430 | 10.4880926 | 2 |
| 59 | 9.5122749 | 9.9757135 | 9.5365613 | 10.4634387 | 10.0242865 | 10.4877251 | 1 |
| 60 | 9.5126419 | 9.9756701 | 9.5369719 | 10.4630281 | 10.0243299 | 10.4873581 | 0 |
| | *LCo-Sine.* | *L. Sine* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant* | *L. Secant.* | M |

71 DEGREES.

19 DEGREES.

| M | N Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 3255682 | 9455185 | 3443276 | 29042109 | 10576207 | 30715535 | 60 |
| 1 | 3258432 | 9454238 | 3446530 | 29014688 | 10577267 | 30689610 | 59 |
| 2 | 3261182 | 9453290 | 3449785 | 28987314 | 10578328 | 30663743 | 58 |
| 3 | 3263931 | 9452341 | 3453040 | 28959986 | 10579390 | 30637898 | 57 |
| 4 | 3266681 | 9451391 | 3456296 | 28932704 | 10580453 | 30612111 | 56 |
| 5 | 3269430 | 9450440 | 3459553 | 28905467 | 10581517 | 30586370 | 55 |
| 6 | 3272179 | 9449489 | 3462810 | 28878277 | 10582583 | 30560675 | 54 |
| 7 | 3274928 | 9448537 | 3466068 | 28851132 | 10583649 | 30535026 | 53 |
| 8 | 3277676 | 9447584 | 3469327 | 28824033 | 10584717 | 30509423 | 52 |
| 9 | 3280424 | 9446630 | 3472586 | 28796979 | 10585786 | 30483864 | 51 |
| 10 | 3283172 | 9445675 | 3475846 | 28769970 | 10586855 | 30458352 | 50 |
| 11 | 3285919 | 9444720 | 3479107 | 28743007 | 10587926 | 30432884 | 49 |
| 12 | 3288666 | 9443764 | 3482368 | 28716088 | 10588999 | 30407462 | 48 |
| 13 | 3291413 | 9442807 | 3485630 | 28689215 | 10590072 | 30382084 | 47 |
| 14 | 3294160 | 9441849 | 3488893 | 28662386 | 10591146 | 30356752 | 46 |
| 15 | 3296906 | 9440890 | 3492156 | 28635602 | 10592221 | 30331464 | 45 |
| 16 | 3299652 | 9439931 | 3495420 | 28608863 | 10593298 | 30306221 | 44 |
| 17 | 3302398 | 9438971 | 3498685 | 28582168 | 10594376 | 30231023 | 43 |
| 18 | 3305144 | 9438010 | 3501950 | 28555517 | 10593454 | 30255868 | 42 |
| 19 | 3307889 | 9437048 | 3505216 | 28528911 | 10596534 | 30230759 | 41 |
| 20 | 3310634 | 9436085 | 3508483 | 28502349 | 10597615 | 30205693 | 40 |
| 21 | 3313379 | 9435121 | 3511750 | 28475831 | 10598697 | 30180672 | 39 |
| 22 | 3316123 | 9434157 | 3515018 | 28449356 | 10599781 | 30155694 | 38 |
| 23 | 3318867 | 9433192 | 3518287 | 28422926 | 10600805 | 30130760 | 37 |
| 24 | 3321611 | 9432226 | 3521556 | 28396539 | 10601951 | 30105870 | 36 |
| 25 | 3324355 | 9431260 | 3524826 | 28370196 | 10603037 | 30081024 | 35 |
| 26 | 3327098 | 9430293 | 3528097 | 28343896 | 10604125 | 30056221 | 34 |
| 27 | 3329841 | 9429325 | 3531368 | 28317639 | 10605214 | 30031462 | 33 |
| 28 | 3332584 | 9428356 | 3534640 | 28291426 | 10606304 | 30006746 | 32 |
| 29 | 3335327 | 9427386 | 3537913 | 28265256 | 10607395 | 29982073 | 31 |
| 30 | 3338069 | 9426415 | 3541186 | 28239129 | 10608487 | 29957443 | 30 |
| 31 | 3340810 | 9425443 | 3544460 | 28213045 | 10609580 | 29932856 | 29 |
| 32 | 3343552 | 9424471 | 3547735 | 28187003 | 10610675 | 29908312 | 28 |
| 33 | 3346293 | 9423498 | 3551010 | 28161104 | 10611770 | 29883811 | 27 |
| 34 | 3349034 | 9422524 | 3554286 | 28135048 | 10612867 | 29859352 | 26 |
| 35 | 3351775 | 9421550 | 3557563 | 28109134 | 10613965 | 29835936 | 25 |
| 36 | 3354516 | 9420575 | 3560840 | 28083263 | 10615064 | 29810563 | 24 |
| 37 | 3357256 | 9419599 | 3564118 | 28057433 | 10616164 | 29786231 | 23 |
| 38 | 3359996 | 9418622 | 3567397 | 28031646 | 10617265 | 29761942 | 22 |
| 39 | 3362735 | 9417644 | 3570676 | 28005901 | 10618367 | 29737695 | 21 |
| 40 | 3365475 | 9416665 | 3573956 | 27980198 | 10619471 | 29713490 | 20 |
| 41 | 3368214 | 9415685 | 3577237 | 27954537 | 10620575 | 29689327 | 19 |
| 42 | 3370953 | 9414705 | 3580518 | 27928917 | 10621681 | 29665205 | 18 |
| 43 | 3373691 | 9413724 | 3583800 | 27903339 | 10622788 | 29641125 | 17 |
| 44 | 3376429 | 9412742 | 3587083 | 27877802 | 10623896 | 29617087 | 16 |
| 45 | 3379167 | 9411760 | 3590367 | 27852307 | 10625005 | 29593090 | 15 |
| 46 | 3381905 | 9410777 | 3593651 | 27826853 | 10626115 | 29569135 | 14 |
| 47 | 3384642 | 9409793 | 3596930 | 27801440 | 10627227 | 29545221 | 13 |
| 48 | 3387379 | 9408808 | 3600222 | 27776069 | 10628339 | 29521348 | 12 |
| 49 | 3390116 | 9407822 | 3603508 | 27750738 | 10629453 | 29497516 | 11 |
| 50 | 3392583 | 9406835 | 3606795 | 27725448 | 10630568 | 29473725 | 10 |
| 51 | 3395589 | 9405848 | 3610083 | 27700199 | 10631684 | 29449975 | 9 |
| 52 | 3398325 | 9404860 | 3613371 | 27674990 | 10632801 | 29426265 | 8 |
| 53 | 3401060 | 9403871 | 3616660 | 27649822 | 10633919 | 29402597 | 7 |
| 54 | 3403795 | 9402881 | 3619950 | 27624695 | 10635038 | 29378968 | 6 |
| 55 | 3406530 | 9401890 | 3623240 | 27599608 | 10636158 | 29355380 | 5 |
| 56 | 3409265 | 9400899 | 3626531 | 27574561 | 10637280 | 29331833 | 4 |
| 57 | 3412000 | 9399907 | 3629823 | 27549554 | 10638403 | 29308326 | 3 |
| 58 | 3414734 | 9398914 | 3633115 | 27524588 | 10639527 | 29284858 | 2 |
| 59 | 3417468 | 9397920 | 3636408 | 27499661 | 10640652 | 29261431 | 1 |
| 60 | 3420202 | 9396926 | 3639702 | 27474774 | 10641778 | 29238044 | 0 |
| | N Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

70 DEGREES.

19 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.5126419 | 9.9756701 | 9.5369719 | 10.4630281 | 10.0243299 | 10.4873581 | 60 |
| 1 | 9.5130086 | 9.9756265 | 9.5373821 | 10.4626179 | 10.0243735 | 10.4869914 | 59 |
| 2 | 9.5133750 | 9.9755830 | 9.5377920 | 10.4622080 | 10.0244170 | 10.4866250 | 58 |
| 3 | 9.5137410 | 9.9755394 | 9.5382017 | 10.4617983 | 10.0244606 | 10.4862590 | 57 |
| 4 | 9.5141067 | 9.9754957 | 9.5386110 | 10.4613890 | 10.0245043 | 10.4858933 | 56 |
| 5 | 9.5144724 | 9.9754521 | 9.5390200 | 10.4609800 | 10.0245479 | 10.4855279 | 55 |
| 6 | 9.5148371 | 9.9754083 | 9.5394237 | 10.4605713 | 10.0245917 | 10.4851629 | 54 |
| 7 | 9.5152017 | 9.9753646 | 9.5398371 | 10.4601629 | 10.0246354 | 10.4847983 | 53 |
| 8 | 9.5155660 | 9.9753208 | 9.5402453 | 10.4597547 | 10.0246792 | 10.4844340 | 52 |
| 9 | 9.5159303 | 9.9752769 | 9.5406531 | 10.4593469 | 10.0247231 | 10.4840700 | 51 |
| 10 | 9.5162936 | 9.9752330 | 9.5410606 | 10.4589394 | 10.0247670 | 10.4837064 | 50 |
| 11 | 9.5166569 | 9.9751891 | 9.5414678 | 10.4585322 | 10.0248109 | 10.4832431 | 49 |
| 12 | 9.5170198 | 9.9751451 | 9.5418747 | 10.4581253 | 10.0248549 | 10.4829802 | 48 |
| 13 | 9.5173824 | 9.9751011 | 9.5422813 | 10.4577187 | 10.0248989 | 10.4826176 | 47 |
| 14 | 9.5177447 | 9.9750570 | 9.5426877 | 10.4573123 | 10.0249430 | 10.4822553 | 46 |
| 15 | 9.5181066 | 9.9750129 | 9.5430937 | 10.4569063 | 10.0249871 | 10.4818934 | 45 |
| 16 | 9.5184682 | 9.9749688 | 9.5434994 | 10.4565006 | 10.0250312 | 10.4815318 | 44 |
| 17 | 9.5188295 | 9.9749246 | 9.5439048 | 10.4560952 | 10.0250754 | 10.4811705 | 43 |
| 18 | 9.5191904 | 9.9748804 | 9.5443100 | 10.4556900 | 10.0251196 | 10.4808096 | 42 |
| 19 | 9.5195510 | 9.9748361 | 9.5447148 | 10.4552852 | 10.0251639 | 10.4804490 | 41 |
| 20 | 9.5199112 | 9.9747918 | 9.5451193 | 10.4548807 | 10.0252082 | 10.4800888 | 40 |
| 21 | 9.5202711 | 9.9747475 | 9.5455236 | 10.4544764 | 10.0252525 | 10.4797289 | 39 |
| 22 | 9.5206307 | 9.9747031 | 9.5459276 | 10.4540724 | 10.0252969 | 10.4793693 | 38 |
| 23 | 9.5209899 | 9.9746587 | 9.5463312 | 10.4536688 | 10.0253413 | 10.4790101 | 37 |
| 24 | 9.5213488 | 9.9746142 | 9.5467346 | 10.4532654 | 10.0253858 | 10.4786512 | 36 |
| 25 | 9.5217074 | 9.9745697 | 9.5471377 | 10.4528623 | 10.0254303 | 10.4782926 | 35 |
| 26 | 9.5220656 | 9.9745252 | 9.5475405 | 10.4524595 | 10.0254748 | 10.4779344 | 34 |
| 27 | 9.5224235 | 9.9744806 | 9.5479430 | 10.4520570 | 10.0255194 | 10.4775765 | 33 |
| 28 | 9.5227811 | 9.9744359 | 9.5483452 | 10.4516548 | 10.0255641 | 10.4772189 | 32 |
| 29 | 9.5231383 | 9.9743913 | 9.5487471 | 10.4512529 | 10.0256087 | 10.4768617 | 31 |
| 30 | 9.5234953 | 9.9743466 | 9.5491487 | 10.4508513 | 10.0256534 | 10.4765047 | 30 |
| 31 | 9.5238518 | 9.9743018 | 9.5495500 | 10.4504500 | 10.0256982 | 10.4761482 | 29 |
| 32 | 9.5242081 | 9.9742570 | 9.5499511 | 10.4500489 | 10.0257430 | 10.4757919 | 28 |
| 33 | 9.5245640 | 9.9742122 | 9.5503519 | 10.4496481 | 10.0257878 | 10.4754360 | 27 |
| 34 | 9.5249196 | 9.9741673 | 9.5507523 | 10.4492477 | 10.0258327 | 10.4750804 | 26 |
| 35 | 9.5252749 | 9.9741224 | 9.5511525 | 10.4488475 | 10.0258776 | 10.4747215 | 25 |
| 36 | 9.5256298 | 9.9740774 | 9.5515524 | 10.4484476 | 10.0259226 | 10.4743702 | 24 |
| 37 | 9.5259844 | 9.9740324 | 9.5519521 | 10.4480479 | 10.0259676 | 10.4740156 | 23 |
| 38 | 9.5263387 | 9.9739873 | 9.5523514 | 10.4476486 | 10.0260127 | 10.4736613 | 22 |
| 39 | 9.5266927 | 9.9739422 | 9.5527504 | 10.4472496 | 10.0260578 | 10.4733073 | 21 |
| 40 | 9.5270463 | 9.9738971 | 9.5531492 | 10.4468508 | 10.0261029 | 10.4729537 | 20 |
| 41 | 9.5273997 | 9.9738519 | 9.5535477 | 10.4464523 | 10.0261481 | 10.4726003 | 19 |
| 42 | 9.5277526 | 9.9738067 | 9.5539459 | 10.4460541 | 10.0261933 | 10.4722474 | 18 |
| 43 | 9.5281053 | 9.9737615 | 9.5543438 | 10.4456562 | 10.0262385 | 10.4718947 | 17 |
| 44 | 9.5284577 | 9.9737162 | 9.5547415 | 10.4452585 | 10.0262838 | 10.4715423 | 16 |
| 45 | 9.5288097 | 9.9736709 | 9.5551388 | 10.4448612 | 10.0263291 | 10.4711903 | 15 |
| 46 | 9.5291614 | 9.9736255 | 9.5555359 | 10.4444641 | 10.0263745 | 10.4708386 | 14 |
| 47 | 9.5295128 | 9.9735801 | 9.5559327 | 10.4440673 | 10.0264199 | 10.4704872 | 13 |
| 48 | 9.5298638 | 9.9735346 | 9.5563292 | 10.4436708 | 10.0264654 | 10.4701362 | 12 |
| 49 | 9.5302146 | 9.9734891 | 9.5567255 | 10.4432745 | 10.0265109 | 10.4697854 | 11 |
| 50 | 9.5305650 | 9.9734435 | 9.5571214 | 10.4428786 | 10.0265565 | 10.4694350 | 10 |
| 51 | 9.5309151 | 9.9733980 | 9.5575171 | 10.4424829 | 10.0266020 | 10.4690849 | 9 |
| 52 | 9.5312649 | 9.9733523 | 9.5579125 | 10.4420895 | 10.0266477 | 10.4687351 | 8 |
| 53 | 9.5316143 | 9.9733067 | 9.5583077 | 10.4416923 | 10.0266933 | 10.4683857 | 7 |
| 54 | 9.5319635 | 9.9732610 | 9.5587025 | 10.4412975 | 10.0267390 | 10.4680365 | 6 |
| 55 | 9.5323123 | 9.9732152 | 9.5590971 | 10.4409029 | 10.0267848 | 10.4676877 | 5 |
| 56 | 9.5326608 | 9.9731694 | 9.5594914 | 10.4405086 | 10.0268306 | 10.4673392 | 4 |
| 57 | 9.5330090 | 9.9731236 | 9.5598854 | 10.4401146 | 10.0268764 | 10.4669910 | 3 |
| 58 | 9.5333569 | 9.9730777 | 9.5602792 | 10.4397208 | 10.0269223 | 10.4666431 | 2 |
| 59 | 9.5337044 | 9.9730318 | 9.5606727 | 10.4393273 | 10.0269682 | 10.4662956 | 1 |
| 60 | 9.5340517 | 9.9729858 | 9.5610659 | 10.4389341 | 10.0270142 | 10.4659483 | 0 |
| | L. Co-Sine. | L Sine. | L. Co Tang. | L. Tangent. | L. Co-Secant | L. Secant. | M |

70 DEGREES.

20 DEGREES

| M | N. Sine | N. Co-Sine | V. Tangent. | N. Co-Tang. | N. Secant | N Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 342 202 | 9396926 | 3639702 | 27474774 | 10641778 | 29238044 | 60 |
| 1 | 3422935 | 9395931 | 3642997 | 27449927 | 10642905 | 29214697 | 59 |
| 2 | 3425668 | 9394935 | 3646292 | 27425120 | 10644033 | 29191389 | 58 |
| 3 | 3428401 | 9393938 | 3649588 | 27400352 | 10645163 | 29168121 | 57 |
| 4 | 3431133 | 9392940 | 3652885 | 27375623 | 10646294 | 29144892 | 56 |
| 5 | 3433865 | 9391942 | 3656182 | 27350934 | 10647426 | 29121703 | 55 |
| 6 | 3436597 | 9390943 | 3659480 | 27326284 | 10648559 | 29098553 | 54 |
| 7 | 3439329 | 9389943 | 3662779 | 27301674 | 10649693 | 29075443 | 53 |
| 8 | 3442060 | 9388942 | 3666079 | 27277102 | 10650828 | 29052372 | 52 |
| 9 | 3444791 | 9387940 | 3669379 | 27252569 | 10651064 | 29029339 | 51 |
| 10 | 3447522 | 9386937 | 3672680 | 27228075 | 10653101 | 29006346 | 50 |
| 11 | 3450252 | 9385934 | 3675982 | 27203620 | 10654240 | 28983391 | 49 |
| 12 | 3452982 | 9384930 | 3679284 | 27179204 | 10655380 | 28960475 | 48 |
| 13 | 3455712 | 9383925 | 3682587 | 27154826 | 10656521 | 28937598 | 47 |
| 14 | 3458442 | 9382919 | 3685891 | 27130487 | 10657663 | 28914760 | 46 |
| 15 | 3461171 | 9381913 | 3689195 | 27106186 | 10658807 | 28891959 | 45 |
| 16 | 3463900 | 9380906 | 3692500 | 27081923 | 10659951 | 28869198 | 44 |
| 17 | 3466629 | 9379898 | 3695806 | 27057699 | 10661097 | 28846474 | 43 |
| 18 | 3469357 | 9378889 | 3699113 | 27033513 | 10662243 | 28823789 | 42 |
| 19 | 3472085 | 9377879 | 3702420 | 27009364 | 10663391 | 28801142 | 41 |
| 20 | 3474813 | 9376869 | 3705728 | 26985254 | 10664540 | 28778532 | 40 |
| 21 | 3477540 | 9375858 | 3709037 | 26961181 | 10665690 | 28755961 | 39 |
| 22 | 3480267 | 9374846 | 3712346 | 26937147 | 10666842 | 28733428 | 38 |
| 23 | 3482994 | 9373833 | 3715656 | 26913149 | 10667994 | 28710932 | 37 |
| 24 | 3485721 | 9372819 | 3718967 | 26889190 | 10669148 | 28688474 | 36 |
| 25 | 3488447 | 9371805 | 3722278 | 26865267 | 10670302 | 28666053 | 35 |
| 26 | 3491173 | 9370790 | 3725590 | 26841383 | 10671458 | 28643670 | 34 |
| 27 | 3493899 | 9369774 | 3728903 | 26817535 | 10672615 | 28621324 | 33 |
| 28 | 3496624 | 9368757 | 3732217 | 26793725 | 10673774 | 28599015 | 32 |
| 29 | 3499349 | 9367740 | 3735532 | 26769951 | 10674934 | 28576744 | 31 |
| 30 | 3502074 | 9366722 | 3738847 | 26746215 | 10676094 | 28554509 | 30 |
| 31 | 3504799 | 9365703 | 3742163 | 26722516 | 10677255 | 28532312 | 29 |
| 32 | 3507523 | 9364683 | 3745479 | 26698853 | 10678418 | 28510152 | 28 |
| 33 | 3510247 | 9363662 | 3748797 | 26675227 | 10679582 | 28488028 | 27 |
| 34 | 3512970 | 9362640 | 3752115 | 26651638 | 10680747 | 28465941 | 26 |
| 35 | 3515693 | 9361618 | 3755434 | 26628085 | 10681914 | 28443891 | 25 |
| 36 | 3518416 | 9360595 | 3758753 | 26604569 | 10683081 | 28421877 | 24 |
| 37 | 3521139 | 9359571 | 3762073 | 26581089 | 10684250 | 28399899 | 23 |
| 38 | 3523862 | 9358546 | 3765394 | 26557645 | 10685420 | 28377959 | 22 |
| 39 | 3526584 | 9357521 | 3768716 | 26534238 | 10686591 | 28356054 | 21 |
| 40 | 3529306 | 9356495 | 3772038 | 26510867 | 10687763 | 28334185 | 20 |
| 41 | 3532027 | 9355468 | 3775361 | 26487531 | 10688936 | 28312353 | 19 |
| 42 | 3534748 | 9354440 | 3778685 | 26464232 | 10690110 | 28290556 | 18 |
| 43 | 3537469 | 9353411 | 3782010 | 26440969 | 10691286 | 28268796 | 17 |
| 44 | 3540190 | 9352382 | 3785335 | 26417741 | 10692463 | 28247071 | 16 |
| 45 | 3542910 | 9351352 | 3788661 | 26394549 | 10693641 | 28225382 | 15 |
| 46 | 3545630 | 9350321 | 3791988 | 26371392 | 10694820 | 28203729 | 14 |
| 47 | 3548350 | 9349289 | 3795316 | 26348271 | 10696000 | 28182111 | 13 |
| 48 | 3551070 | 9348256 | 3798644 | 26325186 | 10697182 | 28160519 | 12 |
| 49 | 3553789 | 9347223 | 3801973 | 26302136 | 10698364 | 28138982 | 11 |
| 50 | 3556508 | 9346189 | 3805303 | 26279121 | 10699548 | 28117471 | 10 |
| 51 | 3559225 | 9345154 | 3808633 | 26256141 | 10700733 | 28095995 | 9 |
| 52 | 3561944 | 9344118 | 3811964 | 26233196 | 10701919 | 28074554 | 8 |
| 53 | 3564662 | 9343082 | 3815296 | 26210286 | 10703106 | 28053148 | 7 |
| 54 | 3567380 | 9342045 | 3818629 | 26187411 | 10704295 | 28031777 | 6 |
| 55 | 3570097 | 9341007 | 3821962 | 26164571 | 10705484 | 28010441 | 5 |
| 56 | 3572814 | 9339968 | 3825296 | 26141766 | 10706675 | 27989140 | 4 |
| 57 | 3575531 | 9338928 | 3828631 | 26118995 | 10707867 | 27967873 | 3 |
| 58 | 3578248 | 9337887 | 3831967 | 26096259 | 10709060 | 27946641 | 2 |
| 59 | 3580964 | 9336846 | 3835303 | 26073558 | 10710254 | 27925444 | 1 |
| 60 | 3583679 | 9335804 | 3838640 | 26050891 | 10711450 | 27904281 | 0 |
| | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N. Co-Secant. | N. Secant | M |

69 DEGREES.

20 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.5340517 | 9.9729858 | 9.5610658 | 10.4389341 | 10.0270142 | 10.4059483 | 60 |
| 1 | 9.5343986 | 9.9729398 | 9.5614588 | 10.4385412 | 10.0270602 | 10.4656014 | 59 |
| 2 | 9.5347452 | 9.9728938 | 9.5618515 | 10.4381485 | 10.0271062 | 10.4652548 | 58 |
| 3 | 9.5350915 | 9.9728477 | 9.5622439 | 10.4377561 | 10.0271523 | 10.4649085 | 57 |
| 4 | 9.5354375 | 9.9728016 | 9.5626360 | 10.4373640 | 10.0271984 | 10.4645625 | 56 |
| 5 | 9.5357832 | 9.9727554 | 9.5630278 | 10.4369722 | 10.0272446 | 10.4642168 | 55 |
| 6 | 9.5361286 | 9.9727092 | 9.5634194 | 10.4365806 | 10.0272908 | 10.4638714 | 54 |
| 7 | 9.5364737 | 9.9726629 | 9.5638107 | 10.4361893 | 10.0273371 | 10.4635263 | 53 |
| 8 | 9.5368184 | 9.9726166 | 9.5642018 | 10.4352982 | 10.0273834 | 10.4631816 | 52 |
| 9 | 9.5371628 | 9.9725703 | 9.5645925 | 10.4354075 | 10.0274297 | 10.4628272 | 51 |
| 10 | 9.5375069 | 9.9725239 | 9.5649831 | 10.4350169 | 10.0274761 | 10.4624930 | 50 |
| 11 | 9.5378508 | 9.9724775 | 9.5653733 | 10.4346267 | 10.0275225 | 10.4621492 | 49 |
| 12 | 9.5381943 | 9.9724310 | 9.5657633 | 10.4342367 | 10.0275690 | 10.4618057 | 48 |
| 13 | 9.5385375 | 9.9723845 | 9.5661530 | 10.4338470 | 10.0276155 | 10.4614625 | 47 |
| 14 | 9.5388804 | 9.9723380 | 9.5665424 | 10.4334576 | 10.0276620 | 10.4611196 | 46 |
| 15 | 9.5392230 | 9.9722914 | 9.5669316 | 10.4330684 | 10.0277086 | 10.4607770 | 45 |
| 16 | 9.5395653 | 9.9722448 | 9.5673205 | 10.4326795 | 10.0277552 | 10.4604347 | 44 |
| 17 | 9.5399073 | 9.9721981 | 9.5677091 | 10.4322909 | 10.0278019 | 10.4600927 | 43 |
| 18 | 9.5402489 | 9.9721514 | 9.5680975 | 10.4319025 | 10.0278486 | 10.4597511 | 42 |
| 19 | 9.5405903 | 9.9721047 | 9.5684856 | 10.4315144 | 10.0278953 | 10.4594097 | 41 |
| 20 | 9.5409314 | 9.9720579 | 9.5688735 | 10.4311265 | 10.0279421 | 10.4590686 | 40 |
| 21 | 9.5412721 | 9.9720110 | 9.5692611 | 10.4307389 | 10.0279890 | 10.4587279 | 39 |
| 22 | 9.5416126 | 9.9719642 | 9.5696484 | 10.4303516 | 10.0280358 | 10.4583874 | 38 |
| 23 | 9.5419527 | 9.9719172 | 9.5700355 | 10.4299645 | 10.0280828 | 10.4580473 | 37 |
| 24 | 9.5422926 | 9.9718703 | 9.5704223 | 10.4295777 | 10.0281297 | 10.4577074 | 36 |
| 25 | 9.5426321 | 9.9718233 | 9.5708088 | 10.4291912 | 10.0281767 | 10.4573679 | 35 |
| 26 | 9.5429713 | 9.9717762 | 9.5711951 | 10.4288049 | 10.0282238 | 10.4570287 | 34 |
| 27 | 9.5433103 | 9.9717291 | 9.5715811 | 10.4284189 | 10.0282709 | 10.4566897 | 33 |
| 28 | 9.5436489 | 9.9716820 | 9.5719669 | 10.4280331 | 10.0283180 | 10.4563511 | 32 |
| 29 | 9.5439873 | 9.9716348 | 9.5723524 | 10.4276476 | 10.0283652 | 10.4560127 | 31 |
| 30 | 9.5443253 | 9.9715876 | 9.5727377 | 10.4272623 | 10.0284124 | 10.4556747 | 30 |
| 31 | 9.5446630 | 9.9715404 | 9.5731227 | 10.4268773 | 10.0284596 | 10.4553370 | 29 |
| 32 | 9.5450005 | 9.9714931 | 9.5735074 | 10.4264926 | 10.0285009 | 10.4549995 | 28 |
| 33 | 9.5453376 | 9.9714457 | 9.5738919 | 10.4261081 | 10.0285543 | 10.4546624 | 27 |
| 34 | 9.5456745 | 9.9713984 | 9.5742761 | 10.4257239 | 10.0286016 | 10.4543255 | 26 |
| 35 | 9.5460110 | 9.9713509 | 9.5746601 | 10.4253399 | 10.0286491 | 10.4539890 | 25 |
| 36 | 9.5463472 | 9.9713035 | 9.5750438 | 10.4249562 | 10.0286965 | 10.4536415 | 24 |
| 37 | 9.5466832 | 9.9712560 | 9.5754272 | 10.4245728 | 10.0287440 | 10.4533168 | 23 |
| 38 | 9.5470189 | 9.9712084 | 9.5758104 | 10.4241896 | 10.0287916 | 10.4529811 | 22 |
| 39 | 9.5473542 | 9.9711608 | 9.5761934 | 10.4238066 | 10.0288392 | 10.4526458 | 21 |
| 40 | 9.5476893 | 9.9711132 | 9.5765761 | 10.4234239 | 10.0288868 | 10.4523107 | 20 |
| 41 | 9.5480240 | 9.9710655 | 9.5769585 | 10.4230415 | 10.0289345 | 10.4519760 | 19 |
| 42 | 9.5483585 | 9.9710178 | 9.5773407 | 10.4226593 | 10.0289822 | 10.4516415 | 18 |
| 43 | 9.5486927 | 9.9709701 | 9.5777226 | 10.4222774 | 10.0290299 | 10.4513073 | 17 |
| 44 | 9.5490266 | 9.9709223 | 9.5781043 | 10.4218957 | 10.0290777 | 10.4509734 | 16 |
| 45 | 9.5493602 | 9.9708744 | 9.5784858 | 10.4215142 | 10.0291256 | 10.4506398 | 15 |
| 46 | 9.5496935 | 9.9708265 | 9.5788669 | 10.4211331 | 10.0291735 | 10.4503065 | 14 |
| 47 | 9.5500265 | 9.9707786 | 9.5792479 | 10.4207521 | 10.0292214 | 10.4499735 | 13 |
| 48 | 9.5503592 | 9.9707306 | 9.5796286 | 10.4203714 | 10.0292694 | 10.4496408 | 12 |
| 49 | 9.5506916 | 9.9706826 | 9.5800090 | 10.4199910 | 10.0293174 | 10.4493084 | 11 |
| 50 | 9.5510237 | 9.9706346 | 9.5803892 | 10.4196108 | 10.0293654 | 10.4489763 | 10 |
| 51 | 9.5513556 | 9.9705865 | 9.5807691 | 10.4192309 | 10.0294135 | 10.4486444 | 9 |
| 52 | 9.5516871 | 9.9705383 | 9.5811488 | 10.4188512 | 10.0294617 | 10.4483129 | 8 |
| 53 | 9.5520184 | 9.9704902 | 9.5815282 | 10.4184718 | 10.0295098 | 10.4479816 | 7 |
| 54 | 9.5523494 | 9.9704419 | 9.5819074 | 10.4180926 | 10.0295581 | 10.4476506 | 6 |
| 55 | 9.5526801 | 9.9703937 | 9.5822864 | 10.4177136 | 10.0296063 | 10.4473199 | 5 |
| 56 | 9.5530105 | 9.9703454 | 9.5826651 | 10.4173349 | 10.0296546 | 10.4469895 | 4 |
| 57 | 9.5533406 | 9.9702970 | 9.5830435 | 10.4169565 | 10.0297030 | 10.4466594 | 3 |
| 58 | 9.5536704 | 9.9702486 | 9.5834217 | 10.4165783 | 10.0297514 | 10.4463295 | 2 |
| 59 | 9.5539999 | 9.9702002 | 9.5837997 | 10.4162003 | 10.0297998 | 10.4460001 | 1 |
| 60 | 9.5543292 | 9.9701517 | 9.5841774 | 10.4158226 | 10.0298483 | 10.4456708 | 0 |
| | L Co-Sine. | L. Sine | L.Co-Tnag. | L. Tangent. | L.Co-Secant | L. Secant. | M |

69 DEGREES.

21 DEGREES.

| M | N Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co- Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 3583679 | 9335804 | 3838640 | 26050891 | 10711450 | 27904281 | 60 |
| 1 | 3586395 | 9334761 | 3841978 | 26028258 | 10712647 | 27883153 | 59 |
| 2 | 3589110 | 9333717 | 3845317 | 26005659 | 10713844 | 27862059 | 58 |
| 3 | 3591825 | 9332673 | 3848656 | 25983095 | 10715043 | 27840999 | 57 |
| 4 | 3594540 | 9331628 | 3851996 | 25960564 | 10716244 | 27819973 | 56 |
| 5 | 3597254 | 9330582 | 3855337 | 25938068 | 10717445 | 27798982 | 55 |
| 6 | 3599968 | 9329535 | 3858679 | 25915606 | 10718647 | 27778024 | 54 |
| 7 | 3602682 | 9328487 | 3862021 | 25893177 | 10719851 | 27757100 | 53 |
| 8 | 3605395 | 9327439 | 3865364 | 25870782 | 10721056 | 27736211 | 52 |
| 9 | 3608108 | 9326390 | 3868708 | 25848421 | 10722262 | 27715355 | 51 |
| 10 | 3610821 | 9325340 | 3872053 | 25826094 | 10723469 | 27694532 | 50 |
| 11 | 3613533 | 9324289 | 3875398 | 25803800 | 10724678 | 27673743 | 49 |
| 12 | 3616246 | 9323238 | 3878744 | 25781539 | 10725887 | 27652988 | 48 |
| 13 | 3618958 | 9322186 | 3882091 | 25759312 | 10727098 | 27632266 | 47 |
| 14 | 3621669 | 9321133 | 3885439 | 25737118 | 10728310 | 27611578 | 46 |
| 15 | 3624380 | 9320079 | 3888787 | 25714957 | 10729523 | 27590923 | 45 |
| 16 | 3627091 | 9319024 | 3892136 | 25692830 | 10730737 | 27570301 | 44 |
| 17 | 3629802 | 9317968 | 3895486 | 25670735 | 10731953 | 27549712 | 43 |
| 18 | 3632512 | 9316912 | 3898837 | 25648674 | 10733170 | 27529157 | 42 |
| 19 | 3635222 | 9315855 | 3902189 | 25626645 | 10734388 | 27508634 | 41 |
| 20 | 3637932 | 9314797 | 3905541 | 25604649 | 10735607 | 27488144 | 40 |
| 21 | 3640641 | 9313738 | 3908894 | 25582686 | 10736827 | 27467687 | 39 |
| 22 | 3643350 | 9312679 | 3912248 | 25560756 | 10738048 | 27447263 | 38 |
| 23 | 3646059 | 9311619 | 3915602 | 25538858 | 10739271 | 27429871 | 37 |
| 24 | 3648768 | 9310558 | 3918957 | 25516992 | 10740495 | 27406512 | 36 |
| 25 | 3651476 | 9309496 | 3922313 | 25495160 | 10741720 | 27386186 | 35 |
| 26 | 3654184 | 9308433 | 3925670 | 25473359 | 10742946 | 27365892 | 34 |
| 27 | 3656892 | 9307370 | 3929028 | 25451591 | 10744173 | 27345630 | 33 |
| 28 | 3659599 | 9306306 | 3932386 | 25429855 | 10745402 | 27325400 | 32 |
| 29 | 3662306 | 9305241 | 3935745 | 25408151 | 10746631 | 27305203 | 31 |
| 30 | 3665013 | 9304175 | 3939105 | 25386479 | 10747862 | 27285038 | 30 |
| 31 | 3667719 | 9303109 | 3942466 | 25364839 | 10749095 | 27264905 | 29 |
| 32 | 3670425 | 9302042 | 3945827 | 25343231 | 10750328 | 27244808 | 28 |
| 33 | 3673131 | 9300974 | 3949189 | 25321655 | 10751562 | 27224735 | 27 |
| 34 | 3675836 | 9299905 | 3952552 | 25300111 | 10752798 | 27204698 | 26 |
| 35 | 3678541 | 9298835 | 3955916 | 25278598 | 10754035 | 27184693 | 25 |
| 36 | 3681246 | 9297765 | 3959280 | 25257117 | 10755273 | 27164719 | 24 |
| 37 | 3683950 | 9296694 | 3962645 | 25235667 | 10756512 | 27144777 | 23 |
| 38 | 3686654 | 9295622 | 3966011 | 25214249 | 10757753 | 27124866 | 22 |
| 39 | 3689358 | 9294549 | 3969378 | 25192863 | 10758995 | 27104987 | 21 |
| 40 | 3692062 | 9293475 | 3972746 | 25161507 | 10760237 | 27085139 | 20 |
| 41 | 3694765 | 9292401 | 3976114 | 25150183 | 10761481 | 27065323 | 19 |
| 42 | 3697463 | 9291326 | 3979483 | 25128890 | 10762727 | 27045538 | 18 |
| 43 | 3700170 | 9290250 | 3982853 | 25107629 | 10763973 | 27025784 | 17 |
| 44 | 3702872 | 9289173 | 3986224 | 25086398 | 10765221 | 27006061 | 16 |
| 45 | 3705574 | 9288095 | 3989596 | 25065198 | 10766470 | 26986370 | 15 |
| 46 | 3708276 | 9287017 | 3992968 | 25044029 | 10767720 | 26966709 | 14 |
| 47 | 3710977 | 9285938 | 3996341 | 25022891 | 10768971 | 26947079 | 13 |
| 48 | 3713678 | 9284858 | 3999715 | 25001784 | 10770224 | 26927480 | 12 |
| 49 | 3716379 | 9283777 | 4003089 | 24980707 | 10771477 | 26907912 | 11 |
| 50 | 3719080 | 9282696 | 4007465 | 24959661 | 10772732 | 26888374 | 10 |
| 51 | 3721780 | 9281614 | 4009841 | 24938645 | 10773988 | 26868867 | 9 |
| 52 | 3724480 | 9280531 | 4013218 | 24917660 | 10774246 | 26849391 | 8 |
| 53 | 3727179 | 9279447 | 4016596 | 24896706 | 10776504 | 26829945 | 7 |
| 54 | 3729878 | 9278362 | 4019975 | 24865781 | 10777765 | 26810530 | 6 |
| 55 | 3732577 | 9276277 | 4023354 | 24854887 | 10779025 | 26791145 | 5 |
| 56 | 3735275 | 9276191 | 4026734 | 24834023 | 10780287 | 26771790 | 4 |
| 57 | 3737973 | 9275104 | 4030115 | 24813190 | 10781550 | 26752465 | 3 |
| 58 | 3740671 | 9274016 | 4033497 | 24792386 | 10782815 | 26733170 | 2 |
| 59 | 3743369 | 9272928 | 4036879 | 24771612 | 10784080 | 26713906 | 1 |
| 60 | 3746066 | 9271839 | 4040262 | 24750869 | 10785347 | 26694672 | 0 |
| | N. Co-Sine. | N. Sine. | N .Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

68 DEGREES.

21 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.5543292 | 9.9701517 | 9.5841774 | 10.4158226 | 10.0298483 | 10.4456708 | 60 |
| 1 | 9.5546581 | 9.9701032 | 9.5845549 | 10.4154451 | 10.0298968 | 10.4453419 | 59 |
| 2 | 9.5549868 | 9.9700547 | 9.5849321 | 10.4150679 | 10.0299453 | 10.4450132 | 58 |
| 3 | 9.5553152 | 9.9700061 | 9.5853091 | 10.4146909 | 10.0299989 | 10.4446848 | 57 |
| 4 | 9.5556433 | 9.9699574 | 9.5856859 | 10.4143141 | 10.0300426 | 10.4443567 | 56 |
| 5 | 9.5559711 | 9.9699087 | 9.5860624 | 10.4139376 | 10.0300913 | 10.4440289 | 55 |
| 6 | 9.5562987 | 9.9698600 | 9.5864386 | 10.4135614 | 10.0301400 | 10.4437013 | 54 |
| 7 | 9.5566259 | 9.9698112 | 9.5868147 | 10.4131853 | 10.0301888 | 10.4433741 | 53 |
| 8 | 9.5569529 | 9.9697624 | 9.5871904 | 10.4128096 | 10.0302376 | 10.4430471 | 52 |
| 9 | 9.5572796 | 9.9697136 | 9.5875660 | 10.4124340 | 10.0302864 | 10.4427204 | 51 |
| 10 | 9.5576060 | 9.9696647 | 9.5879413 | 10.4120587 | 10.0303353 | 10.4423940 | 50 |
| 11 | 9.5579321 | 9.9696158 | 9.5883163 | 10.4116837 | 10.0303842 | 10.4420679 | 49 |
| 12 | 9.5582579 | 9.9695668 | 9.5886912 | 10.4113088 | 10.0304332 | 10.4417421 | 48 |
| 13 | 9.5585835 | 9.9695177 | 9.5890657 | 10.4109343 | 10.0304823 | 10.4414165 | 47 |
| 14 | 9.5589088 | 9.9694687 | 9.5894401 | 10.4105599 | 10.0305313 | 10.4410912 | 46 |
| 15 | 9.5592338 | 9.9694196 | 9.5898142 | 10.4101858 | 10.0305804 | 10.4407662 | 45 |
| 16 | 9.5595585 | 9.9693704 | 9.5901881 | 10.4098119 | 10.0306296 | 10.4404415 | 44 |
| 17 | 9.5598829 | 9.9693212 | 9.5905617 | 10.4094383 | 10.0306788 | 10.4401171 | 43 |
| 18 | 9.5602071 | 9.9692720 | 9.5909351 | 10.4090649 | 10.0307280 | 10.4397929 | 42 |
| 19 | 9.5605310 | 9.9692227 | 9.5913082 | 10.4086918 | 10.0307773 | 10.4394690 | 41 |
| 20 | 9.5608546 | 9.9691734 | 9.5916812 | 10.4083188 | 10.0308266 | 10.4391554 | 40 |
| 21 | 9.5611779 | 9.9691240 | 9.5920539 | 10.4079461 | 10.0308759 | 10.4388221 | 39 |
| 22 | 9.5615010 | 9.9690746 | 9.5924263 | 10.4075737 | 10.0309254 | 10.4384990 | 38 |
| 23 | 9.5618237 | 9.9990252 | 9.5927985 | 10.4072015 | 10.0309748 | 10.4381763 | 37 |
| 24 | 9.5621462 | 9.9689757 | 9.5931705 | 10.4068295 | 10.0310243 | 10.4378538 | 36 |
| 25 | 9.5624685 | 9.9689262 | 9.5935422 | 10.4064577 | 10.0310738 | 10.4375315 | 35 |
| 26 | 9.5627904 | 9.9688766 | 9.5939138 | 10.4060862 | 10.0311234 | 10.4372096 | 34 |
| 27 | 9.5631121 | 9.9688270 | 9.5942851 | 10.4057149 | 10.0311730 | 10.4368879 | 33 |
| 28 | 9.5634335 | 9.9687773 | 9.5946561 | 10.4053439 | 10.0312227 | 10.4365665 | 32 |
| 29 | 9.5637546 | 9.9687276 | 9.5950269 | 10.4049731 | 10.0312724 | 10.4362454 | 31 |
| 30 | 9.5640754 | 9.9686779 | 9.5953975 | 10.4046025 | 10.0313221 | 10.4359246 | 30 |
| 31 | 9.5643960 | 9.9686281 | 9.5957679 | 10.4042321 | 10.0313719 | 10.4356040 | 29 |
| 32 | 9.5647163 | 9.9685783 | 9.5961380 | 10.4038620 | 10.0314217 | 10.4352837 | 28 |
| 33 | 9.5650363 | 9.9685284 | 9.5965079 | 10.4034921 | 10.0314716 | 10.4349637 | 27 |
| 34 | 9.5653561 | 9.9684785 | 9.5968776 | 10.4031224 | 10.0315215 | 10.4346439 | 26 |
| 35 | 9.5656756 | 9.9684286 | 9.5972470 | 10.4027530 | 10.0315714 | 10.4343244 | 25 |
| 36 | 9.5659948 | 9.9683786 | 9.5976162 | 10.4023838 | 10.0316214 | 10.4340052 | 24 |
| 37 | 9.5663137 | 9.9683285 | 9.5979852 | 10.4020148 | 10.0316715 | 10.4336863 | 23 |
| 38 | 9.5666324 | 9.9682784 | 9.5983540 | 10.4016460 | 10.0317216 | 10.4333676 | 22 |
| 39 | 9.5669508 | 9.9682283 | 9.5987225 | 10.4012778 | 10.0317717 | 10.4330492 | 21 |
| 40 | 9.5672689 | 9.9681781 | 9.5990908 | 10.4009092 | 10.0318219 | 10.4327311 | 20 |
| 41 | 9.5675868 | 9.9681279 | 9.5994588 | 10.4005411 | 10.0318721 | 10.4324132 | 19 |
| 42 | 9.5679044 | 9.9680777 | 9.5998267 | 10.4001733 | 10.0319223 | 10.4320956 | 18 |
| 43 | 9.5682217 | 9.9680274 | 9.6001943 | 10.3998057 | 10.0319726 | 10.4317783 | 17 |
| 44 | 9.5685387 | 9.9679771 | 9.6005617 | 10.3994383 | 10.0320229 | 10.4314613 | 16 |
| 45 | 9.5688555 | 9.9679267 | 9.6009289 | 10.3990711 | 10.0320733 | 10.4311445 | 15 |
| 46 | 9.5691721 | 9.9678763 | 9.6012958 | 10.3987042 | 10.0321237 | 10.4308279 | 14 |
| 47 | 9.5694883 | 9.9678258 | 9.6016625 | 10.3983375 | 10.0321742 | 10.4305117 | 13 |
| 48 | 9.5698043 | 9.9677753 | 9.6020290 | 10.3979710 | 10.0322247 | 10.4301957 | 12 |
| 49 | 9.5701200 | 9.9677247 | 9.6023953 | 10.3976047 | 10.0322753 | 10.4298800 | 11 |
| 50 | 9.5704355 | 9.9676741 | 9.6027613 | 10.3972387 | 10.0323259 | 10.4295645 | 10 |
| 51 | 9.5707506 | 9.9676235 | 9.6031271 | 10.3968729 | 10.0323705 | 10.4292494 | 9 |
| 52 | 9.5710656 | 9.9675728 | 9.6034927 | 10.3965073 | 10.0324272 | 10.4289344 | 8 |
| 53 | 9.5713802 | 9.9675221 | 9.6038581 | 10.3961419 | 10.0324779 | 10.4286198 | 7 |
| 54 | 9.5716946 | 9.9674713 | 9.6042233 | 10.3957767 | 10.0325287 | 10.4283054 | 6 |
| 55 | 9.5720087 | 9.9674205 | 9.6045882 | 10.3954118 | 10.0325795 | 10.4279913 | 5 |
| 56 | 9.5723226 | 9.9673697 | 9.6049529 | 10.3950471 | 10.0326303 | 10.4276774 | 4 |
| 57 | 9.5726362 | 9.9673188 | 9.6053174 | 10.3946826 | 10.0326812 | 10.4273638 | 3 |
| 58 | 9.5729495 | 9.9672679 | 9.6056817 | 10.3943183 | 10.0327321 | 10.4270505 | 2 |
| 59 | 9.5732626 | 9.9672169 | 9.6060457 | 10.3939543 | 10.0327831 | 10.4267374 | 1 |
| 60 | 9.5735754 | 9.9671659 | 9.6064096 | 10.3935904 | 10.0328341 | 10.4264246 | 0 |
| | L Co-Sine. | L. Sine | L.Co-Tang. | L. Tangent | L.Co-Secant | L. Secant. | M |

68 DEGREES.

22 DEGREES.

| M | *N. Sine.* | *N. Co-Sine.* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant.* | *N Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 3746066 | 9271839 | 4040262 | 24750869 | 10785347 | 26694672 | 60 |
| 1 | 3748763 | 9270749 | 4043646 | 24730155 | 10786616 | 26675467 | 59 |
| 2 | 3751459 | 9269658 | 4047031 | 24709470 | 10787885 | 26656292 | 58 |
| 3 | 3754156 | 9268566 | 4050417 | 24688816 | 10789156 | 26637148 | 57 |
| 4 | 3756852 | 9267473 | 4053804 | 24668191 | 10796427 | 26618033 | 56 |
| 5 | 3759547 | 9266380 | 4057191 | 24647596 | 10791700 | 26598947 | 55 |
| 6 | 3762243 | 9265286 | 4060579 | 24627030 | 10792975 | 26579891 | 54 |
| 7 | 3764938 | 9264191 | 4063968 | 24606494 | 10794250 | 26560865 | 52 |
| 8 | 3767632 | 9263096 | 4067358 | 24585987 | 10795527 | 26541868 | 51 |
| 9 | 3770327 | 9262000 | 4070748 | 24565509 | 10796805 | 26522901 | 50 |
| 10 | 3773021 | 9260903 | 4074139 | 24545061 | 10798084 | 26503962 | 49 |
| 11 | 3775714 | 9259805 | 4077531 | 24524642 | 10799364 | 26485054 | 53 |
| 12 | 3778408 | 9258706 | 4080924 | 24504252 | 10780646 | 26466174 | 48 |
| 13 | 3781101 | 9257606 | 4084318 | 24483891 | 10801928 | 26447323 | 47 |
| 14 | 3783794 | 9256506 | 4087713 | 24463559 | 10803212 | 26428502 | 46 |
| 15 | 3786486 | 9255405 | 4091108 | 24443256 | 10804497 | 26409709 | 45 |
| 16 | 3789178 | 9254303 | 4094504 | 24422982 | 10805784 | 26390946 | 44 |
| 17 | 3791870 | 9253200 | 4097901 | 24402736 | 10807071 | 26372211 | 43 |
| 18 | 3794562 | 9252097 | 4101299 | 24382519 | 10808360 | 26353505 | 42 |
| 19 | 3797253 | 9250993 | 4104697 | 24362331 | 10809650 | 26334828 | 41 |
| 20 | 3799944 | 9249888 | 4108097 | 24342172 | 10810942 | 26316180 | 40 |
| 21 | 3802634 | 9248782 | 4111497 | 24322041 | 10812234 | 26297560 | 39 |
| 22 | 3805324 | 9247675 | 4114898 | 24301938 | 10813528 | 26278969 | 38 |
| 23 | 3808014 | 9246568 | 4118300 | 24281864 | 10814823 | 26260406 | 37 |
| 24 | 3810704 | 9245460 | 4121703 | 24261819 | 10816119 | 26241872 | 36 |
| 25 | 3813393 | 9244351 | 4125106 | 24241801 | 10817417 | 26223366 | 35 |
| 26 | 3816082 | 9243241 | 4128510 | 24221812 | 10818715 | 26204888 | 34 |
| 27 | 3818770 | 9242131 | 4131915 | 24201851 | 10820015 | 26186439 | 33 |
| 28 | 3821459 | 9241020 | 4135321 | 24181918 | 10821316 | 26168018 | 32 |
| 29 | 3824147 | 9239908 | 4138728 | 24162013 | 10822618 | 26149624 | 31 |
| 30 | 3826834 | 9238795 | 4142136 | 24142136 | 10823922 | 26131259 | 30 |
| 31 | 3829522 | 9237681 | 4145544 | 24122286 | 10825227 | 26112922 | 29 |
| 32 | 3832209 | 9236567 | 4148953 | 24102465 | 10826533 | 26094613 | 28 |
| 33 | 3834895 | 9235452 | 4152363 | 24082672 | 10827840 | 26076332 | 27 |
| 34 | 3837582 | 9234336 | 4155774 | 24062906 | 10829149 | 26058078 | 26 |
| 35 | 3840268 | 9233219 | 4159186 | 24043168 | 10830458 | 26039852 | 25 |
| 36 | 3842953 | 9232102 | 4162599 | 24023457 | 10831769 | 26021654 | 24 |
| 37 | 3845639 | 9230984 | 4166012 | 24002774 | 10833081 | 26003484 | 23 |
| 38 | 3848324 | 9229865 | 4169426 | 23984118 | 10834395 | 25985341 | 22 |
| 39 | 3851008 | 9228745 | 4172841 | 23964490 | 10835709 | 25967225 | 21 |
| 40 | 3853693 | 9227624 | 4176257 | 23944889 | 10837025 | 25949137 | 20 |
| 41 | 3856877 | 9226503 | 4179674 | 23925316 | 10838342 | 25931077 | 19 |
| 42 | 3859060 | 9225381 | 4183091 | 23905769 | 10839661 | 25913043 | 18 |
| 43 | 3861744 | 9224258 | 4186509 | 23886250 | 10840980 | 25895037 | 17 |
| 44 | 3864427 | 9223134 | 4189928 | 23866758 | 10842301 | 25877058 | 16 |
| 45 | 3867110 | 9222009 | 4193348 | 23847293 | 10843623 | 25859107 | 15 |
| 46 | 3869792 | 9220884 | 4196769 | 23827855 | 10844947 | 25841182 | 14 |
| 47 | 3872474 | 9219758 | 4200191 | 23808444 | 10846271 | 25823284 | 13 |
| 48 | 3875156 | 9218631 | 4203613 | 23789060 | 10847597 | 25805414 | 12 |
| 49 | 3877837 | 9217503 | 4207036 | 23769703 | 10848924 | 25787570 | 11 |
| 50 | 3880518 | 9216375 | 4210460 | 23750372 | 10850252 | 25769753 | 10 |
| 51 | 3883199 | 9215246 | 4213885 | 23731068 | 10851582 | 25751963 | 9 |
| 52 | 3885880 | 9214116 | 4217311 | 23711791 | 10852913 | 25734199 | 8 |
| 53 | 3888560 | 9212985 | 4220738 | 23692540 | 10854245 | 25716462 | 7 |
| 54 | 3891239 | 9211854 | 4224166 | 23673316 | 10855578 | 25698752 | 6 |
| 55 | 3893919 | 9210722 | 4227594 | 23654118 | 10856912 | 27681069 | 5 |
| 56 | 3896598 | 9209589 | 4231023 | 23634946 | 10858248 | 25663412 | 4 |
| 57 | 3899277 | 9208455 | 4234453 | 23615801 | 10859585 | 25645781 | 3 |
| 58 | 3901955 | 9207320 | 4237884 | 23596683 | 10860924 | 25628176 | 2 |
| 59 | 3904633 | 9206185 | 4241316 | 23577590 | 10862263 | 25610599 | 1 |
| 60 | 3907311 | 9205049 | 4244749 | 23558524 | 10863604 | 25593047 | 0 |
| | *N. Co-Sine.* | *N. Sine.* | *N. Co-Tang.* | *N. Tangent* | *N. Co-Secant.* | *N. Secant.* | M |

67 DEGREES.

22 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.5735754 | 9.9671659 | 9.6064096 | 10.3935904 | 10.0328341 | 10.4264245 | 60 |
| 1 | 9.5738880 | 9.9671144 | 9.6067732 | 10.3932268 | 10.0328852 | 10.4261120 | 59 |
| 2 | 9.5742003 | 9.9670637 | 9.6071360 | 10.3928634 | 10.0329363 | 10.4257997 | 58 |
| 3 | 9.5745123 | 9.9670125 | 9.6074997 | 10.3925003 | 10.0329875 | 10.4254877 | 57 |
| 4 | 9.5748240 | 9.9669614 | 9.6078627 | 10.3921373 | 10.0330386 | 10.4251760 | 56 |
| 5 | 9.5751356 | 9.9669101 | 9.6082254 | 10.3917746 | 10.0330899 | 10.4248644 | 55 |
| 6 | 9.5754468 | 9.9668588 | 9.6085880 | 10.3914120 | 10.0331412 | 10.4245532 | 54 |
| 7 | 9.5757578 | 9.9668075 | 9.6089503 | 10.3910497 | 10.0331925 | 10.4242422 | 53 |
| 8 | 9.5760685 | 9.9667562 | 9.6093124 | 10.3906876 | 10.0332438 | 10.4239315 | 52 |
| 9 | 9.5763790 | 9.9667048 | 9.6096742 | 10.3903258 | 10.0332952 | 10.4236210 | 51 |
| 10 | 9.5766892 | 9.9666533 | 9.6100359 | 10.3899641 | 10.0333467 | 10.4233108 | 50 |
| 11 | 9.5769991 | 9.9666018 | 9.6103973 | 10.3896027 | 10.0333982 | 10.4230009 | 49 |
| 12 | 9.5773088 | 9.9665503 | 9.6107586 | 10.3892414 | 10.0334497 | 10.4226912 | 48 |
| 13 | 9.5776183 | 9.9664987 | 9.6111196 | 10.3888804 | 10.0335013 | 10.4223817 | 47 |
| 14 | 9.5779275 | 9.9664471 | 9.6114804 | 10.3885196 | 10.0335529 | 10.4220725 | 46 |
| 15 | 9.5782364 | 9.9663954 | 9.6118409 | 10.3881591 | 10.0336046 | 10.4217636 | 45 |
| 16 | 9.5785450 | 9.9663437 | 9.6122013 | 10.3877987 | 10.0336563 | 10.4214550 | 44 |
| 17 | 9.5788535 | 9.9662920 | 9.6125615 | 10.3874385 | 10.0337080 | 10.4211465 | 43 |
| 18 | 9.5791616 | 9.9662402 | 9.6129214 | 10.3870786 | 10.0337598 | 10.4208384 | 42 |
| 19 | 9.5794695 | 9.9661884 | 9.6132812 | 10.3867188 | 10.0338116 | 10.4205305 | 41 |
| 20 | 9.5797772 | 9.9661365 | 9.6136407 | 10.3863593 | 10.0338635 | 10.4202228 | 40 |
| 21 | 9.5800845 | 9.9660846 | 9.6140000 | 10.3860000 | 10.0339154 | 10.4199155 | 39 |
| 22 | 9.5803917 | 9.9660326 | 9.6143591 | 10.3856409 | 10.0339674 | 10.4196083 | 38 |
| 23 | 9.5806986 | 9.9659806 | 9.6147180 | 10.3852820 | 10.0340194 | 10.4193014 | 37 |
| 24 | 9.5810052 | 9.9659285 | 9.6150766 | 10.3849234 | 10.0340715 | 10.4189948 | 36 |
| 25 | 9.5813116 | 9.9658764 | 9.6154351 | 10.3845649 | 10.0341236 | 10.4186884 | 35 |
| 26 | 9.5816177 | 9.9658243 | 9.6157934 | 10.3842066 | 10.0341717 | 10.4183823 | 34 |
| 27 | 9.5819236 | 9.9657721 | 9.6161514 | 10.3838486 | 10.0342279 | 10.4180764 | 33 |
| 28 | 9.5822292 | 9.9657199 | 9.6165093 | 10.3834907 | 10.0342801 | 10.4177708 | 32 |
| 29 | 9.5825345 | 9.9656677 | 9.6168669 | 10.3831331 | 10.0343323 | 10.4174655 | 31 |
| 30 | 9.5828397 | 9.9656153 | 9.6172243 | 10.3827757 | 10.0343847 | 10.4171603 | 30 |
| 31 | 9.5831445 | 9.9655630 | 9.6175815 | 10.3824185 | 10.0344370 | 10.4168555 | 29 |
| 32 | 9.5834491 | 9.9655106 | 9.6176385 | 10.3820615 | 10.0344894 | 10.4165509 | 28 |
| 33 | 9.5837535 | 9.9654582 | 9.6182953 | 10.3817047 | 10.0345418 | 10.4162465 | 27 |
| 34 | 9.5840576 | 9.9654057 | 9.6186519 | 10.3813481 | 10.0345943 | 10.4159424 | 26 |
| 35 | 9.5843615 | 9.9653532 | 9.6190083 | 10.3809917 | 10.0346468 | 10.4156385 | 25 |
| 36 | 9.5846651 | 9.9653006 | 9.6193645 | 10.3806355 | 10.0346994 | 10.4153349 | 24 |
| 37 | 9.5849685 | 9.9652480 | 9.6197205 | 10.3802795 | 10.0347520 | 10.4150315 | 23 |
| 38 | 9.5852716 | 9.9651952 | 9.6200762 | 10.3799238 | 10.0348047 | 10.4147284 | 22 |
| 39 | 9.5855745 | 9.9651426 | 9.6204318 | 10.3795682 | 10.0348574 | 10.4144255 | 21 |
| 40 | 9.5858771 | 9.9650899 | 9.6207872 | 10.3792128 | 10.0349101 | 10.4141229 | 20 |
| 41 | 9.5861795 | 9.9650371 | 9.6211423 | 10.3788577 | 10.0349629 | 10.4138205 | 19 |
| 42 | 9.5864816 | 9.9649843 | 9.6214973 | 10.3785027 | 10.0350157 | 10.4135188 | 18 |
| 43 | 9.5867835 | 9.9649314 | 9.6218520 | 10.3781480 | 10.0350686 | 10.4132165 | 17 |
| 44 | 9.5870851 | 9.9648785 | 9.6222066 | 10.3777934 | 10.0351215 | 10.4129149 | 16 |
| 45 | 9.5873865 | 9.9648256 | 9.6225609 | 10.3774391 | 10.0351744 | 10.4126135 | 15 |
| 46 | 9.5876876 | 9.9647726 | 9.6229150 | 10.3770850 | 10.0352274 | 10.4123124 | 14 |
| 47 | 9.5879885 | 9.9647195 | 9.6232690 | 10.3767310 | 10.0352805 | 10.4120115 | 13 |
| 48 | 9.5882892 | 9.9646665 | 9.6236227 | 10.3763773 | 10.0353335 | 10.4117108 | 12 |
| 49 | 9.5885896 | 9.9646133 | 9.6239763 | 10.3760237 | 10.0353867 | 10.4114104 | 11 |
| 50 | 9.5888897 | 9.9645602 | 9.6243296 | 10.3756704 | 10.0354398 | 10.4111103 | 10 |
| 51 | 9.5891897 | 9.9645069 | 9.6246827 | 10.3753173 | 10.0354931 | 10.4108103 | 9 |
| 52 | 9.5894893 | 9.9644537 | 9.6250356 | 10.3749644 | 10.0355463 | 10.4105107 | 8 |
| 53 | 9.5897888 | 9.9644004 | 9.6253884 | 10.3746116 | 10.0355996 | 10.4102112 | 7 |
| 54 | 9.5900880 | 9.9643470 | 9.6257407 | 10.3742591 | 10.0356530 | 10.4099120 | 6 |
| 55 | 9.5903869 | 9.9642937 | 9.6260932 | 10.3739068 | 10.0357063 | 10.4096131 | 5 |
| 56 | 9.5906856 | 9.9642402 | 9.6264454 | 10.3735546 | 10.0357598 | 10.4093144 | 4 |
| 57 | 9.5909840 | 9.9641868 | 9.6267973 | 10.3732027 | 10.0358132 | 10.4090159 | 3 |
| 58 | 9.5912823 | 9.9641332 | 9.6271491 | 10.3728509 | 10.0358668 | 10.4087177 | 2 |
| 59 | 9.5915803 | 9.9640797 | 9.6275006 | 10.3724994 | 10.0359203 | 10.4084197 | 1 |
| 60 | 9.5918780 | 9.9640261 | 9.6278519 | 10.3721481 | 10.0359739 | 10.4081220 | 0 |
| | L. Co-Sine. | L. Sine | L. Co-Tang. | L. Tangent. | L. Co-Secant | L. Secant. | M |

67 DEGREES.

23 DEGREES

| M | *N. Sine* | *N. Co-Sin* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant* | *N Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 3907311 | 9205049 | 4244749 | 23558524 | 10863604 | 25593047 | 60 |
| 1 | 3909989 | 9203912 | 4248182 | 23539483 | 10864946 | 25575521 | 59 |
| 2 | 3912666 | 9202774 | 4251616 | 23520469 | 10866289 | 25558022 | 58 |
| 3 | 3915343 | 9201635 | 4255051 | 23501481 | 10867634 | 25540548 | 57 |
| 4 | 3918019 | 9200496 | 4258487 | 23482519 | 10868979 | 25523101 | 56 |
| 5 | 3920695 | 9199356 | 4261924 | 23463582 | 10870326 | 25505680 | 55 |
| 6 | 3923371 | 9198215 | 4265362 | 23444672 | 10871675 | 25488284 | 54 |
| 7 | 3926047 | 9197073 | 4268800 | 23425787 | 10873024 | 25470915 | 53 |
| 8 | 3928722 | 9195931 | 4272239 | 23406928 | 10874375 | 25453571 | 52 |
| 9 | 3931397 | 9194788 | 4275679 | 23388095 | 10875727 | 25436253 | 51 |
| 10 | 3934071 | 9193644 | 4279120 | 23369287 | 10877080 | 25418961 | 50 |
| 11 | 3936745 | 9192499 | 4282562 | 23350505 | 10878435 | 25401694 | 49 |
| 12 | 3939419 | 9191353 | 4286005 | 23331748 | 10879791 | 25384452 | 48 |
| 13 | 3942093 | 9190207 | 4289449 | 23313017 | 10881148 | 25367238 | 47 |
| 14 | 3944766 | 9189060 | 4292894 | 23294311 | 10882506 | 25350048 | 46 |
| 15 | 3947439 | 9187912 | 4296339 | 23275630 | 10883866 | 25332883 | 45 |
| 16 | 3950111 | 9186763 | 4299785 | 23256975 | 10885227 | 25315744 | 44 |
| 17 | 3952783 | 9185614 | 4303232 | 23238345 | 10886589 | 25298630 | 43 |
| 18 | 3955455 | 9184464 | 4306680 | 23219740 | 10887952 | 25281541 | 42 |
| 19 | 3958127 | 9183313 | 4310129 | 23201160 | 10889317 | 25264478 | 41 |
| 20 | 3960798 | 9182161 | 4313579 | 23182606 | 10890683 | 25247440 | 40 |
| 21 | 3963469 | 9181008 | 4317030 | 23164076 | 10892050 | 25230426 | 39 |
| 22 | 3966139 | 9179855 | 4320481 | 23145571 | 10893418 | 25213438 | 38 |
| 23 | 3968809 | 9178701 | 4323933 | 23127091 | 10894788 | 25196475 | 37 |
| 24 | 3971479 | 9177546 | 4327386 | 23108636 | 10896159 | 25179537 | 36 |
| 25 | 3974148 | 9176390 | 4330840 | 23090206 | 10897531 | 25162624 | 35 |
| 26 | 3976817 | 9175234 | 4334295 | 23071801 | 10898904 | 25145735 | 34 |
| 27 | 3979486 | 9174077 | 4337751 | 23053420 | 10900279 | 25128872 | 33 |
| 28 | 3982155 | 9172919 | 4341208 | 23035064 | 10901655 | 25112032 | 32 |
| 29 | 3984823 | 9171760 | 4344666 | 23016732 | 10903032 | 25095218 | 31 |
| 30 | 3987491 | 9170601 | 4348124 | 22998425 | 10904411 | 25078428 | 30 |
| 31 | 3990158 | 9169441 | 4351583 | 22980143 | 10905791 | 25061663 | 29 |
| 32 | 3992825 | 9168280 | 4355043 | 22961885 | 10907172 | 25044923 | 28 |
| 33 | 3995492 | 9167118 | 4358504 | 22943651 | 10908554 | 25028207 | 27 |
| 34 | 3998158 | 9165955 | 4361966 | 22925442 | 10909938 | 25011515 | 26 |
| 35 | 4000824 | 9164791 | 4365429 | 22907257 | 10910323 | 24994847 | 25 |
| 36 | 4003490 | 9163627 | 4368893 | 22889096 | 10912709 | 24978204 | 24 |
| 37 | 4006156 | 9162462 | 4372358 | 22870959 | 10914097 | 24961586 | 23 |
| 38 | 4008821 | 9161296 | 4375823 | 22852846 | 10915486 | 24944991 | 22 |
| 39 | 4011486 | 9160130 | 4379289 | 22834758 | 10916876 | 24928421 | 21 |
| 40 | 4014150 | 9158963 | 4382756 | 22816693 | 10918267 | 24911874 | 20 |
| 41 | 4016814 | 9157795 | 4386224 | 22798653 | 10919659 | 24895352 | 19 |
| 42 | 4019478 | 9156626 | 4389693 | 22780636 | 10921053 | 24878854 | 18 |
| 43 | 4022141 | 9155456 | 4393163 | 22762643 | 10922448 | 24862380 | 17 |
| 44 | 4024804 | 9154286 | 4396634 | 22744674 | 10923845 | 24845929 | 16 |
| 45 | 4027467 | 9153115 | 4400106 | 22726729 | 10925243 | 24829503 | 15 |
| 46 | 4030129 | 9151943 | 4403578 | 22708807 | 10926642 | 24813100 | 14 |
| 47 | 4032791 | 9150770 | 4407051 | 22690909 | 10928042 | 24796721 | 13 |
| 48 | 4035453 | 9149596 | 4410525 | 22673035 | 10929444 | 24780366 | 12 |
| 49 | 4038114 | 9148422 | 4414000 | 22655184 | 10930847 | 24764034 | 11 |
| 50 | 4040775 | 9147247 | 4417476 | 22637357 | 10932251 | 24747726 | 10 |
| 51 | 4043436 | 9146071 | 4420953 | 22619553 | 10933656 | 24731442 | 9 |
| 52 | 4046096 | 9144895 | 4424431 | 22601773 | 10935063 | 24715181 | 8 |
| 53 | 4048756 | 9143718 | 4427910 | 22584016 | 10936471 | 24698943 | 7 |
| 54 | 4051416 | 9142540 | 4431390 | 22566283 | 10937880 | 24682729 | 6 |
| 55 | 4054075 | 9141361 | 4434871 | 22548572 | 10939291 | 24666538 | 5 |
| 56 | 4056734 | 9140181 | 4438353 | 22530885 | 10940703 | 24650371 | 4 |
| 57 | 4059393 | 9139000 | 4441835 | 22513221 | 10942116 | 24634227 | 3 |
| 58 | 4062051 | 9137819 | 4445318 | 22495580 | 10943530 | 24618106 | 2 |
| 59 | 4064709 | 9136637 | 4448802 | 22477962 | 10944946 | 24602008 | 1 |
| 60 | 4067366 | 9135454 | 4452287 | 22460368 | 10946363 | 24585933 | 0 |
| | *N. Co-Sine* | *N. Sine.* | *N Co Tang.* | *N. Tangent.* | *N.Co-Secant* | *N. Secant* | M |

66 DEGREES.

23 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.5918780 | 9.9640261 | 9.6278519 | 10.3721481 | 10.0359739 | 10.4081220 | 60 |
| 1 | 9.5921755 | 9.9639724 | 9.6282031 | 10.3717969 | 10.0360276 | 10.4078243 | 59 |
| 2 | 9.5924728 | 9.9639187 | 9.6285540 | 10.3714460 | 10.0360813 | 10.4079372 | 58 |
| 3 | 9.5927698 | 9.9638650 | 9.6289048 | 10.3710952 | 10.0361350 | 10.4072302 | 57 |
| 4 | 9.5930666 | 9.9638112 | 9.6292553 | 10.3707447 | 10.0361888 | 10.4069334 | 56 |
| 5 | 9.5933631 | 9.9637574 | 9.6296057 | 10.3703943 | 10.0362426 | 10.4066369 | 55 |
| 6 | 9.5936594 | 9.9637036 | 9.6299558 | 10.3700442 | 10.0362964 | 10.4063406 | 54 |
| 7 | 9.5939555 | 9.9636496 | 9.6303058 | 10.3696942 | 10.0363504 | 10.4060445 | 53 |
| 8 | 9.5942513 | 9.9635957 | 9.6306556 | 10.3693444 | 10.0364043 | 10.4057487 | 52 |
| 9 | 9.5945469 | 9.9635417 | 9.6310052 | 10.3689948 | 10.0364583 | 10.4054531 | 51 |
| 10 | 9.5948422 | 9.9634877 | 9.6313545 | 10.3686455 | 10.0365123 | 10.4051578 | 50 |
| 11 | 9.5951373 | 9.9634336 | 9.6317037 | 10.3682963 | 10.0365664 | 10.4048627 | 49 |
| 12 | 9.5954322 | 9.9633795 | 9.6320527 | 10.3679473 | 10.0366205 | 10.4045678 | 48 |
| 13 | 9.5957268 | 9.9633253 | 9.6324015 | 10.3675985 | 10.0366747 | 10.4042732 | 47 |
| 14 | 9.5960212 | 9.9632711 | 9.6327501 | 10.3672499 | 10.0367289 | 10.4039788 | 46 |
| 15 | 9.5963154 | 9.9632168 | 9.6330985 | 10.3669015 | 10.0367832 | 10.4036846 | 45 |
| 16 | 9.5966093 | 9.9631625 | 9.6334468 | 10.3665532 | 10.0368375 | 10.4033907 | 44 |
| 17 | 9.5969030 | 9.9631082 | 9.6337948 | 10.3662052 | 10.0368918 | 10.4030970 | 43 |
| 18 | 9.5971965 | 9.9630538 | 9.6341426 | 10.3658574 | 10.0369462 | 10.4028035 | 42 |
| 19 | 9.5974897 | 9.9629994 | 9.6344903 | 10.3655097 | 10.0370006 | 10.4025103 | 41 |
| 20 | 9.5977827 | 9.9629449 | 9.6348378 | 10.3651622 | 10.0370551 | 10.4022175 | 40 |
| 21 | 9.5980754 | 9.9628904 | 9.6351850 | 10.3648150 | 10.0371096 | 10.4019246 | 39 |
| 22 | 9.5983679 | 9.9628358 | 9.6355321 | 10.3644679 | 10.0371642 | 10.4016321 | 38 |
| 23 | 9.5986602 | 9.9627812 | 9.6358790 | 10.3641210 | 10.0372188 | 10.4013398 | 37 |
| 24 | 9.5989523 | 9.9627266 | 9.6362257 | 10.3637743 | 10.0372734 | 10.4010477 | 36 |
| 25 | 9.5992441 | 9.9626719 | 9.6365722 | 10.3634278 | 10.0373281 | 10.4007559 | 35 |
| 26 | 9.5995357 | 9.9626172 | 9.6369185 | 10.3630815 | 10.0373828 | 10.4004643 | 34 |
| 27 | 9.5998271 | 9.9625624 | 9.6372646 | 10.3627354 | 10.0374376 | 10.4001730 | 33 |
| 28 | 9.6001181 | 9.9625076 | 9.6376106 | 10.3623894 | 10.0374924 | 10.3998819 | 32 |
| 29 | 9.6004090 | 9.9624527 | 9.6379563 | 10.3620437 | 10.0375473 | 10.3995910 | 31 |
| 30 | 9.6006997 | 9.9623978 | 9.6383019 | 10.3616981 | 10.0376022 | 10.3993003 | 30 |
| 31 | 9.6009901 | 9.9623428 | 9.6386473 | 10.3613527 | 10.0376572 | 10.3990099 | 29 |
| 32 | 9.6012803 | 9.9622878 | 9.6389925 | 10.3610075 | 10.0377122 | 10.3987197 | 28 |
| 33 | 9.6015703 | 9.9622328 | 9.6393375 | 10.3606625 | 10.0377672 | 10.3984297 | 27 |
| 34 | 9.6018600 | 9.9621777 | 9.6396823 | 10.3603177 | 10.0378223 | 10.3981400 | 26 |
| 35 | 9.6021495 | 9.9621226 | 9.6400269 | 10.3599731 | 10.0378774 | 10.3978505 | 25 |
| 36 | 9.6024388 | 9.9620674 | 9.6403714 | 10.3596286 | 10.0379326 | 10.3975612 | 24 |
| 37 | 9.6027278 | 9.9620122 | 9.6407156 | 10.3592844 | 10.0379878 | 10.3972722 | 23 |
| 38 | 9.6030166 | 9.9619569 | 9.6410597 | 10.3589403 | 10.0380431 | 10.3969834 | 22 |
| 39 | 9.6033052 | 9.9619016 | 9.6414036 | 10.3585964 | 10.0382984 | 10.3966948 | 21 |
| 40 | 9.6035936 | 9.9618463 | 9.6417473 | 10.3582527 | 10.0381537 | 10.3964064 | 20 |
| 41 | 9.6038817 | 9.9617909 | 9.6420908 | 10.3579092 | 10.0382091 | 10.3961183 | 19 |
| 42 | 9.6041696 | 9.9617355 | 9.6424342 | 10.3575658 | 10.0382645 | 10.3958304 | 18 |
| 43 | 9.6044573 | 9.9616800 | 9.6427773 | 10.3572228 | 10.0383200 | 10.3955427 | 17 |
| 44 | 9.6047448 | 9.9616245 | 9.6431203 | 10.3568797 | 10.0383755 | 10.3952522 | 16 |
| 45 | 9.6050320 | 9.9615689 | 9.6434631 | 10.3565369 | 10.0384311 | 10.3949680 | 15 |
| 46 | 9.6053190 | 9.9615133 | 9.6438057 | 10.3561943 | 10.0384867 | 10.3946810 | 14 |
| 47 | 9.6056057 | 9.9614576 | 9.6441481 | 10.3558519 | 10.0385424 | 10.3943943 | 13 |
| 48 | 9.6058923 | 9.9614020 | 9.6444903 | 10.3555097 | 10.0385980 | 10.3941077 | 12 |
| 49 | 9.6061786 | 9.9613463 | 9.6448324 | 10.3551676 | 10.0386538 | 10.3938214 | 11 |
| 50 | 9.6064647 | 9.9612904 | 9.6451743 | 10.3548257 | 10.0387096 | 10.3935353 | 10 |
| 51 | 9.6067506 | 9.9612346 | 9.6455160 | 10.3544840 | 10.0387654 | 10.3932494 | 9 |
| 52 | 9.6070362 | 9.9611787 | 9.6458575 | 10.3541425 | 10.0388213 | 10.3929638 | 8 |
| 53 | 9.6073216 | 9.9611228 | 9.6461988 | 10.3538012 | 10.0388772 | 10.3926784 | 7 |
| 54 | 9.6076068 | 9.9610668 | 9.6465400 | 10.3534600 | 10.0389332 | 10.3923932 | 6 |
| 55 | 9.6078918 | 9.9610108 | 9.6468810 | 10.3531190 | 10.0389892 | 10.3921082 | 5 |
| 56 | 9.6081765 | 9.9609548 | 9.6472217 | 10.3527783 | 10.0390452 | 10.3918235 | 4 |
| 57 | 9.6084611 | 9.9608987 | 9.6475624 | 10.3524376 | 10.0391013 | 10.3915389 | 3 |
| 58 | 9.6087454 | 9.9608426 | 9.6479028 | 10.3520972 | 10.0391574 | 10.3912546 | 2 |
| 59 | 9.6090294 | 9.9607864 | 9.6482431 | 10.3517569 | 10.0392136 | 10.3909706 | 1 |
| 60 | 9.6093133 | 9.9607302 | 9.6485831 | 10.3514169 | 10.0392698 | 10.3906867 | 0 |
| | L Co-Sine. | L. Sine | L.Co-Tang. | L. Tangent. | L.Co-Secant | L. Secant. | M |

66 DEGREES.

24 DEGREES

| M | *N. Sine* | *N. Co-Sine.* | *N. Tangent.* | *N. Co-Tang.* | *N. Secant* | *N Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 4067366 | 9135454 | 4452287 | 22460368 | 10946363 | 24585933 | 60 |
| 1 | 4070023 | 9134271 | 4455773 | 22442796 | 10947781 | 24569882 | 59 |
| 2 | 4072680 | 9133087 | 4459260 | 22425247 | 10949201 | 24553853 | 58 |
| 3 | 4075337 | 9131902 | 4462748 | 22407721 | 10950622 | 24537848 | 57 |
| 4 | 4077993 | 9130716 | 4466237 | 22390218 | 10952044 | 24521865 | 56 |
| 5 | 4080649 | 9129529 | 4469727 | 22372738 | 10953467 | 24505905 | 55 |
| 6 | 4083305 | 9128342 | 4473217 | 22355280 | 10954892 | 24489968 | 54 |
| 7 | 4085960 | 9127154 | 4476708 | 22337845 | 10956318 | 24474054 | 53 |
| 8 | 4088615 | 9125965 | 4480200 | 22320433 | 10957746 | 24458163 | 52 |
| 9 | 4091269 | 9124775 | 4483693 | 22303043 | 10959174 | 24442294 | 51 |
| 10 | 4093923 | 9123584 | 4487187 | 22285676 | 10960604 | 24426448 | 50 |
| 11 | 4096577 | 9122393 | 4490682 | 22268331 | 10962036 | 24410624 | 49 |
| 12 | 4099230 | 9121201 | 4494178 | 22251009 | 10963468 | 24394823 | 48 |
| 13 | 4101883 | 9120008 | 4497675 | 22233709 | 10964902 | 24379045 | 47 |
| 14 | 4104536 | 9118814 | 4501173 | 22216432 | 10966337 | 24363289 | 46 |
| 15 | 4107189 | 9117620 | 4504672 | 22199177 | 10967774 | 24347555 | 45 |
| 16 | 4109841 | 9116425 | 4508172 | 22181944 | 10969212 | 24331844 | 44 |
| 17 | 4112493 | 9115229 | 4511673 | 22164733 | 10970651 | 24316155 | 43 |
| 18 | 4115144 | 9114032 | 4515174 | 22147545 | 10972091 | 24300489 | 42 |
| 19 | 4117795 | 9112835 | 4518676 | 22130379 | 10973533 | 24284844 | 41 |
| 20 | 4120446 | 9111637 | 4522179 | 22113234 | 10974976 | 24269222 | 40 |
| 21 | 4123096 | 9110438 | 4525683 | 22096112 | 10976420 | 24253622 | 39 |
| 22 | 4125746 | 9109238 | 4529188 | 22079012 | 10977866 | 24238044 | 38 |
| 23 | 4128395 | 9108038 | 4532694 | 22061934 | 10979313 | 24222488 | 37 |
| 24 | 4131044 | 9106837 | 4536201 | 22044878 | 10980761 | 24206954 | 36 |
| 25 | 4133693 | 9105635 | 4539709 | 22027843 | 10982211 | 24191442 | 35 |
| 26 | 4136342 | 9104432 | 4543218 | 22010831 | 10983662 | 24175952 | 34 |
| 27 | 4138990 | 9103228 | 4546728 | 21993840 | 10985114 | 24160484 | 33 |
| 28 | 4141638 | 9102024 | 4550239 | 21976871 | 10986568 | 24145038 | 32 |
| 29 | 4144285 | 9100819 | 4553751 | 21959923 | 10988023 | 24129613 | 31 |
| 30 | 4146932 | 9099613 | 4557264 | 21942997 | 10989479 | 24114210 | 30 |
| 31 | 4149579 | 9098406 | 4560777 | 21926093 | 10990936 | 24098829 | 29 |
| 32 | 4152226 | 9097198 | 4564291 | 21909210 | 10992395 | 24083469 | 28 |
| 33 | 4154872 | 9095990 | 4567806 | 21892349 | 10993855 | 24068132 | 27 |
| 34 | 4157518 | 9094781 | 4571322 | 21875510 | 10995317 | 24052815 | 26 |
| 35 | 4160163 | 9093571 | 4574839 | 21858691 | 10996779 | 24037520 | 25 |
| 36 | 4162808 | 9092361 | 4578357 | 21841894 | 10998243 | 24022247 | 24 |
| 37 | 4165453 | 9091150 | 4581876 | 21825119 | 10999709 | 24006995 | 23 |
| 38 | 4168097 | 9089938 | 4585396 | 21808364 | 11001176 | 23991764 | 22 |
| 39 | 4170741 | 9088725 | 4588917 | 21791631 | 11002644 | 23976555 | 21 |
| 40 | 4173385 | 9087511 | 4592439 | 21774920 | 11004113 | 23961367 | 20 |
| 41 | 4176028 | 9086297 | 4595962 | 21758229 | 11005584 | 23946201 | 19 |
| 42 | 4178671 | 9085082 | 4599486 | 21741559 | 11007056 | 23931055 | 18 |
| 43 | 4181313 | 9083866 | 4603011 | 21724911 | 11008529 | 23915931 | 17 |
| 44 | 4183955 | 9082649 | 4606537 | 21708283 | 11010004 | 23900828 | 16 |
| 45 | 4186597 | 9081432 | 4610064 | 21691677 | 11011480 | 23885746 | 15 |
| 46 | 4189239 | 9080214 | 4613591 | 21675091 | 11012957 | 23870685 | 14 |
| 47 | 4191880 | 9078995 | 4617119 | 21658527 | 11014436 | 23855645 | 13 |
| 48 | 4194521 | 9077775 | 4620648 | 21641983 | 11015916 | 23840625 | 12 |
| 49 | 4197161 | 9076554 | 4624178 | 21625460 | 11017397 | 23825627 | 11 |
| 50 | 4199801 | 9075333 | 4627709 | 21608958 | 11018879 | 23810650 | 10 |
| 51 | 4202441 | 9074111 | 4631242 | 21592476 | 11020363 | 23795693 | 9 |
| 52 | 4205080 | 9072888 | 4634776 | 21576015 | 11021849 | 23780758 | 8 |
| 53 | 4207719 | 9071664 | 4638311 | 21559575 | 11023335 | 23765843 | 7 |
| 54 | 4210358 | 9070440 | 4641846 | 21543156 | 11024823 | 23750949 | 6 |
| 55 | 4212996 | 9069215 | 4645382 | 21526757 | 11026313 | 23736075 | 5 |
| 56 | 4215634 | 9067989 | 4648919 | 21510378 | 11027803 | 23721222 | 4 |
| 57 | 4218272 | 9066762 | 4652457 | 21494020 | 11029295 | 23706390 | 3 |
| 58 | 4220909 | 9065535 | 4655996 | 21477683 | 11030789 | 23691578 | 2 |
| 59 | 4223546 | 9064307 | 4659536 | 21461366 | 11032283 | 23676787 | 1 |
| 60 | 4226183 | 9063078 | 4663077 | 21445069 | 11033779 | 23662016 | 0 |
| M | *N. Co-Sine* | *N. Sine.* | *N Co-Tang.* | *N. Tangent.* | *N.Co-Secant.* | *N. Secant* | M |

65 DEGREES.

24 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co-Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6093133 | 9.9607302 | 9.6485831 | 10.3514169 | 10.0392698 | 10.3906867 | 60 |
| 1 | 9.6095969 | 9.9606739 | 9.6489230 | 10.3510770 | 10.0393261 | 10.3904031 | 59 |
| 2 | 9.6098803 | 9.9606176 | 9.6492628 | 10.3507372 | 10.0393824 | 10.3901197 | 58 |
| 3 | 9.6101635 | 9.9605612 | 9.6496023 | 10.3503977 | 10.0394388 | 10.3898365 | 57 |
| 4 | 9.6104465 | 9.9605048 | 9.6499417 | 10.3500583 | 10.0394952 | 10.3895535 | 56 |
| 5 | 9.6107293 | 9.9604484 | 9.6502809 | 10.3497191 | 10.0395516 | 10.3892707 | 55 |
| 6 | 9.6110118 | 9.9603919 | 9.6506199 | 10.3493801 | 10.0396081 | 10.3889882 | 54 |
| 7 | 9.6112941 | 9.9603354 | 9.6509587 | 10.3490413 | 10.0396646 | 10.3887059 | 53 |
| 8 | 9.6115762 | 9.9602788 | 9.6512974 | 10.3487026 | 10.0397212 | 10.3884238 | 52 |
| 9 | 9.6118580 | 9.9602222 | 9.6516359 | 10.3483641 | 10.0397778 | 10.3881420 | 51 |
| 10 | 9.6121397 | 9.9601655 | 9.6519742 | 10.3480258 | 10.0398345 | 10.3878603 | 50 |
| 11 | 9.6124211 | 9.9601088 | 9.6523123 | 10.3476877 | 10.0398912 | 10.3875789 | 49 |
| 12 | 9.6127023 | 9.9600520 | 9.6526503 | 10.3473497 | 10.0399480 | 10.3872977 | 48 |
| 13 | 9.6129833 | 9.9599952 | 9.6529881 | 10.3470119 | 10.0400048 | 10.3870167 | 47 |
| 14 | 9.6132641 | 9.9599384 | 9.6533257 | 10.3466743 | 10.0400616 | 10.3867359 | 46 |
| 15 | 9.6135446 | 9.9598815 | 9.6536631 | 10.3463369 | 10.0401185 | 10.3864554 | 45 |
| 16 | 9.6138250 | 9.9598246 | 9.6540004 | 10.3459996 | 10.0401754 | 10.3861750 | 44 |
| 17 | 9.6141051 | 9.9597676 | 9.6543375 | 10.3456625 | 10.0402324 | 10.3858949 | 43 |
| 18 | 9.6143850 | 9.9597106 | 9.6546744 | 10.3453256 | 10.0402894 | 10.3856150 | 42 |
| 19 | 9.6146647 | 9.9596535 | 9.6550112 | 10.3449888 | 10.0403465 | 10.3853353 | 41 |
| 20 | 9.6149441 | 9.9595964 | 9.6553477 | 10.3446523 | 10.0404036 | 10.3850559 | 40 |
| 21 | 9.6152234 | 9.9595393 | 9.6556841 | 10.3443159 | 10.0404607 | 10.3847765 | 39 |
| 22 | 9.6155024 | 9.9594821 | 9.6560204 | 10.3439796 | 10.0405179 | 10.3844976 | 38 |
| 23 | 9.6157812 | 9.9594248 | 9.6563564 | 10.3436436 | 10.0405752 | 10.3842188 | 37 |
| 24 | 9.6160598 | 9.9593675 | 9.6566923 | 10.3433077 | 10.0406325 | 10.3839401 | 36 |
| 25 | 9.6163382 | 9.9593102 | 9.6570280 | 10.3429720 | 10.0406898 | 10.3836618 | 35 |
| 26 | 9.6166164 | 9.9592528 | 9.6573636 | 10.3426364 | 10.0407472 | 10.3833836 | 34 |
| 27 | 9.6168944 | 9.9591954 | 9.6576989 | 10.3423011 | 10.0408046 | 10.3831056 | 33 |
| 28 | 9.6171721 | 9.9591380 | 9.6580341 | 10.3419659 | 10.0408620 | 10.3828279 | 32 |
| 29 | 9.6174496 | 9.9590805 | 9.6583692 | 10.3416308 | 10.0409195 | 10.3825504 | 31 |
| 30 | 9.6177270 | 9.9590229 | 9.6587041 | 10.3412960 | 10.0409771 | 10.3822730 | 30 |
| 31 | 9.6180041 | 9.9589653 | 9.6590387 | 10.3409613 | 10.0410347 | 10.3819959 | 29 |
| 32 | 9.6182809 | 9.9589077 | 9.6593733 | 10.3406267 | 10.0410923 | 10.3817191 | 28 |
| 33 | 9.6185576 | 9.9588500 | 9.6597076 | 10.3402924 | 10.0411500 | 10.3814424 | 27 |
| 34 | 9.6188341 | 9.9587923 | 9.6600418 | 10.3399582 | 10.0412077 | 10.3811659 | 26 |
| 35 | 9.6191103 | 9.9587345 | 9.6603758 | 10.3396242 | 10.0412655 | 10.3808897 | 25 |
| 36 | 9.6193864 | 9.9586767 | 9.6607097 | 10.3392903 | 10.0413233 | 10.3806136 | 24 |
| 37 | 9.6196622 | 9.9586188 | 9.6610434 | 10.3389566 | 10.0413812 | 10.3803378 | 23 |
| 38 | 9.6199378 | 9.9585609 | 9.6613769 | 10.3386231 | 10.0414391 | 10.3800622 | 22 |
| 39 | 9.6202132 | 9.9585030 | 9.6617103 | 10.3382897 | 10.0414970 | 10.3797868 | 21 |
| 40 | 9.6204884 | 9.9584450 | 9.6620434 | 10.3379566 | 10.0415550 | 10.3795116 | 20 |
| 41 | 9.6207634 | 9.9583869 | 9.6623765 | 10.3376235 | 10.0416131 | 10.3792366 | 19 |
| 42 | 9.6210382 | 9.9583288 | 9.6627093 | 10.3372907 | 10.0416712 | 10.3789618 | 18 |
| 43 | 9.6213127 | 9.9582707 | 9.6630420 | 10.3369580 | 10.0417293 | 10.3786837 | 17 |
| 44 | 9.6215871 | 9.9582125 | 9.6633745 | 10.3366255 | 10.0417875 | 10.3784129 | 16 |
| 45 | 9.6218612 | 9.9581543 | 9.6637069 | 10.3362931 | 10.0418457 | 10.3781388 | 15 |
| 46 | 9.6221351 | 9.9580961 | 9.6640391 | 10.3359609 | 10.0419039 | 10.3778649 | 14 |
| 47 | 9.6224088 | 9.9580378 | 9.6643711 | 10.3356289 | 10.0419622 | 10.3775912 | 13 |
| 48 | 9.6226824 | 9.9579794 | 9.6647030 | 10.3352970 | 10.0420206 | 10.3773176 | 12 |
| 49 | 9.6229557 | 9.9579210 | 9.6650346 | 10.3349654 | 10.0420790 | 10.3770443 | 11 |
| 50 | 9.6232287 | 9.9578626 | 9.6653662 | 10.3346338 | 10.0421374 | 10.3767713 | 10 |
| 51 | 9.6235016 | 9.9578041 | 9.6656975 | 10.3343025 | 10.0421959 | 10.3764984 | 9 |
| 52 | 9.6237743 | 9.9577456 | 9.6660288 | 10.3339712 | 10.0422544 | 10.3762257 | 8 |
| 53 | 9.6230467 | 9.9576870 | 9.6663598 | 10.3336402 | 10.0423130 | 10.3759532 | 7 |
| 54 | 9.6243190 | 9.9576284 | 9.6666907 | 10.3333093 | 10.0423716 | 10.3756810 | 6 |
| 55 | 9.6245911 | 9.9575697 | 9.6670214 | 10.3329786 | 10.0424303 | 10.3754089 | 5 |
| 56 | 9.6248629 | 9.9575110 | 9.6673519 | 10.3326481 | 10.0424890 | 10.3751371 | 4 |
| 57 | 9.6251346 | 9.9574522 | 9.6676823 | 10.3323177 | 10.0425478 | 10.3748654 | 3 |
| 58 | 9.6254060 | 9.9573934 | 9.6680126 | 10.3319874 | 10.0426066 | 10.3745940 | 2 |
| 59 | 9.6256772 | 9.9573346 | 9.6683426 | 10.3316574 | 10.0426654 | 10.3743228 | 1 |
| 60 | 9.6259483 | 9.9572757 | 9.6686725 | 10.3313275 | 10.0427243 | 10.3740517 | 0 |
| | L Co-Sine. | L. Sine | L.Co-Tnag. | L. Tangent. | L.Co-Secant | L. Secant. | M |

65 DEGREES.

25 DEGREES

| M | N. Sine | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant | N Co-secant | |
|---|---|---|---|---|---|---|---|
| 0 | 4226183 | 9063078 | 4663077 | 21445069 | 11033719 | 23662016 | 60 |
| 1 | 4228819 | 9061848 | 4666619 | 21428793 | 11035277 | 23647265 | 59 |
| 2 | 4231455 | 9060617 | 4670162 | 21412537 | 11036775 | 23632535 | 58 |
| 3 | 4234090 | 9059386 | 4673706 | 21396301 | 11038275 | 23617826 | 57 |
| 4 | 4236725 | 9058154 | 4677251 | 21380085 | 11039777 | 23603136 | 56 |
| 5 | 4239360 | 9056921 | 4680797 | 21363889 | 11041279 | 23588467 | 55 |
| 6 | 4241994 | 9055688 | 4684343 | 21347714 | 11042783 | 23573818 | 54 |
| 7 | 4244628 | 9054454 | 4687890 | 21331559 | 11044289 | 23559189 | 53 |
| 8 | 4247262 | 9053219 | 4691438 | 21315423 | 11045795 | 23544581 | 52 |
| 9 | 4249895 | 9051983 | 4694988 | 21299308 | 11047303 | 23529992 | 51 |
| 10 | 4252528 | 9050746 | 4698539 | 21283213 | 11048813 | 23515424 | 50 |
| 11 | 4255161 | 9049509 | 4702090 | 21267137 | 11050324 | 23500875 | 49 |
| 12 | 4257793 | 9048271 | 4705643 | 21251082 | 11051836 | 23486347 | 48 |
| 13 | 4260425 | 9047032 | 4709196 | 21235046 | 11053349 | 23471838 | 47 |
| 14 | 4263056 | 9045792 | 4712751 | 21219030 | 11054864 | 23457349 | 46 |
| 15 | 4265687 | 9044551 | 4716306 | 21203034 | 11056380 | 23442880 | 45 |
| 16 | 4268318 | 9043310 | 4719863 | 21187057 | 11057898 | 23428431 | 44 |
| 17 | 4270949 | 9042068 | 4723420 | 21171101 | 11059417 | 23414002 | 43 |
| 18 | 4273579 | 9040825 | 4726978 | 21155164 | 11060937 | 23399593 | 42 |
| 19 | 4276209 | 9039582 | 4730538 | 21139246 | 11062458 | 23385203 | 41 |
| 20 | 4278838 | 9038338 | 4734098 | 21123348 | 11063981 | 23370833 | 40 |
| 21 | 4281467 | 9037093 | 4737659 | 21107470 | 11065506 | 23356482 | 39 |
| 22 | 4284095 | 9035847 | 4741222 | 21091611 | 11067031 | 23342152 | 38 |
| 23 | 4286723 | 9034600 | 4744785 | 21075771 | 11068558 | 23327840 | 37 |
| 24 | 4289351 | 9033353 | 4748349 | 21059951 | 11070087 | 23313548 | 36 |
| 25 | 4291979 | 9032105 | 4751914 | 21044150 | 11071616 | 23299276 | 35 |
| 26 | 4294606 | 9030856 | 4755481 | 21028369 | 11073147 | 23285023 | 34 |
| 27 | 4297233 | 9029606 | 4759048 | 21012607 | 11074680 | 23270790 | 33 |
| 28 | 4299859 | 9028356 | 4762616 | 20996864 | 11070214 | 23256575 | 32 |
| 29 | 4302485 | 9027105 | 4766185 | 20981140 | 11077749 | 23242381 | 31 |
| 30 | 4305111 | 9025853 | 4769755 | 20965436 | 11079285 | 23228205 | 30 |
| 31 | 4307736 | 9024600 | 4773326 | 20949751 | 11080823 | 23214049 | 29 |
| 32 | 4310361 | 9023347 | 4776899 | 20934084 | 11082363 | 23199911 | 28 |
| 33 | 4312986 | 9022093 | 4780472 | 20918437 | 11083903 | 23185794 | 27 |
| 34 | 4315610 | 9020838 | 4784046 | 20902809 | 11085445 | 23171695 | 26 |
| 35 | 4318234 | 9019582 | 4787621 | 20887200 | 11086989 | 23157615 | 25 |
| 36 | 4320857 | 9014325 | 4791197 | 20871610 | 11088533 | 23143554 | 24 |
| 37 | 4323480 | 9017068 | 4794774 | 20856039 | 11090079 | 23129513 | 23 |
| 38 | 4326103 | 9015810 | 4798352 | 20840486 | 11091627 | 23115490 | 22 |
| 39 | 4328726 | 9014551 | 4801932 | 20824953 | 11093176 | 23101486 | 21 |
| 40 | 4331348 | 9013291 | 4805512 | 20809438 | 11094726 | 23087501 | 20 |
| 41 | 4333970 | 9012031 | 4809093 | 20793942 | 11096277 | 23073535 | 19 |
| 42 | 4236591 | 9010770 | 4812675 | 20778465 | 11097830 | 23059588 | 18 |
| 43 | 4339212 | 9009508 | 4816258 | 20763007 | 11099385 | 23045660 | 17 |
| 44 | 4341833 | 9008245 | 4819842 | 20747567 | 11100941 | 23031751 | 16 |
| 45 | 4344453 | 9006982 | 4823427 | 20732146 | 11102498 | 23017860 | 15 |
| 46 | 4347073 | 9005718 | 4827014 | 20716743 | 11104056 | 23003988 | 14 |
| 47 | 4349692 | 9004453 | 4830601 | 20701359 | 11105616 | 22990134 | 13 |
| 48 | 4352311 | 9003187 | 4834189 | 20685993 | 11107177 | 22976299 | 12 |
| 49 | 4354930 | 9001921 | 4837778 | 20670646 | 11108740 | 22962483 | 11 |
| 50 | 4357548 | 9000654 | 4841368 | 20655318 | 11110304 | 22948685 | 10 |
| 51 | 4360166 | 8999386 | 4844959 | 20640008 | 11111869 | 22934906 | 9 |
| 52 | 4362784 | 8998117 | 4848552 | 20624716 | 11113436 | 22921145 | 8 |
| 53 | 4365401 | 8996848 | 4852145 | 20609442 | 11115004 | 22907403 | 7 |
| 54 | 4368018 | 8995578 | 4855739 | 20594187 | 11116573 | 22893679 | 6 |
| 55 | 4370634 | 8994307 | 4859334 | 20578950 | 11118144 | 22879974 | 5 |
| 56 | 4373250 | 8993035 | 4862931 | 20563732 | 11119716 | 22866286 | 4 |
| 57 | 4375866 | 8991762 | 4866528 | 20548531 | 11121290 | 22852618 | 3 |
| 58 | 4378482 | 8990489 | 4870126 | 20533349 | 11122865 | 22838967 | 2 |
| 59 | 4381097 | 8989215 | 4873726 | 20518184 | 11124442 | 22825334 | 1 |
| 60 | 4383712 | 8987940 | 4877326 | 20503038 | 11126019 | 22811720 | 0 |
| | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N.Co-Secant. | N. Secant | M |

64 DEGREES.

25 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6259483 | 9.9572757 | 9.6686725 | 10.3313275 | 10.0427243 | 10.3740517 | 60 |
| 1 | 9.6262191 | 9.9572168 | 9.6690023 | 10.3309977 | 10.0427832 | 10.3737809 | 59 |
| 2 | 9.6264897 | 9.9571578 | 9.6693319 | 10.3306681 | 10.0428422 | 10.3735103 | 58 |
| 3 | 9.6267601 | 9.9570988 | 9.6696613 | 10.3303387 | 10.0429012 | 10.3732399 | 57 |
| 4 | 9.6270303 | 9.9570397 | 9.6699906 | 10.3300094 | 10.0429603 | 10.3729697 | 56 |
| 5 | 9.6273003 | 9.9569806 | 9.6703197 | 10.3296803 | 10.0430194 | 10.3726997 | 55 |
| 6 | 9.6275701 | 9.9569215 | 9.6706486 | 10.3293514 | 10.0430785 | 10.3724299 | 54 |
| 7 | 9.6278397 | 9.9568623 | 9.6709774 | 10.3290226 | 10.0431377 | 10.3721603 | 53 |
| 8 | 9.6281090 | 9.9568030 | 9.6713060 | 10.3286940 | 10.0431970 | 10.3718910 | 52 |
| 9 | 9.6283782 | 9.9567437 | 9.6716345 | 10.3283555 | 10.0432563 | 10.3716218 | 51 |
| 10 | 9.6286472 | 9.9566844 | 9.6719628 | 10.3280372 | 10.0433156 | 10.3713528 | 50 |
| 11 | 9.6289160 | 9.9566250 | 9.6722910 | 10.3277090 | 10.0433790 | 10.3710840 | 49 |
| 12 | 9.6291845 | 9.9565656 | 9.6726190 | 10.3273810 | 10.0434344 | 10.3708155 | 48 |
| 13 | 9.6294529 | 9.9565061 | 9.6729468 | 10.3270532 | 10.0434939 | 10.3705471 | 47 |
| 14 | 9.6297211 | 9.9564466 | 9.6732745 | 10.3267255 | 10.0435534 | 10.3702789 | 46 |
| 15 | 9.6299890 | 9.9563870 | 9.6736020 | 10.3263980 | 10.0436130 | 10.3700110 | 45 |
| 16 | 9.6302568 | 9.9563274 | 9.6739294 | 10.3260706 | 10.0436726 | 10.3697432 | 44 |
| 17 | 9.6305243 | 9.9562678 | 9.6742566 | 10.3257434 | 10.0437322 | 10.3694757 | 43 |
| 18 | 9.6307617 | 9.9562081 | 9.6745836 | 10.3254164 | 10.0437919 | 10.3692083 | 42 |
| 19 | 9.6310589 | 9.9561483 | 9.6749105 | 10.3250895 | 10.0438517 | 10.3689411 | 41 |
| 20 | 9.6313258 | 9.9560886 | 9.6752372 | 10.3247628 | 10.0439114 | 10.3686742 | 40 |
| 21 | 9.6315926 | 9.9560287 | 9.6755638 | 10.3244362 | 10.0439713 | 10.3684074 | 39 |
| 22 | 9.6318591 | 9.9559689 | 9.6758902 | 10.3241097 | 10.0440311 | 10.3681409 | 38 |
| 23 | 9.6321255 | 9.9559089 | 9.6762165 | 10.3237835 | 10.0440911 | 10.3678745 | 37 |
| 24 | 9.6323916 | 9.9558490 | 9.6765426 | 10.3234574 | 10.0441510 | 10.3676084 | 36 |
| 25 | 9.6326576 | 9.9557890 | 9.6768686 | 10.3231314 | 10.0442110 | 10.3673424 | 35 |
| 26 | 9.6329233 | 9.9557289 | 9.6771944 | 10.3228056 | 10.0442711 | 10.3670767 | 34 |
| 27 | 9.6331889 | 9.9556688 | 9.6775201 | 10.3224799 | 10.0443312 | 10.3668111 | 33 |
| 28 | 9.6334542 | 9.9556087 | 9.6778456 | 10.3221544 | 10.0443913 | 10.3665458 | 32 |
| 29 | 9.6337194 | 9.9555485 | 9.6781709 | 10.3218291 | 10.0444515 | 10.3662806 | 31 |
| 30 | 9.6339844 | 9.9554882 | 9.6784961 | 10.3215039 | 10.0445118 | 10.3660156 | 30 |
| 31 | 9.6342491 | 9.9554280 | 9.6788211 | 10.3211789 | 10.0445720 | 10.3657509 | 29 |
| 32 | 9.6345137 | 9.9553676 | 9.6791460 | 10.3208540 | 10.0446324 | 10.3654863 | 28 |
| 33 | 9.6347780 | 9.9553073 | 9.6794708 | 10.3205292 | 10.0446927 | 10.3652220 | 27 |
| 34 | 9.6350422 | 9.9552469 | 9.6797953 | 10.3202047 | 10.0447531 | 10.3649578 | 26 |
| 35 | 9.6353062 | 9.9551864 | 9.6801198 | 10.3198803 | 10.0448136 | 10.3646938 | 25 |
| 36 | 9.6355699 | 9.9551259 | 9.6804440 | 10.3195560 | 10.0448741 | 10.3644301 | 24 |
| 37 | 9.6358335 | 9.9550653 | 9.6807682 | 10.3192318 | 10.0449347 | 10.3641665 | 23 |
| 38 | 9.6360969 | 9.9550047 | 9.6810921 | 10.3189079 | 10.0449953 | 10.3639031 | 22 |
| 39 | 9.6363601 | 9.9549441 | 9.6814160 | 10.3185840 | 10.0450559 | 10.3636299 | 21 |
| 40 | 9.6366231 | 9.9548834 | 9.6817396 | 10.3182604 | 10.0451166 | 10.3633760 | 20 |
| 41 | 9.6368859 | 9.9548227 | 9.6820632 | 10.3179368 | 10.0451773 | 10.3631141 | 19 |
| 42 | 9.6371484 | 9.9547619 | 9.6823865 | 10.3176135 | 10.0452381 | 10.3628516 | 18 |
| 43 | 9.6374108 | 9.9547011 | 9.6827098 | 10.3172902 | 10.0452989 | 10.3625892 | 17 |
| 44 | 9.6376731 | 9.9546402 | 9.6830328 | 10.3169672 | 10.0453589 | 10.3623269 | 16 |
| 45 | 9.6379351 | 9.9545793 | 9.6833557 | 10.3166443 | 10.0454207 | 10.3620649 | 15 |
| 46 | 9.6381969 | 9.9545184 | 9.6836785 | 10.3163215 | 10.0454816 | 10.3618031 | 14 |
| 47 | 9.6384585 | 9.9544574 | 9.6840011 | 10.3159989 | 10.0455426 | 10.3615415 | 13 |
| 48 | 9.6387199 | 9.9543963 | 9.6843236 | 10.3156764 | 10.0456037 | 10.3612801 | 12 |
| 49 | 9.6389812 | 9.9543352 | 9.6846459 | 10.3153541 | 10.0456648 | 10.3610188 | 11 |
| 50 | 9.6392422 | 9.9542741 | 9.6849681 | 10.3150319 | 10.0457259 | 10.3607578 | 10 |
| 51 | 9.6395030 | 9.9542129 | 9.6852901 | 10.3147099 | 10.0457871 | 10.3604970 | 9 |
| 52 | 9.6397637 | 9.9541517 | 9.6856120 | 10.3143880 | 10.0457483 | 10.3602363 | 8 |
| 53 | 9.6400241 | 9.9540904 | 9.6859338 | 10.3140662 | 10.0459096 | 10.3599759 | 7 |
| 54 | 9.6402844 | 9.9540291 | 9.6862553 | 10.3137447 | 10.0459709 | 10.3597156 | 6 |
| 55 | 9.6405445 | 9.9539677 | 9.6865768 | 10.3134232 | 10.0460323 | 10.3594555 | 5 |
| 56 | 9.6408044 | 9.9539063 | 9.6868981 | 10.3131019 | 10.0460937 | 10.3591956 | 4 |
| 57 | 9.6410640 | 9.9538448 | 9.6872192 | 10.3127808 | 10.0461552 | 10.3589360 | 3 |
| 58 | 9.6413235 | 9.9537833 | 9.6875402 | 10.3124598 | 10.0462167 | 10.3586765 | 2 |
| 59 | 9.6415828 | 9.9537218 | 9.6878611 | 10.3121389 | 10.0462782 | 10.3584172 | 1 |
| 60 | 9.6418420 | 9.9536602 | 9.6881818 | 10.3118182 | 10.0463398 | 10.3581580 | 0 |
| | L. Co-Sine. | L Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L Secant | M |

64 DEGREES.

26 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 4383712 | 8987940 | 4877326 | 20503038 | 11126019 | 22811720 | 60 |
| 1 | 4386326 | 8986665 | 4880927 | 20487910 | 11127598 | 22798124 | 59 |
| 2 | 4388940 | 8985389 | 4884530 | 20472800 | 11129179 | 22784546 | 58 |
| 3 | 4391553 | 8984112 | 4888133 | 20457708 | 11130761 | 22770986 | 57 |
| 4 | 4394166 | 8982834 | 4891737 | 20442634 | 11132345 | 22757445 | 56 |
| 5 | 4396779 | 8981555 | 4895343 | 20427578 | 11133930 | 22743921 | 55 |
| 6 | 4399392 | 8980276 | 4898949 | 20412540 | 11135516 | 22730415 | 54 |
| 7 | 4402004 | 8978996 | 4902557 | 20397519 | 11137103 | 22716927 | 53 |
| 8 | 4404616 | 8977715 | 4906166 | 20382517 | 11138692 | 22703457 | 52 |
| 9 | 4407227 | 8976433 | 4909775 | 20367532 | 11140282 | 22690005 | 51 |
| 10 | 4409838 | 8975151 | 4913386 | 20352565 | 11141874 | 22676571 | 50 |
| 11 | 4412448 | 8973868 | 4916997 | 20337615 | 11143467 | 22663155 | 49 |
| 12 | 4415058 | 8972584 | 4920610 | 20322683 | 11145062 | 22649756 | 48 |
| 13 | 4417668 | 8971299 | 4924224 | 20307769 | 11146658 | 22636375 | 47 |
| 14 | 4420278 | 8970013 | 4927838 | 20292473 | 11148255 | 22623012 | 46 |
| 15 | 4422887 | 8968727 | 4931454 | 20277994 | 11149854 | 22609667 | 45 |
| 16 | 4425496 | 8967440 | 4935071 | 20263133 | 11151454 | 22596339 | 44 |
| 17 | 4428104 | 8966152 | 4938689 | 20248289 | 11153056 | 22583029 | 43 |
| 18 | 4430712 | 8964864 | 4942308 | 20233462 | 11154659 | 22569736 | 42 |
| 19 | 4433320 | 8963575 | 4945928 | 20218653 | 11156263 | 22556461 | 41 |
| 20 | 4435927 | 8962285 | 4949549 | 20203862 | 11157869 | 22543204 | 40 |
| 21 | 4438534 | 8960994 | 4953171 | 20189088 | 11159476 | 22529964 | 39 |
| 22 | 4441140 | 8959703 | 4956794 | 20174331 | 11161084 | 22516741 | 38 |
| 23 | 4443746 | 8958411 | 4960418 | 20159592 | 11162694 | 22503536 | 37 |
| 24 | 4446452 | 8957118 | 4964043 | 20144869 | 11164306 | 22490348 | 36 |
| 25 | 4448957 | 8955824 | 4967669 | 20130164 | 11165919 | 22477178 | 35 |
| 26 | 4451562 | 8954529 | 4971297 | 20115477 | 11167533 | 22464024 | 34 |
| 27 | 4454167 | 8953234 | 4974925 | 20100806 | 11169149 | 22450889 | 33 |
| 28 | 4456771 | 8951938. | 4978554 | 20086153 | 11170766 | 22437770 | 32 |
| 29 | 4459375 | 8950641 | 4982185 | 20071516 | 11172384 | 22424669 | 31 |
| 30 | 4461978 | 8949343 | 4985816 | 20056897 | 11174004 | 22411584 | 30 |
| 31 | 4464581 | 8948045 | 4989449 | 20042295 | 11175625 | 22398517 | 29 |
| 32 | 4467184 | 8946746 | 4993082 | 20027710 | 11177248 | 22385467 | 28 |
| 33 | 4469786 | 8945446 | 4996717 | 20013142 | 11178872 | 22372435 | 27 |
| 34 | 4472388 | 8944145 | 5000352 | 19998590 | 11180498 | 22359419 | 26 |
| 35 | 4474990 | 8942844 | 5003989 | 19984056 | 11182125 | 22346420 | 25 |
| 36 | 4477591 | 8941542 | 5007627 | 19969539 | 11183753 | 22333438 | 24 |
| 37 | 4480192 | 8940239 | 5011266 | 19955038 | 11185383 | 22320474 | 23 |
| 38 | 4482792 | 8938936 | 5014906 | 19940554 | 11187014 | 22307526 | 22 |
| 39 | 4485392 | 8937632 | 5018547 | 19926087 | 11188647 | 22294595 | 21 |
| 40 | 4487992 | 8936327 | 5022189 | 19911637 | 11190281 | 22281681 | 20 |
| 41 | 4490591 | 8935021 | 5025832 | 19897204 | 11191916 | 22268783 | 19 |
| 42 | 4493190 | 8933714 | 5029476 | 19882787 | 11193553 | 22255903 | 18 |
| 43 | 4495789 | 8932406 | 5033121 | 19868387 | 11195191 | 22243039 | 17 |
| 44 | 4498387 | 8921098 | 5036767 | 19854003 | 11196831 | 22230192 | 16 |
| 45 | 4500985 | 8929789 | 5040415 | 19839636 | 11198472 | 22217362 | 15 |
| 46 | 4503582 | 8928479 | 5044063 | 19825286 | 11200115 | 22204548 | 14 |
| 47 | 4506179 | 8927169 | 5047713 | 19810952 | 11201759 | 22191751 | 13 |
| 48 | 4508776 | 8925858 | 5051363 | 19796635 | 11203405 | 22178971 | 12 |
| 49 | 4511372 | 8924546 | 5055015 | 19782334 | 11205052 | 22166207 | 11 |
| 50 | 4513968 | 8923233 | 5058668 | 19768050 | 11206700 | 22153460 | 10 |
| 51 | 4516563 | 8921920 | 5062322 | 19753782 | 11208350 | 22140730 | 9 |
| 52 | 4519158 | 8920606 | 5065977 | 19739531 | 11210001 | 22128016 | 8 |
| 53 | 4521753 | 8919291 | 5069633 | 19725296 | 11211653 | 22115318 | 7 |
| 54 | 4524347 | 8917975 | 5073290 | 19711077 | 15213307 | 22102637 | 6 |
| 55 | 4526941 | 8916659 | 5076948 | 19696874 | 11214963 | 22089972 | 5 |
| 56 | 4529535 | 8915342 | 5080607 | 19682688 | 11216620 | 22077323 | 4 |
| 57 | 4532128 | 8914024 | 5084267 | 19668518 | 11218278 | 22064691 | 3 |
| 58 | 4534721 | 8912705 | 5087928 | 19654364 | 11219938 | 22052075 | 2 |
| 59 | 4537313 | 8911385 | 5091591 | 19640227 | 11221600 | 22039476 | 1 |
| 60 | 4539905 | 8910065 | 5095254 | 19626105 | 11223262 | 22026893 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

63 DEGREES.

26 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co-Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6418420 | 9.9536602 | 9.6881818 | 10.3118182 | 10.0463398 | 10.3581580 | 60 |
| 1 | 9.6421009 | 9.9535985 | 9.6885023 | 10.3114977 | 10.0464015 | 10.3578991 | 59 |
| 2 | 9.6423596 | 9.9535369 | 9.6888227 | 10.3111773 | 10.0464631 | 10.3576404 | 58 |
| 3 | 9.6426182 | 9.9534751 | 9.6891430 | 10.3108570 | 10.0465249 | 10.3573818 | 57 |
| 4 | 9.6428765 | 9.9534134 | 9.6894631 | 10.3105369 | 10.0465866 | 10.3571235 | 56 |
| 5 | 9.6431347 | 9.9533515 | 9.6897831 | 10.3102169 | 10.0466485 | 10.3568653 | 55 |
| 6 | 9.6433926 | 9.9532898 | 9.6901030 | 10.3098970 | 10.0467103 | 10.3566074 | 54 |
| 7 | 9.6436504 | 9.9532278 | 9.6904226 | 10.3095774 | 10.0467722 | 10.3563496 | 53 |
| 8 | 9.6439080 | 9.9531658 | 9.6907422 | 10.3092578 | 10.0468342 | 10.3560920 | 52 |
| 9 | 9.6441654 | 9.9531038 | 9.6910616 | 10.3089384 | 10.0468962 | 10.3558346 | 51 |
| 10 | 9.6444226 | 9.9530418 | 9.6913809 | 10.3086191 | 10.0469582 | 10.3555774 | 50 |
| 11 | 9.6446796 | 9.9529797 | 9.6917000 | 10.3083000 | 10.0470203 | 10.3553204 | 49 |
| 12 | 9.6449365 | 9.9529175 | 9.6920189 | 10.3079811 | 10.0470825 | 10.3550635 | 48 |
| 13 | 9.6451931 | 9.9528553 | 9.6923378 | 10.3076622 | 10.0471447 | 10.3548069 | 47 |
| 14 | 9.6454496 | 9.9527931 | 9.6926565 | 10.3073435 | 10.0472069 | 10.3545504 | 46 |
| 15 | 9.6457058 | 9.9527308 | 9.6929750 | 10.3070250 | 10.0472692 | 10.3542942 | 45 |
| 16 | 9.6459619 | 9.9526685 | 9.6932934 | 10.3067066 | 10.0473315 | 10.3540381 | 44 |
| 17 | 9.6462178 | 9.9526061 | 9.6936117 | 10.3063883 | 10.0473939 | 10.3537822 | 43 |
| 18 | 9.6464735 | 9.9525437 | 9.6939298 | 10.3060702 | 10.0474563 | 10.3535265 | 42 |
| 19 | 9.6467290 | 9.9524813 | 9.6942478 | 10.3057522 | 10.0475187 | 10.3532710 | 41 |
| 20 | 9.6469844 | 9.9524188 | 9.6945656 | 10.3054344 | 10.0475812 | 10.3530156 | 40 |
| 21 | 9.6472395 | 9.9523562 | 9.6948833 | 10.3051167 | 10.0476438 | 10.3527605 | 39 |
| 22 | 9.6474945 | 9.9522936 | 9.6952009 | 10.3047991 | 10.0477064 | 10.3525055 | 38 |
| 23 | 9.6477492 | 9.9522310 | 9.6955183 | 10.3044817 | 10.0477690 | 10.3522508 | 37 |
| 24 | 9.6480038 | 9.9521683 | 9.6958355 | 10.3041645 | 10.0478317 | 10.3519962 | 36 |
| 25 | 9.6482582 | 9.9521055 | 9.6961527 | 10.3038473 | 10.0478945 | 10.3517418 | 35 |
| 26 | 9.6485124 | 9.9520428 | 9.6964697 | 10.3035303 | 10.0479572 | 10.3514876 | 34 |
| 27 | 9.6487665 | 9.9519799 | 9.6967865 | 10.3032135 | 10.0480201 | 10.3512335 | 33 |
| 28 | 9.6490203 | 9.9519171 | 9.6971032 | 10.3028968 | 10.0480829 | 10.3509797 | 32 |
| 29 | 9.6492740 | 9.9518541 | 9.6974198 | 10.3025802 | 10.0481459 | 10.3507260 | 31 |
| 30 | 9.6495274 | 9.9517912 | 9.6977363 | 10.3022637 | 10.0482088 | 10.3504726 | 30 |
| 31 | 9.6497807 | 9.9517282 | 9.6980526 | 10.3019474 | 10.0482718 | 10.3502193 | 29 |
| 32 | 9.6500338 | 9.9516651 | 9.6983687 | 10.3016313 | 10.0483349 | 10.3499662 | 28 |
| 33 | 9.6502868 | 9.9516020 | 9.6986847 | 10.3013153 | 10.0483980 | 10.3497132 | 27 |
| 34 | 9.6505395 | 9.9515389 | 9.6990006 | 10.3009994 | 10.0484611 | 10.3494605 | 26 |
| 35 | 9.6507920 | 9.9514757 | 9.6993164 | 10.3006836 | 10.0485243 | 10.3492080 | 25 |
| 36 | 9.6510444 | 9.9514124 | 9.6996320 | 10.3003680 | 10.0485876 | 10.3489556 | 24 |
| 37 | 9.6512966 | 9.9513492 | 9.6999474 | 10.3000526 | 10.0486508 | 10.3487034 | 23 |
| 38 | 9.6515486 | 9.9512858 | 9.7002628 | 10.2997372 | 10.0487142 | 10.3484514 | 22 |
| 39 | 9.6518004 | 9.9512224 | 9.7005780 | 10.2994220 | 10.0487776 | 10.3481996 | 21 |
| 40 | 9.6520521 | 9.9511590 | 9.7008930 | 10.2991070 | 10.0488410 | 10.3479479 | 20 |
| 41 | 9.6523035 | 9.9510956 | 9.7012080 | 10.2987920 | 10.0489044 | 10.3476965 | 19 |
| 42 | 9.6525548 | 9.9510320 | 9.7015227 | 10.2984773 | 10.0489680 | 10.3474452 | 18 |
| 43 | 9.6528059 | 9.9509685 | 9.7018374 | 10.2981626 | 10.0490315 | 10.3471941 | 17 |
| 44 | 9.6530568 | 9.9509049 | 9.7021519 | 10.2978481 | 10.0490951 | 10.3469432 | 16 |
| 45 | 9.6533075 | 9.9508412 | 9.7024663 | 10.2975337 | 10.0491588 | 10.3466925 | 15 |
| 46 | 9.6535581 | 9.9507775 | 9.7027805 | 10.2972195 | 10.0492225 | 10.3464419 | 14 |
| 47 | 9.6538084 | 9.9507138 | 9.7030946 | 10.2969054 | 10.0492862 | 10.3461916 | 13 |
| 48 | 9.6540586 | 9.9506500 | 9.7034086 | 10.2965914 | 10.0493500 | 10.3459414 | 12 |
| 49 | 9.6543086 | 9.9505861 | 9.7037225 | 10.2962775 | 10.0494139 | 10.3456914 | 11 |
| 50 | 9.6545584 | 9.9505223 | 9.7040362 | 10.2959638 | 10.0494777 | 10.3454416 | 10 |
| 51 | 9.6548081 | 9.9504583 | 9.7043497 | 10.2956503 | 10.0495417 | 10.3451919 | 9 |
| 52 | 9.6550575 | 9.9503944 | 9.7046632 | 10.2953368 | 10.0496056 | 10.3449425 | 8 |
| 53 | 9.6553068 | 9.9503303 | 9.7049765 | 10.2950235 | 10.0496697 | 10.3446932 | 7 |
| 54 | 9.6555559 | 9.9502663 | 9.7052897 | 10.2947103 | 10.0497337 | 10.3444441 | 6 |
| 55 | 9.6558048 | 9.9502022 | 9.7056027 | 10.2943973 | 10.0497978 | 10.3441952 | 5 |
| 56 | 9.6560536 | 9.9501380 | 9.7059156 | 10.2940844 | 10.0498620 | 10.3439404 | 4 |
| 57 | 9.6563021 | 9.9500738 | 9.7062284 | 10.2937716 | 10.0499262 | 10.3436979 | 3 |
| 58 | 9.6565505 | 9.9500095 | 9.7065410 | 10.2934590 | 10.0499905 | 10.3434495 | 2 |
| 59 | 9.6567987 | 9.9499452 | 9.7068535 | 10.2931465 | 10.0500548 | 10.3432013 | 1 |
| 60 | 9.6570468 | 9.9498809 | 9.7071659 | 10.2928341 | 10.0501191 | 10.3429532 | 0 |
| | L. Co-Sine. | L Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L Secant. | M |

63 DEGREES.

27 DEGREES.

| M | N. Sine. | N. Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 4539905 | 8910065 | 5095254 | 19626105 | 11223262 | 22026893 | 60 |
| 1 | 4542497 | 8908744 | 5098919 | 19612000 | 11224926 | 22014326 | 59 |
| 2 | 4545088 | 8907422 | 5102585 | 19597910 | 11226592 | 22001775 | 58 |
| 3 | 4547679 | 8906100 | 5106252 | 19583837 | 11228259 | 21989240 | 57 |
| 4 | 4550269 | 8904777 | 5109919 | 19569780 | 11229928 | 21976721 | 56 |
| 5 | 4552859 | 8903453 | 5113588 | 19555739 | 11231598 | 21964219 | 55 |
| 6 | 4555449 | 8902128 | 5117259 | 19541713 | 11233269 | 21951733 | 54 |
| 7 | 4558038 | 8900802 | 5120930 | 19527704 | 11234942 | 21939262 | 53 |
| 8 | 4560627 | 8899476 | 5124602 | 19513711 | 11236616 | 21926808 | 52 |
| 9 | 4563216 | 8898149 | 5128275 | 19499733 | 11238292 | 21914370 | 51 |
| 10 | 4565804 | 8896821 | 5131950 | 19485771 | 11239969 | 21901947 | 50 |
| 11 | 4568392 | 8895493 | 5135625 | 19471826 | 11241648 | 21889541 | 49 |
| 12 | 4570979 | 8894164 | 5139302 | 19457896 | 11243328 | 21877150 | 48 |
| 13 | 4573566 | 8892834 | 5142980 | 19443981 | 11245010 | 21864775 | 47 |
| 14 | 4576153 | 8891503 | 5146658 | 19430083 | 11246693 | 21852417 | 46 |
| 15 | 4578739 | 8890171 | 5150338 | 19416200 | 11248377 | 21840074 | 45 |
| 16 | 4581325 | 8888839 | 5154019 | 19402333 | 11250063 | 21827746 | 44 |
| 17 | 4583910 | 8887506 | 5157702 | 19388481 | 11251750 | 21815435 | 43 |
| 18 | 4586495 | 8886172 | 5161385 | 19374645 | 11253439 | 21803139 | 42 |
| 19 | 4589080 | 8884837 | 5165069 | 19360825 | 11255129 | 21790859 | 41 |
| 20 | 4591664 | 8883502 | 5168755 | 19347020 | 11256821 | 21778594 | 40 |
| 21 | 4594248 | 8882166 | 5172441 | 19333231 | 11258514 | 21766346 | 39 |
| 22 | 4596832 | 8880829 | 5176129 | 19319457 | 11260209 | 21754112 | 38 |
| 23 | 4599415 | 8879492 | 5179818 | 19305698 | 11261905 | 21741895 | 37 |
| 24 | 4601998 | 8878154 | 5183508 | 19291956 | 11263603 | 21729593 | 36 |
| 25 | 4604580 | 8876815 | 5187199 | 19278228 | 11265302 | 21717506 | 35 |
| 26 | 4607162 | 8875475 | 5190891 | 19264516 | 11267003 | 21705335 | 34 |
| 27 | 4609744 | 8874134 | 5194584 | 19250819 | 11268705 | 21693180 | 33 |
| 28 | 4612325 | 8872793 | 5198278 | 19237138 | 11270408 | 21681040 | 32 |
| 29 | 4614906 | 8871451 | 5201974 | 19223472 | 11272113 | 21668915 | 31 |
| 30 | 4617486 | 8870108 | 5205670 | 19209821 | 11273819 | 21656806 | 30 |
| 31 | 4620066 | 8868764 | 5209368 | 19196186 | 11275527 | 21644712 | 29 |
| 32 | 4622646 | 8867420 | 5213067 | 19182565 | 11277237 | 21632633 | 28 |
| 33 | 4625225 | 8866075 | 5216767 | 19168960 | 11278948 | 21620570 | 27 |
| 34 | 4627804 | 8864725 | 5220468 | 19155370 | 11280660 | 21608522 | 26 |
| 35 | 4630382 | 8863383 | 5224170 | 19141795 | 11282374 | 21596489 | 25 |
| 36 | 4632960 | 8862036 | 5227874 | 19128236 | 11284089 | 21584471 | 24 |
| 37 | 4635538 | 8860688 | 5231578 | 19114691 | 11285806 | 21572469 | 23 |
| 38 | 4638115 | 8859339 | 5235284 | 19101162 | 11287524 | 21560482 | 22 |
| 39 | 4640692 | 8857989 | 5238990 | 19087647 | 11289244 | 21548510 | 21 |
| 40 | 4643269 | 8856639 | 5242698 | 19074147 | 11290965 | 21536553 | 20 |
| 41 | 4645845 | 8855288 | 5246407 | 19060663 | 11292688 | 21524611 | 19 |
| 42 | 4648421 | 8853936 | 5250117 | 19047193 | 11294412 | 21512684 | 18 |
| 43 | 4650996 | 8852583 | 5253829 | 19033738 | 11296137 | 21500772 | 17 |
| 44 | 4653571 | 8851230 | 5257541 | 19020299 | 11297864 | 21488875 | 16 |
| 45 | 4656145 | 8849876 | 5261254 | 19006874 | 11299593 | 21476993 | 15 |
| 46 | 4658719 | 8848521 | 5264969 | 18993464 | 11301323 | 21465127 | 14 |
| 47 | 4661293 | 8847166 | 5268685 | 18980068 | 11303055 | 21453275 | 13 |
| 48 | 4663866 | 8845810 | 5272402 | 18966688 | 11304788 | 21441437 | 12 |
| 49 | 4666439 | 8844453 | 5276120 | 18953322 | 11306522 | 21429615 | 11 |
| 50 | 4669012 | 8843095 | 5279839 | 18939971 | 11308258 | 21417808 | 10 |
| 51 | 4671584 | 8841736 | 5283559 | 18926634 | 11309996 | 21406015 | 9 |
| 52 | 4674156 | 8840377 | 5287281 | 18913313 | 11311735 | 21394238 | 8 |
| 53 | 4676727 | 8839017 | 5291004 | 18900006 | 11313475 | 21382475 | 7 |
| 54 | 4679298 | 8837656 | 5294727 | 18886713 | 11315217 | 21370726 | 6 |
| 55 | 4681869 | 8836294 | 5298452 | 18873436 | 11316961 | 21358993 | 5 |
| 56 | 4684439 | 8834932 | 5302178 | 18860172 | 11318706 | 21347274 | 4 |
| 57 | 4687009 | 8833569 | 5305906 | 18846924 | 11320452 | 21335570 | 3 |
| 58 | 4689578 | 8832205 | 5309634 | 18833690 | 11322200 | 21323880 | 2 |
| 59 | 4692147 | 8830841 | 5313364 | 18820470 | 11323950 | 21312205 | 1 |
| 60 | 4694716 | 8829476 | 5317094 | 18807265 | 11325701 | 21200545 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. Co-Secant. | N. Secant. | M |

62 DEGREES.

27 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6570468 | 9.9498809 | 9.7071659 | 10.2928341 | 10.0501191 | 10.3429532 | 60 |
| 1 | 9.6572946 | 9.9498165 | 9.7074781 | 10.2925219 | 10.0501835 | 10.3427054 | 59 |
| 2 | 9.6575423 | 9.9497521 | 9.7077902 | 10.2922098 | 10.0502479 | 10.3424577 | 58 |
| 3 | 9.6577898 | 9.9496876 | 9.7081022 | 10.2918978 | 10.0503124 | 10.3422102 | 57 |
| 4 | 9.6580371 | 9.9496230 | 9.7084141 | 10.2915859 | 10.0503770 | 10.3419629 | 56 |
| 5 | 9.6582842 | 9.9495585 | 9.7087258 | 10.2912742 | 10.0504415 | 10.3417158 | 55 |
| 6 | 9.6585312 | 9.9494938 | 9.7090374 | 10.2909626 | 10.0505062 | 10.3414688 | 54 |
| 7 | 9.6587780 | 9.9494292 | 9.7093488 | 10.2906512 | 10.0505708 | 10.3412220 | 53 |
| 8 | 9.6590246 | 9.9493645 | 9.7096601 | 10.2903399 | 10.0506355 | 10.3409754 | 52 |
| 9 | 9.6592710 | 9.9492997 | 9.7099713 | 10.2900287 | 10.0507003 | 10.3407290 | 51 |
| 10 | 9.6595173 | 9.9492349 | 9.7102824 | 10.2897176 | 10.0507651 | 10.3404827 | 50 |
| 11 | 9.6597634 | 9.9491700 | 9.7105933 | 10.2894067 | 10.0508300 | 10.3402367 | 49 |
| 12 | 9.6600093 | 9.9491051 | 9.7109041 | 10.2890959 | 10.0508949 | 10.3399907 | 48 |
| 13 | 9.6602550 | 9.9490402 | 9.7112148 | 10.2887852 | 10.0509598 | 10.3397450 | 47 |
| 14 | 9.6605005 | 9.9489752 | 9.7115254 | 10.2884746 | 10.0510248 | 10.3394995 | 46 |
| 15 | 9.6607459 | 9.9489101 | 9.7118358 | 10.2881642 | 10.0510899 | 10.3392541 | 45 |
| 16 | 9.6609911 | 9.9488450 | 9.7121461 | 10.2878539 | 10.0511500 | 10.3390089 | 44 |
| 17 | 9.6612361 | 9.9487799 | 9.7124562 | 10.2875433 | 10.0512201 | 10.3387639 | 43 |
| 18 | 9.6614810 | 9.9487147 | 9.7127662 | 10.2872338 | 10.0512853 | 10.3385190 | 42 |
| 19 | 9.6617257 | 9.9486495 | 9.7130761 | 10.2869239 | 10.0513505 | 10.3382743 | 41 |
| 20 | 9.6619701 | 9.9485842 | 9.7133859 | 10.2866141 | 10.0514158 | 10.3380298 | 40 |
| 21 | 9.6622145 | 9.9485189 | 9.7136956 | 10.2863044 | 10.0514811 | 10.3377855 | 39 |
| 22 | 9.6624586 | 9.9484535 | 9.7140051 | 10.2859949 | 10.0515465 | 10.3375414 | 38 |
| 23 | 9.6627026 | 9.9483881 | 9.7143145 | 10.2856855 | 10.0516119 | 10.3372974 | 37 |
| 24 | 9.6629464 | 9.9483227 | 9.7146237 | 10.2853763 | 10.0516773 | 10.3370536 | 36 |
| 25 | 9.6631900 | 9.9482572 | 9.7149329 | 10.2850671 | 10.0517428 | 10.3368100 | 35 |
| 26 | 9.6634335 | 9.9481916 | 9.7152419 | 10.2847581 | 10.0518084 | 10.3365665 | 34 |
| 27 | 9.6636768 | 9.9481260 | 9.7155508 | 10.2844492 | 10.0518740 | 10.3363232 | 33 |
| 28 | 9.6639199 | 9.9480604 | 9.7158595 | 10.2841405 | 10.0519396 | 10.3360801 | 32 |
| 29 | 9.6641628 | 9.9479947 | 9.7161682 | 10.2838318 | 10.0520053 | 10.3358372 | 31 |
| 30 | 9.6644056 | 9.9479289 | 9.7164767 | 10.2835233 | 10.0520711 | 10.3355944 | 30 |
| 31 | 9.6646482 | 9.9478631 | 9.7167851 | 10.2832149 | 10.0521369 | 10.3353518 | 29 |
| 32 | 9.6648906 | 9.9477973 | 9.7170933 | 10.2829067 | 10.0522027 | 10.3351094 | 28 |
| 33 | 9.6651329 | 9.9477314 | 9.7174014 | 10.2825986 | 10.0522686 | 10.3348671 | 27 |
| 34 | 9.6653749 | 9.9476655 | 9.7177094 | 10.2822906 | 10.0523345 | 10.3346251 | 26 |
| 35 | 9.6656168 | 9.9475995 | 9.7180173 | 10.2819827 | 10.0524005 | 10.3343832 | 25 |
| 36 | 9.6658586 | 9.9475335 | 9.7183251 | 10.2816749 | 10.0524665 | 10.3341414 | 24 |
| 37 | 9.6661001 | 9.9474674 | 9.7186327 | 10.2813673 | 10.0525326 | 10.3338999 | 23 |
| 38 | 9.6663415 | 9.9474013 | 9.7189402 | 10.2810598 | 10.0525987 | 10.3336585 | 22 |
| 39 | 9.6665828 | 9.9473352 | 9.7192476 | 10.2807524 | 10.0526648 | 10.3334172 | 21 |
| 40 | 9.6668238 | 9.9472689 | 9.7195549 | 10.2804451 | 10.0527311 | 10.3331762 | 20 |
| 41 | 9.6670647 | 9.9472027 | 9.7198620 | 10.2801380 | 10.0527973 | 10.3329353 | 19 |
| 42 | 9.6673054 | 9.9471364 | 9.7201690 | 10.2798310 | 10.0528636 | 10.3326946 | 18 |
| 43 | 9.6675459 | 9.9470700 | 9.7204759 | 10.2795241 | 10.0529300 | 10.3324541 | 17 |
| 44 | 9.6677863 | 9.9470036 | 9.7207827 | 10.2792173 | 10.0529964 | 10.3322137 | 16 |
| 45 | 9.6680265 | 9.9469372 | 9.7210893 | 10.2789107 | 10.0530628 | 10.3319735 | 15 |
| 46 | 9.6682665 | 9.9468707 | 9.7213958 | 10.2786042 | 10.0531293 | 10.3317335 | 14 |
| 47 | 9.6689064 | 9.9468042 | 9.7217022 | 10.2782978 | 10.0531958 | 10.3314936 | 13 |
| 48 | 9.6687461 | 9.9467376 | 9.7220085 | 10.2779915 | 10.0532624 | 10.3312539 | 12 |
| 49 | 9.6689856 | 9.9466710 | 9.7223147 | 10.2776853 | 10.0533290 | 10.3310144 | 11 |
| 50 | 9.6692250 | 9.9466043 | 9.7226207 | 10.2773793 | 10.0533957 | 10.3307750 | 10 |
| 51 | 9.6694642 | 9.9465376 | 9.7229266 | 10.2770734 | 10.0534624 | 10.3305358 | 9 |
| 52 | 9.6697032 | 9.9464708 | 9.7232324 | 10.2767676 | 10.0535292 | 10.3302968 | 8 |
| 53 | 9.6699420 | 9.9464040 | 9.7235381 | 10.2764619 | 10.0535960 | 10.3300580 | 7 |
| 54 | 9.6701807 | 9.9463371 | 9.7238436 | 10.2761564 | 10.0536629 | 10.3298193 | 6 |
| 55 | 9.6704192 | 9.9462702 | 9.7241490 | 10.2758510 | 10.0537298 | 10.3295808 | 5 |
| 56 | 9.6706576 | 9.9462032 | 9.7244543 | 10.2755457 | 10.0537968 | 10.3293424 | 4 |
| 57 | 9.6708958 | 9.9461362 | 9.7247595 | 10.2752405 | 10.0538638 | 10.3291042 | 3 |
| 58 | 9.6711338 | 9.9460692 | 9.7250646 | 10.2749354 | 10.0539308 | 10.3288662 | 2 |
| 59 | 9.6713716 | 9.9460021 | 9.7253695 | 10.2746305 | 10.0539979 | 10.3286284 | 1 |
| 60 | 9.6716093 | 9.9459349 | 9.7256744 | 10.2743256 | 10.0540651 | 10.3283907 | 0 |
| | L. Co-Sine. | L Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L- Secant. | M |

62 DEGREES.

28 DEGREES.

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 46947 6 | 8829476 | 5317091 | 18807265 | 11325701 | 21300545 | 60 |
| 1 | 4697284 | 8828110 | 5320826 | 18794074 | 11327453 | 21288899 | 59 |
| 2 | 4699852 | 8826743 | 5324559 | 18780898 | 11329207 | 21277267 | 58 |
| 3 | 4702419 | 8825375 | 5328293 | 18767736 | 11330962 | 21265651 | 57 |
| 4 | 4704986 | 8824007 | 5332029 | 18754588 | 11332719 | 21254048 | 56 |
| 5 | 4707553 | 8822638 | 5335765 | 18741455 | 11334478 | 21242460 | 55 |
| 6 | 4710119 | 8821268 | 5339503 | 18728336 | 11336238 | 21230887 | 54 |
| 7 | 4712685 | 8819898 | 5343242 | 18715231 | 11337999 | 21219328 | 53 |
| 8 | 4715250 | 8818527 | 5346982 | 18702141 | 11339762 | 21207783 | 52 |
| 9 | 4717815 | 8817155 | 5350723 | 18689064 | 11341527 | 21196253 | 51 |
| 10 | 4720380 | 8815782 | 5354465 | 18676003 | 11343293 | 21184737 | 50 |
| 11 | 4722944 | 8814409 | 5358208 | 18662955 | 11345090 | 21173235 | 49 |
| 12 | 4725508 | 8813035 | 5361953 | 18649921 | 11346829 | 21161748 | 48 |
| 13 | 4728071 | 8811660 | 5365699 | 18636902 | 11348600 | 21150274 | 47 |
| 14 | 4730634 | 8810284 | 5369446 | 18623896 | 11350372 | 21138815 | 46 |
| 15 | 4733197 | 8808907 | 5373194 | 18610905 | 11352146 | 21127371 | 45 |
| 16 | 4735759 | 8807530 | 5376943 | 18597928 | 11353921 | 21115940 | 44 |
| 17 | 4738321 | 8806152 | 5380694 | 18584965 | 11355698 | 21104523 | 43 |
| 18 | 4740882 | 8804773 | 5384445 | 18572015 | 11357476 | 21093121 | 42 |
| 19 | 4743443 | 8803394 | 5388198 | 18559080 | 11359255 | 21081733 | 41 |
| 20 | 4746004 | 8802014 | 5391952 | 18546159 | 11361036 | 21070359 | 40 |
| 21 | 4748564 | 8800633 | 5395707 | 18533252 | 11362819 | 21058998 | 39 |
| 22 | 4751124 | 8799251 | 5399464 | 18520358 | 11364603 | 21047652 | 38 |
| 23 | 4753683 | 8797869 | 5403221 | 18507479 | 11366389 | 21036320 | 37 |
| 24 | 4756242 | 8796486 | 5406980 | 18494613 | 11368176 | 21025002 | 36 |
| 25 | 4758801 | 8795102 | 5410740 | 18481761 | 11369965 | 21013698 | 35 |
| 26 | 4761359 | 8793717 | 5414501 | 18468923 | 11371755 | 21002408 | 34 |
| 27 | 4763917 | 8792332 | 5418263 | 18456099 | 11373547 | 20991131 | 33 |
| 28 | 4766474 | 8790946 | 5422027 | 18443289 | 11375340 | 20979869 | 32 |
| 29 | 4769031 | 8789559 | 5425791 | 18430492 | 11377135 | 20968620 | 31 |
| 30 | 4771588 | 8788171 | 5429557 | 18417709 | 11378932 | 20957385 | 30 |
| 31 | 4774144 | 8786783 | 5433324 | 18404939 | 11380730 | 20946164 | 29 |
| 32 | 4779700 | 8785294 | 5437092 | 18392184 | 11382529 | 20934957 | 28 |
| 33 | 4779255 | 8784004 | 5440862 | 18379442 | 11384330 | 20923764 | 27 |
| 34 | 4781810 | 8782613 | 5444632 | 18366713 | 11386133 | 20912584 | 26 |
| 35 | 4784364 | 8781222 | 5448404 | 18353999 | 11387937 | 20901418 | 25 |
| 36 | 4786918 | 8770830 | 5452177 | 18341297 | 11389743 | 20890265 | 24 |
| 37 | 4789472 | 8778437 | 5455951 | 18328610 | 11391550 | 20879127 | 23 |
| 38 | 4792026 | 8777043 | 5459726 | 18315936 | 11393359 | 20868002 | 22 |
| 39 | 4794579 | 8775649 | 5463503 | 18303275 | 11395169 | 20856890 | 21 |
| 40 | 4797171 | 8774254 | 5467281 | 18290628 | 11396981 | 20845792 | 20 |
| 41 | 4799683 | 8772858 | 5471060 | 18277994 | 11398795 | 20834708 | 19 |
| 42 | 4802235 | 8771461 | 5474840 | 18265374 | 11400609 | 20823637 | 18 |
| 43 | 4804786 | 8770064 | 5478621 | 18252767 | 11402425 | 20812580 | 17 |
| 44 | 4807337 | 8768666 | 5482404 | 18240173 | 11404243 | 20801536 | 16 |
| 45 | 4809888 | 8767267 | 5486188 | 18227593 | 11406062 | 20790506 | 15 |
| 46 | 4812438 | 8765868 | 5489973 | 18215026 | 11407883 | 20779489 | 14 |
| 47 | 4814983 | 8764468 | 5493759 | 18202473 | 11409706 | 20768486 | 13 |
| 48 | 4817537 | 8763067 | 5497546 | 18189932 | 11411530 | 20757496 | 12 |
| 49 | 4820086 | 8761665 | 5501335 | 18177405 | 11413356 | 20746519 | 11 |
| 50 | 4822634 | 8760262 | 5505125 | 18164892 | 11415183 | 20735556 | 10 |
| 51 | 4825182 | 8758859 | 5508916 | 18152391 | 11417012 | 20724606 | 9 |
| 52 | 4827730 | 8757455 | 5512708 | 18139904 | 11418842 | 20713670 | 8 |
| 53 | 4830277 | 8756050 | 5516502 | 18127430 | 11420674 | 20702746 | 7 |
| 54 | 4832824 | 8754645 | 5520257 | 18114969 | 11422507 | 20691836 | 6 |
| 55 | 4835370 | 8753239 | 5524093 | 18102521 | 11424342 | 20680940 | 5 |
| 56 | 4837916 | 8751832 | 5527890 | 18090086 | 11426179 | 20670056 | 4 |
| 57 | 4840462 | 8750424 | 5531688 | 18077664 | 11428017 | 20659186 | 3 |
| 58 | 4843007 | 8749016 | 5535488 | 18065256 | 11429857 | 20648328 | 2 |
| 59 | 4845552 | 8747607 | 5539288 | 18052860 | 11431698 | 20637484 | 1 |
| 60 | 4848096 | 8746197 | 5543090 | 18040478 | 11433541 | 20626653 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. Co Secant. | N. Secant. | M |

61 DEGREES.

28 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent. | L. Co. Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6716093 | 9.9459349 | 9.7256744 | 10.2743256 | 10.0540651 | 10.3283907 | 60 |
| 1 | 9.6718468 | 9.9458077 | 9.7259791 | 10.2740209 | 10.0541323 | 10.3281532 | 59 |
| 2 | 9.6720841 | 9.9458005 | 9.7262837 | 10.2737163 | 10.0541995 | 10.3279159 | 58 |
| 3 | 9.6723213 | 9.9457332 | 9.7265881 | 10.2734119 | 10.0542668 | 10.3276787 | 57 |
| 4 | 9.6725583 | 9.9456659 | 9.7268925 | 10.2731075 | 10.0543341 | 10.3274417 | 56 |
| 5 | 9.6727952 | 9.9455985 | 9.7271967 | 10.2728033 | 10.0544015 | 10.3272048 | 55 |
| 6 | 9.6730319 | 9.9455310 | 9.7275008 | 10.2724992 | 10.0544690 | 10.3269681 | 54 |
| 7 | 9.6732684 | 9.9454036 | 9.7278048 | 10.2721952 | 10.0545364 | 10.3267316 | 53 |
| 8 | 9.6735047 | 9.9453960 | 9.7281087 | 10.2718913 | 10.0546040 | 10.3264953 | 52 |
| 9 | 9.6737409 | 9.9453285 | 9.7284124 | 10.2715876 | 10.0546715 | 10.3262591 | 51 |
| 10 | 9.6739769 | 9.9452609 | 9.7287161 | 10.2712839 | 10.0547391 | 10.3260231 | 50 |
| 11 | 9.6742128 | 9.9451932 | 9.7290196 | 10.2709804 | 10.0548068 | 10.3257872 | 49 |
| 12 | 9.6744485 | 9.9451255 | 9.7293230 | 10.2706770 | 10.0548745 | 10.3255515 | 48 |
| 13 | 9.6746840 | 9.9450577 | 9.7296263 | 10.2703737 | 10.0549423 | 10.3253160 | 47 |
| 14 | 9.6749194 | 9.9449899 | 9.7299295 | 10.2700705 | 10.0550101 | 10.3250806 | 46 |
| 15 | 9.6751346 | 9.9449220 | 9.7302325 | 10.2697675 | 10.0550780 | 10.3248454 | 45 |
| 16 | 9.6753896 | 9.9448541 | 9.7305354 | 10.2694646 | 10.0551459 | 10.3246104 | 44 |
| 17 | 9.6756245 | 9.9447862 | 9.7308383 | 10.2691617 | 10.0552138 | 10.3243756 | 43 |
| 18 | 9.6758592 | 9.9447182 | 9.7311410 | 10.2688590 | 10.0552818 | 10.3241408 | 42 |
| 19 | 9.6760937 | 9.9446501 | 9.7314436 | 10.2685564 | 10.0553499 | 10.3239063 | 41 |
| 20 | 9.6763281 | 9.9445821 | 9.7317460 | 10.2682540 | 10.0554179 | 10.3236719 | 40 |
| 21 | 9.6765623 | 9.9445139 | 9.7320484 | 10.2679516 | 10.0554861 | 10.3234377 | 39 |
| 22 | 9.6767963 | 9.9444457 | 9.7323506 | 10.2676494 | 10.0555543 | 10.3232037 | 38 |
| 23 | 9.6770302 | 9.9443775 | 9.7326527 | 10.2673473 | 10.0556225 | 10.3229698 | 37 |
| 24 | 9.6772640 | 9.9443092 | 9.7329547 | 10.2670453 | 10.0556908 | 10.3227360 | 36 |
| 25 | 9.6774975 | 9.9442409 | 9.7332566 | 10.2667434 | 10.0557591 | 10.3225025 | 35 |
| 26 | 9.6777309 | 9.9441725 | 9.7335584 | 10.2664416 | 10.0558275 | 10.3222691 | 34 |
| 27 | 9.6779642 | 9.9441041 | 9.7338601 | 10.2661399 | 10.0558959 | 10.3220358 | 33 |
| 28 | 9.6781972 | 9.9440356 | 9.7341616 | 10.2658384 | 10.0559644 | 10.3218028 | 32 |
| 29 | 9.6784301 | 9.9439671 | 9.7344631 | 10.2655369 | 10.0560329 | 10.3215699 | 31 |
| 30 | 9.6786629 | 9.9438985 | 9.7347644 | 10.2652356 | 10.0561015 | 10.3213371 | 30 |
| 31 | 9.6788955 | 9.9438299 | 9.7350656 | 10.2649344 | 10.0561701 | 10.3211045 | 29 |
| 32 | 9.6791279 | 9.9437612 | 9.7353667 | 10.2646333 | 10.0562388 | 10.3208721 | 28 |
| 33 | 9.6793602 | 9.9436925 | 9.7356677 | 10.2643323 | 10.0563075 | 10.3206298 | 27 |
| 34 | 9.6795923 | 9.9436238 | 9.7359685 | 10.2640315 | 10.0563762 | 10.3204077 | 26 |
| 35 | 9.6798243 | 9.9435549 | 9.7362693 | 10.2637307 | 10.0564451 | 10.3201757 | 25 |
| 36 | 9.6800560 | 9.9434861 | 9.7365699 | 10.2634301 | 10.0565139 | 10.3199440 | 24 |
| 37 | 9.6802877 | 9.9434172 | 9.7368705 | 10.2631295 | 10.0565828 | 10.3197123 | 23 |
| 38 | 9.6805191 | 9.9433482 | 9.7371709 | 10.2628291 | 10.0566518 | 10.3194809 | 22 |
| 39 | 9.6807504 | 9.9432792 | 9.7374712 | 10.2625288 | 10.0567208 | 10.3192496 | 21 |
| 40 | 9.6809816 | 9.9432102 | 9.7377714 | 10.2622286 | 10.0567898 | 10.3190184 | 20 |
| 41 | 9.6812126 | 9.9431411 | 9.7380715 | 10.2619285 | 10.0568589 | 10.3187874 | 19 |
| 42 | 9.6814434 | 9.9430720 | 9.7383714 | 10.2616286 | 10.0569280 | 10.3185566 | 18 |
| 43 | 9.6816741 | 9.9430028 | 9.7386713 | 10.2613287 | 10.0569972 | 10.3183259 | 17 |
| 44 | 9.6819046 | 9.9429335 | 9.7389710 | 10.2610290 | 10.0570665 | 10.3180954 | 16 |
| 45 | 9.6821349 | 9.9428643 | 9.7392707 | 10.2607293 | 10.0571357 | 10.3178651 | 15 |
| 46 | 9.6823651 | 9.9427949 | 9.7395702 | 10.2604298 | 10.0572051 | 10.3176349 | 14 |
| 47 | 9.6825952 | 9.9427255 | 9.7398696 | 10.2601304 | 10.0572745 | 10.3174048 | 13 |
| 48 | 9.6828250 | 9.9426561 | 9.7401689 | 10.2598311 | 10.0573439 | 10.3171750 | 12 |
| 49 | 9.6830548 | 9.9425866 | 9.7404681 | 10.2595319 | 10.0574134 | 10.3169452 | 11 |
| 50 | 9.6832843 | 9.9425171 | 9.7407672 | 10.2592328 | 10.0574829 | 10.3167157 | 10 |
| 51 | 9.6835137 | 9.9424476 | 9.7410662 | 10.2589338 | 10.0575524 | 10.3164863 | 9 |
| 52 | 9.6837430 | 9.9423779 | 9.7413650 | 10.2586350 | 10.0576221 | 10.3162570 | 8 |
| 53 | 9.6839720 | 9.9423083 | 9.7416638 | 10.2583362 | 10.0576917 | 10.3160280 | 7 |
| 54 | 9.6842010 | 9.9422386 | 9.7419624 | 10.2580376 | 10.0577614 | 10.3157990 | 6 |
| 55 | 9.6844297 | 9.9421688 | 9.7422609 | 10.2577391 | 10.0578312 | 10.3155703 | 5 |
| 56 | 9.6846583 | 9.9420990 | 9.7425594 | 10.2574406 | 10.0579010 | 10.3153417 | 4 |
| 57 | 9.6848868 | 9.9420291 | 9.7428577 | 10.2571423 | 10.0579709 | 10.3151132 | 3 |
| 58 | 9.6851151 | 9.9419592 | 9.7431559 | 10.2568441 | 10.0580408 | 10.3148849 | 2 |
| 59 | 9.6853432 | 9.9418893 | 9.7434540 | 10.2565460 | 10.0581107 | 10.3146568 | 1 |
| 60 | 9.6855712 | 9.9418193 | 9.7437520 | 10.2562480 | 10.0581807 | 10.3144288 | 0 |
| | L. Co-Sine. | L. Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L. Secant. | M |

61 DEGREES.

29 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 4848096 | 8746197 | 5543090 | 18040478 | 11433541 | 20626653 | 60 |
| 1 | 4850640 | 8744786 | 5546894 | 18028108 | 11435385 | 20615836 | 59 |
| 2 | 4853184 | 8743375 | 5550698 | 18015751 | 11437231 | 20605031 | 58 |
| 3 | 4855727 | 8741963 | 5554504 | 18003408 | 11439078 | 20594239 | 57 |
| 4 | 4858270 | 8740550 | 5558311 | 17991077 | 11440927 | 20583460 | 56 |
| 5 | 4860812 | 8739136 | 5562119 | 17978759 | 11442778 | 20572695 | 55 |
| 6 | 4863354 | 8737722 | 5565929 | 17966454 | 11444630 | 20561942 | 54 |
| 7 | 4865895 | 8736307 | 5569739 | 17954162 | 11446484 | 20551203 | 53 |
| 8 | 4868436 | 8734891 | 5573551 | 17941883 | 11448339 | 20540476 | 52 |
| 9 | 4870977 | 8733475 | 5577364 | 17929616 | 11450196 | 20529762 | 51 |
| 10 | 4873517 | 8732058 | 5581179 | 17917362 | 11452055 | 20519061 | 50 |
| 11 | 4876057 | 8730640 | 5584994 | 17905121 | 11453915 | 20508373 | 49 |
| 12 | 4878597 | 8729221 | 5588811 | 17892893 | 11555776 | 20497698 | 48 |
| 13 | 4881136 | 8727801 | 5592629 | 17880678 | 11457639 | 20487036 | 47 |
| 14 | 4883674 | 8726381 | 5596448 | 17868475 | 11459504 | 20476386 | 46 |
| 15 | 4886212 | 8724960 | 5600269 | 17856285 | 11461370 | 20465750 | 45 |
| 16 | 4888750 | 8723538 | 5604091 | 17844107 | 11463238 | 20455125 | 44 |
| 17 | 4891287 | 8722116 | 5607914 | 17831943 | 11465108 | 20444515 | 43 |
| 18 | 4893824 | 8720693 | 5611738 | 17819790 | 11466979 | 20433916 | 42 |
| 19 | 4896361 | 8719269 | 5615564 | 17807651 | 11468852 | 20423330 | 41 |
| 20 | 4898897 | 8717844 | 5619391 | 17795524 | 11470726 | 20412757 | 40 |
| 21 | 4901433 | 8716419 | 5623219 | 17783409 | 11472602 | 20402197 | 39 |
| 22 | 4903968 | 8714993 | 5627048 | 17771307 | 11474479 | 20391649 | 38 |
| 23 | 4906503 | 8713566 | 5630879 | 17759218 | 11476358 | 20381114 | 37 |
| 24 | 4909037 | 8712138 | 5634710 | 17747141 | 11478239 | 20370592 | 36 |
| 25 | 4911571 | 8710710 | 5638543 | 17735076 | 11480121 | 20360082 | 35 |
| 26 | 4914105 | 8709281 | 5642378 | 17723024 | 11482005 | 20349585 | 34 |
| 27 | 4916638 | 8707851 | 5646213 | 17710985 | 11483890 | 20339100 | 33 |
| 28 | 4919171 | 8706420 | 5650050 | 17698958 | 11485777 | 20328627 | 32 |
| 29 | 4921704 | 8704989 | 5653888 | 17686943 | 11487665 | 20318168 | 31 |
| 30 | 4924236 | 8703557 | 5657728 | 17674940 | 11489555 | 20307720 | 30 |
| 31 | 4926767 | 8702124 | 5661568 | 17662950 | 11491447 | 20297286 | 29 |
| 32 | 4929298 | 8700690 | 5665410 | 17650972 | 11493340 | 20286863 | 28 |
| 33 | 4931829 | 8699256 | 5669253 | 17639007 | 11495235 | 20226453 | 27 |
| 34 | 4934359 | 8697821 | 5673098 | 17627053 | 11497132 | 20266056 | 26 |
| 35 | 4936889 | 8696385 | 5676944 | 17615112 | 11499030 | 20245670 | 25 |
| 36 | 4939419 | 8694949 | 5680791 | 17603183 | 11500930 | 20245297 | 24 |
| 37 | 4941948 | 8693512 | 5684639 | 17591267 | 11502831 | 20234937 | 23 |
| 38 | 4944477 | 8692074 | 5688488 | 17579362 | 11504734 | 20224589 | 22 |
| 39 | 4947005 | 8690635 | 5692339 | 17567470 | 11502638 | 20214258 | 21 |
| 40 | 4949533 | 8689196 | 5696191 | 17555590 | 11508544 | 20203929 | 20 |
| 41 | 4952060 | 8687756 | 5700045 | 17543722 | 11510452 | 20193617 | 19 |
| 42 | 4954587 | 8686315 | 5703899 | 17531866 | 11512361 | 20183318 | 18 |
| 43 | 4957113 | 8684873 | 5707755 | 17520023 | 11514272 | 20173031 | 17 |
| 44 | 4959639 | 8683431 | 5711612 | 17508191 | 11516185 | 20162756 | 16 |
| 45 | 4962165 | 8681988 | 5715471 | 17496371 | 11518099 | 20152494 | 15 |
| 46 | 4964690 | 8680544 | 5719331 | 17484564 | 11520015 | 20142243 | 14 |
| 47 | 4967215 | 8679100 | 5723192 | 17472768 | 11521932 | 20132005 | 13 |
| 48 | 4969740 | 8677655 | 5727054 | 17460984 | 11523851 | 20121779 | 12 |
| 49 | 4972264 | 8676209 | 5730918 | 17449213 | 11525772 | 20111564 | 11 |
| 50 | 4974787 | 8674762 | 5734783 | 17437453 | 11527694 | 20101362 | 10 |
| 51 | 4977310 | 8673314 | 5738649 | 17425705 | 11529618 | 20091172 | 9 |
| 52 | 4979833 | 8671866 | 5742516 | 17413969 | 11531543 | 20080994 | 8 |
| 53 | 4982355 | 8670417 | 5746385 | 17402245 | 11533470 | 20070828 | 7 |
| 54 | 4984877 | 8668967 | 5750255 | 17390533 | 11535399 | 20060674 | 6 |
| 55 | 4987399 | 8667517 | 5754126 | 17378833 | 11537329 | 20050532 | 5 |
| 56 | 4989920 | 8666066 | 5757999 | 17367144 | 11539261 | 20040402 | 4 |
| 57 | 4992441 | 8664614 | 5761873 | 17355468 | 11541195 | 20030283 | 3 |
| 58 | 4994961 | 8663161 | 5765748 | 17343803 | 11543130 | 20020177 | 2 |
| 59 | 4997481 | 8661708 | 5769625 | 17332149 | 11545067 | 20010083 | 1 |
| 60 | 5000000 | 8660254 | 5773503 | 17320508 | 11547005 | 20000000 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. CoSecant. | N. Secant. | M |

60 DEGREES.

29 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6855712 | 9.9418193 | 9.7437527 | 10.2562480 | 10.0581807 | 10.3144288 | 60 |
| 1 | 9.6857991 | 9.9417492 | 9.7440499 | 10.2559501 | 10.0582508 | 10.3142009 | 59 |
| 2 | 9.6860267 | 9.9416791 | 9.7443476 | 10.2556524 | 10.0583209 | 10.3139733 | 58 |
| 3 | 9.6862542 | 9.9416090 | 9.7446453 | 10.2553547 | 10.0583910 | 10.3137458 | 57 |
| 4 | 9.6864816 | 9.9415388 | 9.7449428 | 10.2550572 | 10.0584612 | 10.3135184 | 56 |
| 5 | 9.6867088 | 9.9414685 | 9.7452403 | 10.2547597 | 10.0585315 | 10.3132912 | 55 |
| 6 | 9.6869359 | 9.9413982 | 9.7455376 | 10.2544624 | 10.0586018 | 10.3130641 | 54 |
| 7 | 9.6871625 | 9.9413279 | 9.7458349 | 10.2541651 | 10.0586721 | 10.3128372 | 53 |
| 8 | 9.6873895 | 9.9412575 | 9.7461320 | 10.2538680 | 10.0587425 | 10.3126105 | 52 |
| 9 | 9.6876161 | 9.9411871 | 9.7464290 | 10.2535710 | 10.0588129 | 10.3123839 | 51 |
| 10 | 9.6878425 | 9.9411166 | 9.7467259 | 10.2532741 | 10.0588834 | 10.3121575 | 50 |
| 11 | 9.6880688 | 9.9410461 | 9.7470227 | 10.2529773 | 10.0589539 | 10.3119312 | 49 |
| 12 | 9.6882949 | 9.9409755 | 9.7473194 | 10.2526806 | 10.0590245 | 10.3117051 | 48 |
| 13 | 9.6885209 | 9.9409048 | 9.7476160 | 10.2523840 | 10.0590952 | 10.3114791 | 47 |
| 14 | 9.6887467 | 9.9408342 | 9.7479125 | 10.2520875 | 10.0591658 | 10.3112533 | 46 |
| 15 | 9.6889723 | 9.9407634 | 9.7482089 | 10.2517911 | 10.0592366 | 10.3110277 | 45 |
| 16 | 9.6891978 | 9.9406927 | 9.7485052 | 10.2514948 | 10.0593073 | 10.3108022 | 44 |
| 17 | 9.6894232 | 9.9406219 | 9.7488013 | 10.2511987 | 10.0593781 | 10.3105768 | 43 |
| 18 | 9.6896484 | 9.9405510 | 9.7490974 | 10.2509026 | 10.0594490 | 10.3103516 | 42 |
| 19 | 9.6898734 | 9.9404801 | 9.7493934 | 10.2506066 | 10.0595199 | 10.3101266 | 41 |
| 20 | 9.6900983 | 9.9404091 | 9.7496892 | 10.2503108 | 10.0595909 | 10.3099017 | 40 |
| 21 | 9.6903231 | 9.9403381 | 9.7499850 | 10.2500150 | 10.0596619 | 10.3096769 | 39 |
| 22 | 9.6905476 | 9.9402670 | 9.7502806 | 10.2497194 | 10.0597330 | 10.3094524 | 38 |
| 23 | 9.6907721 | 9.9401959 | 9.7505762 | 10.2494238 | 10.0598041 | 10.3092279 | 37 |
| 24 | 9.6909964 | 9.9401248 | 9.7508716 | 10.2491284 | 10.0598752 | 10.3090036 | 36 |
| 25 | 9.6912205 | 9.9400535 | 9.7511669 | 10.2488331 | 10.0599465 | 10.3087795 | 35 |
| 26 | 9.6914445 | 9.9399823 | 9.7514622 | 10.2485378 | 10.0600177 | 10.3085555 | 34 |
| 27 | 9.6916683 | 9.9399110 | 9.7517573 | 10.2482427 | 10.0600890 | 10.3083317 | 33 |
| 28 | 9.6918919 | 9.9398396 | 9.7520523 | 10.2479477 | 10.0601604 | 10.3081081 | 32 |
| 29 | 9.6921155 | 9.9397682 | 9.7523472 | 10.2476528 | 10.0602318 | 10.3078845 | 31 |
| 30 | 9.6923388 | 9.9396968 | 9.7526420 | 10.2473580 | 10.0603032 | 10.3076612 | 30 |
| 31 | 9.6925620 | 9.9396253 | 9.7529368 | 10.2470632 | 10.0603747 | 10.3074380 | 29 |
| 32 | 9.6927851 | 9.9395537 | 9.7532314 | 10.2467686 | 10.0604463 | 10.3072149 | 28 |
| 33 | 9.6930080 | 9.9394821 | 9.7535259 | 10.2464741 | 10.0605179 | 10.3069920 | 27 |
| 34 | 9.6932308 | 9.9394105 | 9.7538203 | 10.2461797 | 10.0605895 | 10.3067692 | 26 |
| 35 | 9.6934534 | 9.9393388 | 9.7541146 | 10.2458854 | 10.0606612 | 10.3065466 | 25 |
| 36 | 9.6936758 | 9.9392671 | 9.7544088 | 10.2455912 | 10.0607329 | 10.3063242 | 24 |
| 37 | 9.6938981 | 9.9391953 | 9.7547029 | 10.2452971 | 10.0608047 | 10.3061019 | 23 |
| 38 | 9.6941203 | 9.9391234 | 9.7549969 | 10.2450031 | 10.0608766 | 10.3058797 | 22 |
| 39 | 9.6943423 | 9.9390515 | 9.7552908 | 10.2447092 | 10.0609485 | 10.3056577 | 21 |
| 40 | 9.6945642 | 9.9389796 | 9.7555846 | 10.2444154 | 10.0610204 | 10.3054358 | 20 |
| 41 | 9.6947859 | 9.9389076 | 9.7558783 | 10.2441217 | 10.0610924 | 10.3052141 | 19 |
| 42 | 9.6950074 | 9.9388356 | 9.7561718 | 10.2438282 | 10.0611644 | 10.3049926 | 18 |
| 43 | 9.6952288 | 9.9387635 | 9.7564653 | 10.2435347 | 10.0612365 | 10.3047712 | 17 |
| 44 | 9.6954501 | 9.9386914 | 9.7567587 | 10.2432413 | 10.0613086 | 10.3045499 | 16 |
| 45 | 9.6956712 | 9.9386192 | 9.7570520 | 10.2429480 | 10.0613808 | 10.3043288 | 15 |
| 46 | 9.6958922 | 9.9385470 | 9.7573452 | 10.2426548 | 10.0614530 | 10.3041078 | 14 |
| 47 | 9.6961130 | 9.9384747 | 9.7576383 | 10.2423617 | 10.0615253 | 10.3038870 | 13 |
| 48 | 9.6963336 | 9.9384024 | 9.7579313 | 10.2420687 | 10.0615976 | 10.3036664 | 12 |
| 49 | 9.6965541 | 9.9383300 | 9.7582242 | 10.2417758 | 10.0616700 | 10.3034459 | 11 |
| 50 | 9.6967745 | 9.9382576 | 9.7585170 | 10.2414830 | 10.0617424 | 10.3032255 | 10 |
| 51 | 9.6969947 | 9.9381851 | 9.7582096 | 10.2411904 | 10.0618149 | 10.3030053 | 9 |
| 52 | 9.6972148 | 9.9381126 | 9.7591022 | 10.2408978 | 10.0618874 | 10.3027852 | 8 |
| 53 | 9.6974347 | 9.9380400 | 9.7593947 | 10.2406053 | 10.0619600 | 10.3025653 | 7 |
| 54 | 9.6976545 | 9.9379674 | 9.7596871 | 10.2403129 | 10.0620325 | 10.3023455 | 6 |
| 55 | 9.6978741 | 9.9378947 | 6.7599794 | 10.2400206 | 10.0621053 | 10.3021259 | 5 |
| 56 | 9.6980936 | 9.9378220 | 9.7602716 | 10.2397284 | 10.0621780 | 10.3019064 | 4 |
| 57 | 9.6983129 | 9.9377492 | 9.7605637 | 10.2394363 | 10.0622508 | 10.3016871 | 3 |
| 58 | 9.6985321 | 9.9376764 | 9.7608557 | 10.2391443 | 10.0623236 | 10.3014679 | 2 |
| 59 | 9.6987511 | 9.9376035 | 9.7611476 | 10.2388524 | 10.0623965 | 10.3012489 | 1 |
| 60 | 9.6989700 | 9.9375306 | 9.7614391 | 10.2385606 | 10.0624694 | 10.3010300 | 0 |
| | L Co-Tang | L. Sine | L.Co-Sine | L. Tangent. | L.Co-Secant | L. Secant | |

60 DEGREES.

30 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5000000 | 8660254 | 5773503 | 17320508 | 11547005 | 20000000 | 60 |
| 1 | 5002519 | 8658799 | 5777382 | 17308878 | 11548945 | 19989929 | 59 |
| 2 | 5005038 | 8657343 | 5781262 | 17297260 | 11550887 | 19979870 | 58 |
| 3 | 5007556 | 8655887 | 5785144 | 17285654 | 11552830 | 19969823 | 57 |
| 4 | 5010074 | 8654430 | 5789027 | 17274060 | 11554775 | 19959788 | 56 |
| 5 | 5012591 | 8652972 | 5792911 | 17262477 | 11556722 | 19949764 | 55 |
| 6 | 5015108 | 8651514 | 5796797 | 17250905 | 11558670 | 19939753 | 54 |
| 7 | 5017624 | 8650055 | 5800684 | 17239345 | 11560620 | 19929752 | 53 |
| 8 | 5020140 | 8648595 | 5804573 | 17227797 | 11562572 | 19919764 | 52 |
| 9 | 5022655 | 8647134 | 5808462 | 17216261 | 11564525 | 19909787 | 51 |
| 10 | 5025170 | 8645673 | 5812353 | 17204736 | 11566480 | 19899822 | 50 |
| 11 | 5027685 | 8644211 | 5816245 | 17193222 | 11568436 | 19889869 | 49 |
| 12 | 5030199 | 8642748 | 5820139 | 17181720 | 11570394 | 19879926 | 48 |
| 13 | 5032713 | 8641284 | 5824034 | 17170230 | 11572354 | 19869997 | 47 |
| 14 | 5035227 | 8639820 | 5827930 | 17158751 | 11574315 | 19860080 | 46 |
| 15 | 5037740 | 8638355 | 5831828 | 17147283 | 11576278 | 19850172 | 45 |
| 16 | 5040253 | 8636889 | 5835727 | 17135827 | 11578243 | 19840276 | 44 |
| 17 | 5042765 | 8635423 | 5839627 | 17124382 | 11580209 | 19830393 | 43 |
| 18 | 5045277 | 8633956 | 5843528 | 17112949 | 11582177 | 19820520 | 42 |
| 19 | 5047788 | 8632488 | 5847431 | 17101527 | 11584147 | 19810659 | 41 |
| 20 | 5050299 | 8631019 | 5851335 | 17090116 | 11586118 | 19800810 | 40 |
| 21 | 5052809 | 8629549 | 5855241 | 17078717 | 11588091 | 19790972 | 39 |
| 22 | 5055319 | 8628079 | 5859148 | 17067329 | 11590065 | 19781146 | 38 |
| 23 | 5057828 | 8626608 | 5863056 | 17055953 | 11592041 | 19771331 | 37 |
| 24 | 5060337 | 8625136 | 5866965 | 17044587 | 11594019 | 19761527 | 36 |
| 25 | 5062846 | 8623664 | 5870876 | 17033233 | 11595999 | 19751735 | 35 |
| 26 | 5065355 | 8622191 | 5874788 | 17021890 | 11597980 | 19741954 | 34 |
| 27 | 5067863 | 8620717 | 5878702 | 17010559 | 11599963 | 19732185 | 33 |
| 28 | 5070370 | 8619243 | 5882617 | 16999238 | 11601947 | 19722426 | 32 |
| 29 | 5072877 | 8617768 | 5886533 | 16987929 | 11603933 | 19712680 | 31 |
| 30 | 5075384 | 8616292 | 5890450 | 16976632 | 11605921 | 19702944 | 30 |
| 31 | 5077890 | 8614815 | 5894369 | 16965344 | 11607911 | 19693220 | 29 |
| 32 | 5080396 | 8613337 | 5898289 | 16954069 | 11609902 | 19683507 | 28 |
| 33 | 5082901 | 8611859 | 5902211 | 16942804 | 11611895 | 19673805 | 27 |
| 34 | 5085406 | 8610380 | 5906134 | 16931550 | 11613889 | 19664114 | 26 |
| 35 | 5087910 | 8608900 | 5910058 | 16920308 | 11615885 | 19654434 | 25 |
| 36 | 5590414 | 8607420 | 5913983 | 16909077 | 11617883 | 19644767 | 24 |
| 37 | 5092918 | 8605939 | 5917910 | 16897856 | 11619882 | 19635110 | 23 |
| 38 | 5095421 | 8604457 | 5921839 | 16886647 | 11621883 | 19625464 | 22 |
| 39 | 5097924 | 8602974 | 5925768 | 16875449 | 11623886 | 19615829 | 21 |
| 40 | 5100426 | 8601491 | 5929699 | 16864261 | 11625891 | 19606206 | 20 |
| 41 | 5102928 | 8600007 | 5933632 | 16853085 | 11627897 | 19596593 | 19 |
| 42 | 5105429 | 8598522 | 5937566 | 16841919 | 11629905 | 19586992 | 18 |
| 43 | 5107930 | 8597037 | 5941501 | 16830765 | 11631914 | 19577401 | 17 |
| 44 | 5110431 | 8595551 | 5945437 | 16819621 | 11633925 | 19567822 | 16 |
| 45 | 5112931 | 8594064 | 5949375 | 16808489 | 11635938 | 19558254 | 15 |
| 46 | 5115431 | 8592576 | 5953314 | 16797367 | 11637953 | 19548697 | 14 |
| 47 | 5117930 | 8591088 | 5957254 | 16786256 | 11639969 | 19539150 | 13 |
| 48 | 5120429 | 8589599 | 5961196 | 16775156 | 11641987 | 19529615 | 12 |
| 49 | 5122927 | 8588109 | 5965140 | 16764067 | 11644007 | 19520091 | 11 |
| 50 | 5125425 | 8586618 | 5969084 | 16752988 | 11646028 | 19510577 | 10 |
| 51 | 5127922 | 8585127 | 5973030 | 16741921 | 11648051 | 19501075 | 9 |
| 52 | 5130419 | 8583635 | 5976978 | 16730864 | 11650076 | 19491583 | 8 |
| 53 | 5132916 | 8582142 | 5980927 | 16719818 | 11652102 | 19482102 | 7 |
| 54 | 5135412 | 8580649 | 5984877 | 16708782 | 11654130 | 19472632 | 6 |
| 55 | 5137908 | 8579155 | 5988828 | 16697758 | 11656160 | 19463173 | 5 |
| 56 | 5140404 | 8577660 | 5992781 | 16686744 | 11658191 | 19453725 | 4 |
| 57 | 5142899 | 8576164 | 5996735 | 16675741 | 11660224 | 19444288 | 3 |
| 58 | 5145393 | 8574668 | 6000691 | 16664748 | 11662259 | 19434861 | 2 |
| 59 | 5147887 | 8573171 | 6004648 | 16653766 | 11664296 | 19425445 | 1 |
| 60 | 5150381 | 8571673 | 6008606 | 16642795 | 11666334 | 19416040 | 0 |
| | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N.Co-Secant. | N. Secant | M |

59 DEGREES.

30 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.6989700 | 9.9375306 | 9.7614394 | 10 2385606 | 10.0624694 | 10.3010300 | 60 |
| 1 | 9.6991887 | 9.9374577 | 9.7617311 | 10.2382689 | 10.0625423 | 10.3008113 | 59 |
| 2 | 9.6994073 | 9.9373847 | 9.7620227 | 10.2379773 | 10.0626153 | 10.3005927 | 58 |
| 3 | 9.6996258 | 9.9373116 | 9.7623142 | 10.2376858 | 10.0626884 | 10.3003742 | 57 |
| 4 | 9.6998441 | 9.9372385 | 9.7626056 | 10.2373944 | 10.0627615 | 10.3001559 | 56 |
| 5 | 9.7000622 | 9.9371653 | 9.7628969 | 10.2371031 | 10.0628347 | 10.2999378 | 55 |
| 6 | 9.7002802 | 9.9370921 | 9.7631881 | 10.2368119 | 10.0629079 | 10.2997198 | 54 |
| 7 | 9.7004981 | 9.9370189 | 9.7634792 | 10 2365208 | 10.0629811 | 10.2995019 | 53 |
| 8 | 9.7007158 | 9 9369456 | 9.7637702 | 10.2362298 | 10.0630544 | 10.2992842 | 52 |
| 9 | 9.7009334 | 9.9368722 | 9.7640612 | 10.2359388 | 10.0631278 | 10.2990666 | 51 |
| 10 | 9.7011508 | 9.9367988 | 9.7643520 | 10.2356480 | 10.0632012 | 10.2988492 | 50 |
| 11 | 9.7013681 | 9.9367254 | 9.7646427 | 10.2353573 | 10.0632746 | 10.2986319 | 49 |
| 12 | 9.7015852 | 9.9366519 | 9.7649334 | 10.2350666 | 10.0633481 | 10.2984148 | 48 |
| 13 | 9.7018022 | 9.9365783 | 9.7652239 | 10.2347761 | 10.0634217 | 10.2981978 | 47 |
| 14 | 9.7020190 | 9.9365047 | 9.7655143 | 10.2344857 | 10.0634953 | 10.2979810 | 46 |
| 15 | 9.7022387 | 9.9364311 | 9.7658047 | 10.2341953 | 10.0635689 | 10.2977663 | 45 |
| 16 | 9.7024523 | 9.9363574 | 9.7660949 | 10.2339051 | 10.0636426 | 10.2975477 | 44 |
| 17 | 9.7026687 | 9.9362836 | 9.7663851 | 10.2336149 | 10.0637164 | 10.2973413 | 43 |
| 18 | 9.7028849 | 9.9362098 | 9.7666751 | 10.2333249 | 10.0637902 | 10.2971151 | 42 |
| 19 | 9.7031011 | 9.9361360 | 9.7669651 | 10.2330349 | 10.0638640 | 10.2968989 | 41 |
| 20 | 9.7033170 | 9.9360621 | 9.7672550 | 10.2327450 | 10.0639379 | 10.2966830 | 40 |
| 21 | 9.7035329 | 9.9359881 | 9.7675448 | 10.2324552 | 10.0640119 | 10.2964671 | 39 |
| 22 | 9.7037486 | 9.9359141 | 9.7678344 | 10.2321656 | 10.0640859 | 10.2962514 | 38 |
| 23 | 9.7039641 | 9.9358401 | 9 7681240 | 10.2318760 | 10.0641599 | 10.2960359 | 37 |
| 24 | 9.7041795 | 9.9357660 | 9.7684135 | 10.2315865 | 10.0642340 | 10.2958205 | 36 |
| 25 | 9.7043947 | 9.9356918 | 9.7687029 | 10.2312971 | 10.0643082 | 10.2956052 | 35 |
| 26 | 9.7046099 | 9.9356177 | 9.7689922 | 10.2310078 | 10.0643823 | 10.2953901 | 34 |
| 27 | 9.7048248 | 9.9355434 | 9.7692814 | 10.2307186 | 10.0644566 | 10.2951752 | 33 |
| 28 | 9.7050397 | 9.9354691 | 9.7695705 | 10.2304295 | 10.0645309 | 10.2949603 | 32 |
| 29 | 9.7052543 | 9.9353948 | 9.7698596 | 10.2301404 | 10.0646052 | 10.2947457 | 31 |
| 30 | 9.7054689 | 9 9353204 | 9.7701485 | 10.2298515 | 10.0646796 | 10.2945311 | 30 |
| 31 | 9.7056833 | 9.9352459 | 9.7704373 | 10.2295627 | 10.0647541 | 10.2943167 | 29 |
| 32 | 9.7058975 | 9.9351715 | 9.7707261 | 10.2292739 | 10.0648285 | 10.2941025 | 28 |
| 33 | 9.7061116 | 9.9350969 | 9.7710147 | 10.2289853 | 10.0649031 | 10.2938884 | 27 |
| 34 | 9.7063256 | 9.9350223 | 9.7713033 | 10.2286967 | 10.0649777 | 10.2936744 | 26 |
| 35 | 9 7065394 | 9.9349477 | 9.7715917 | 10.2284083 | 10.0650523 | 10.2934606 | 25 |
| 36 | 9.7067531 | 9.9348730 | 9.7718801 | 10.2281199 | 10.0651270 | 10.2932469 | 24 |
| 37 | 9.7069667 | 9.9347983 | 9.7721684 | 10.2278316 | 10.0652017 | 10.2930333 | 23 |
| 38 | 9.7071801 | 9.9347235 | 9.7724566 | 10.2275434 | 10.0652765 | 10.2928199 | 22 |
| 39 | 9.7073933 | 9.9346486 | 9.7727447 | 10.2272553 | 10.0653514 | 10.2926067 | 21 |
| 40 | 9.7076064 | 9.9345738 | 9.7730327 | 10.2269673 | 10.0654262 | 10.2923936 | 20 |
| 41 | 9.7078194 | 9.9344988 | 9.7733206 | 10.2266794 | 10.0655012 | 10.2921806 | 19 |
| 42 | 9.7080323 | 9.9344238 | 9.7736084 | 10.2263916 | 10.0655762 | 10.2919677 | 18 |
| 43 | 9.7082450 | 9.9343488 | 9.7738961 | 10.2261039 | 10.0656512 | 10.2917550 | 17 |
| 44 | 9.7084575 | 9.9342737 | 9.7741838 | 10.2258162 | 10.0657263 | 10.2915425 | 16 |
| 45 | 9.7086699 | 9.9341986 | 9.7744713 | 10.2255287 | 10.0658014 | 10.2913301 | 15 |
| 46 | 9.7088822 | 9.9341234 | 9.7747588 | 10.2252812 | 10.0658766 | 10.2911178 | 14 |
| 47 | 9.7090943 | 9.9340482 | 9.7750462 | 10.2249738 | 10.0659518 | 10.2909057 | 13 |
| 48 | 9.7093063 | 9.9339729 | 9.7753334 | 10.2246665 | 10.0660271 | 10.2906937 | 12 |
| 49 | 9.7095182 | 9.9338976 | 9.7756206 | 10.2243794 | 10.0661024 | 10.2904818 | 11 |
| 50 | 9.7097299 | 9.9338222 | 9.7759077 | 10.2240923 | 10.0661778 | 10.2902701 | 10 |
| 51 | 9.7099415 | 9.9337467 | 9.7761947 | 10.2238053 | 10.0662533 | 10.2900585 | 9 |
| 52 | 9.7101529 | 9.9336713 | 9.7764816 | 10.2235184 | 10.0663287 | 10.2898471 | 8 |
| 53 | 9.7103642 | 9.9335957 | 9.7767685 | 10.2232315 | 10.0664043 | 10.2896358 | 7 |
| 54 | 9.7105753 | 9.9335201 | 9.7770552 | 10.2229448 | 10 0664799 | 10.2894247 | 6 |
| 55 | 9.7107863 | 9.9334445 | 9.7773418 | 10.2226582 | 10.0665555 | 10.2892137 | 5 |
| 56 | 9.7109972 | 9.9333688 | 9.7776284 | 10.2223716 | 10.0666312 | 10.2890028 | 4 |
| 57 | 9.7112080 | 9.9332931 | 9.7779149 | 10.2220851 | 10.0667069 | 10.2887920 | 3 |
| 58 | 9.7114186 | 9.9332173 | 9.7782022 | 10.2217988 | 10.0667827 | 10.2885814 | 2 |
| 59 | 9.7116290 | 9.9331415 | 9.7784875 | 10.2215125 | 10-0668585 | 10.2883710 | 1 |
| 60 | 9.7118393 | 9.9330656 | 9.7787737 | 10.2212268 | 10.0669344 | 10.2881607 | 0 |
| | L Co Sine. | L. Sine | L.Co-Taug. | L. Tangent. | L.Co-Secant | L. Secant. | M |

59 DEGREES.

31 DEGREES

| M | N. Sine | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5150381 | 8571673 | 6008606 | 16642795 | 11666334 | 19416040 | 60 |
| 1 | 5152874 | 8570174 | 6012566 | 16631834 | 11668374 | 19406646 | 59 |
| 2 | 5155367 | 8568675 | 6016527 | 16620884 | 11670416 | 19397262 | 58 |
| 3 | 5157859 | 8567175 | 6020490 | 16609945 | 11672459 | 19387889 | 57 |
| 4 | 5160351 | 8565674 | 6024454 | 16599016 | 11674504 | 19378527 | 56 |
| 5 | 5162842 | 8564173 | 6028419 | 16588097 | 11676551 | 19369176 | 55 |
| 6 | 5165333 | 8562671 | 6032386 | 16577189 | 11678599 | 19359835 | 54 |
| 7 | 5167824 | 8561168 | 6036354 | 16566292 | 11680649 | 19350505 | 53 |
| 8 | 5170314 | 8559664 | 6040323 | 16555405 | 11682701 | 19341185 | 52 |
| 9 | 5172804 | 8558160 | 6044294 | 16544529 | 11684755 | 19331876 | 51 |
| 10 | 5175293 | 8556655 | 6048266 | 16533663 | 11686810 | 19322578 | 50 |
| 11 | 5177782 | 8555149 | 6052240 | 16522808 | 11688867 | 19313290 | 49 |
| 12 | 5180270 | 8553642 | 6056215 | 16511963 | 11690926 | 19304013 | 48 |
| 13 | 5182758 | 8552135 | 6060192 | 16501128 | 11692986 | 19294746 | 47 |
| 14 | 5185246 | 8550627 | 6064170 | 16490304 | 11695048 | 19285490 | 46 |
| 15 | 5187733 | 8549118 | 6068149 | 16479490 | 11697112 | 19276244 | 45 |
| 16 | 5190219 | 8547609 | 6072130 | 16468686 | 11699178 | 19267009 | 44 |
| 17 | 5192705 | 8546099 | 6076112 | 16457893 | 11701245 | 19257784 | 43 |
| 18 | 5195191 | 8544588 | 6080095 | 16447111 | 11703314 | 19248570 | 42 |
| 19 | 5197676 | 8543076 | 6084080 | 16436338 | 11705385 | 19239366 | 41 |
| 20 | 5200161 | 8541564 | 6088067 | 16425576 | 11707457 | 19230173 | 40 |
| 21 | 5202646 | 8540051 | 6092054 | 16414824 | 11709531 | 19220990 | 39 |
| 22 | 5205130 | 8538537 | 6096043 | 16404082 | 11711607 | 19211817 | 38 |
| 23 | 5207613 | 8537023 | 6100034 | 16393351 | 11713685 | 19202655 | 37 |
| 24 | 5210096 | 8535508 | 6104026 | 16382630 | 11713314 | 19193503 | 36 |
| 25 | 5212579 | 8533992 | 6108019 | 16371919 | 11717845 | 19184362 | 35 |
| 26 | 5215061 | 8532475 | 6112014 | 16361218 | 11719928 | 19175230 | 34 |
| 27 | 5217543 | 8530958 | 6116011 | 16350528 | 11722013 | 19166109 | 33 |
| 28 | 5220024 | 8529440 | 6120008 | 16339847 | 11724099 | 19156999 | 32 |
| 29 | 5222505 | 8527921 | 6124007 | 16329177 | 11726187 | 19147899 | 31 |
| 30 | 5224986 | 8526402 | 6128008 | 16318517 | 11728277 | 19138809 | 30 |
| 31 | 5227466 | 8524881 | 6132010 | 16307867 | 11730369 | 19129729 | 29 |
| 32 | 5229945 | 8523360 | 6136013 | 16297227 | 11732462 | 19120659 | 28 |
| 33 | 5232424 | 8521838 | 6140018 | 16286597 | 11734557 | 19111600 | 27 |
| 34 | 5234903 | 8520316 | 6144024 | 16275977 | 11736654 | 19102551 | 26 |
| 35 | 5237381 | 8518793 | 6148032 | 16265368 | 11738752 | 19093512 | 25 |
| 36 | 5239850 | 8517269 | 6152041 | 16254768 | 11740852 | 19084483 | 24 |
| 37 | 5242336 | 8515744 | 6156052 | 16244178 | 11742954 | 19075464 | 23 |
| 38 | 5244813 | 8514219 | 6160064 | 16233599 | 11745058 | 19066456 | 22 |
| 39 | 5247290 | 8512693 | 6164077 | 16223029 | 11747164 | 19057457 | 21 |
| 40 | 5249766 | 8511166 | 6168092 | 16212469 | 11749271 | 19048469 | 20 |
| 41 | 5252241 | 8509639 | 6172108 | 16201920 | 11751380 | 19039491 | 19 |
| 42 | 5254716 | 8508111 | 6176126 | 16191380 | 11753491 | 19030522 | 18 |
| 43 | 5257191 | 8506582 | 6180145 | 16180850 | 11755603 | 19021564 | 17 |
| 44 | 5254665 | 8505052 | 6184166 | 16170330 | 11757717 | 19012616 | 16 |
| 45 | 5262135 | 8503522 | 6188188 | 16159820 | 11759833 | 19003678 | 15 |
| 46 | 5264612 | 8501991 | 6192211 | 16149320 | 11761951 | 18994710 | 14 |
| 47 | 5267085 | 8500459 | 6196236 | 16138829 | 11764070 | 18985832 | 13 |
| 48 | 5269558 | 8498927 | 6200263 | 16128349 | 11766191 | 18976924 | 12 |
| 49 | 5272030 | 8497394 | 6204291 | 16117878 | 11768314 | 18968026 | 11 |
| 50 | 5274502 | 8495860 | 6208320 | 16107417 | 11770439 | 18959138 | 10 |
| 51 | 5276973 | 8494325 | 6212351 | 16096966 | 11772566 | 18950259 | 9 |
| 52 | 5279444 | 8492790 | 6216383 | 16086525 | 11774694 | 18941391 | 8 |
| 53 | 5281914 | 8491254 | 6220417 | 16076094 | 11776824 | 18932532 | 7 |
| 54 | 5284384 | 8489717 | 6224452 | 16065672 | 11778956 | 18923684 | 6 |
| 55 | 5286853 | 8488179 | 6228488 | 16055260 | 11781090 | 18914845 | 5 |
| 56 | 5289322 | 8486641 | 6232526 | 16044858 | 11783225 | 18906016 | 4 |
| 57 | 5291790 | 8485102 | 6236566 | 16034465 | 11785362 | 18897197 | 3 |
| 58 | 5294258 | 8483562 | 6240607 | 16024082 | 11787501 | 18888388 | 2 |
| 59 | 5296726 | 8482022 | 6244650 | 16013709 | 11789642 | 18879589 | 1 |
| 60 | 5299193 | 8480481 | 6248694 | 16003345 | 11791784 | 18870799 | 0 |
| | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N.Co-Secant. | N. Secant | M |

58 DEGREES.

31 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co Tang.* | *L. Secant.* | *L Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7118393 | 9.9330656 | 9.7787737 | 10.2212263 | 10.0669344 | 10.2881607 | 60 |
| 1 | 9.7120495 | 9.9329897 | 9.7790599 | 10.2209401 | 10.0670103 | 10.2879505 | 59 |
| 2 | 9.7122596 | 9.9329137 | 9.7793459 | 10.2206541 | 10.0670863 | 10.2877404 | 58 |
| 3 | 9.7124695 | 9.9328376 | 9.7796318 | 10.2203682 | 10.0671624 | 10.2875305 | 57 |
| 4 | 9.7126792 | 9.9327616 | 9.7799177 | 10.2200823 | 10.0672384 | 10.2873208 | 56 |
| 5 | 9.7128889 | 9.9326854 | 9.7802034 | 10.2197966 | 10.0673146 | 10.2871111 | 55 |
| 6 | 9.7130983 | 9.9326092 | 9.7804891 | 10.2195109 | 10.0673908 | 10.2869017 | 54 |
| 7 | 9.7133077 | 9.9325330 | 9.7807747 | 10.2192253 | 10.0674670 | 10.2866923 | 53 |
| 8 | 9.7135169 | 9.9324567 | 9.7810602 | 10.2189398 | 10.0675433 | 10.2864831 | 52 |
| 9 | 9.7137260 | 9.9323804 | 9.7813456 | 10.2186544 | 10.0676196 | 10.2862740 | 51 |
| 10 | 9.7139349 | 9.9323040 | 9.7816309 | 10.2183691 | 10.0676960 | 10.2860651 | 50 |
| 11 | 9.7141437 | 9.9322276 | 9.7819162 | 10.2180838 | 10.0677724 | 10.2858563 | 49 |
| 12 | 9.7143524 | 9.9321511 | 9.7822013 | 10.2177987 | 10.0678489 | 10.2856476 | 48 |
| 13 | 9.7145609 | 9.9320746 | 9.7824864 | 10.2175136 | 10.0679254 | 10.2854391 | 47 |
| 14 | 9.7147693 | 9.9319980 | 9.7827713 | 10.2172287 | 10.0680020 | 10.2852307 | 46 |
| 15 | 9.7149776 | 9.9319213 | 9.7830562 | 10.2169438 | 10.0680787 | 10.2850224 | 45 |
| 16 | 9.7151857 | 9.9318447 | 9.7833410 | 10.2166590 | 10.0681553 | 10.2848143 | 44 |
| 17 | 9.7153937 | 9.9317679 | 9.7836258 | 10.2163742 | 10.0682321 | 10.2846063 | 43 |
| 18 | 9.7156015 | 9.9316911 | 9.7839104 | 10.2160896 | 10.0683089 | 10.2843985 | 42 |
| 19 | 9.7158092 | 9.9316143 | 9.7841949 | 10.2158051 | 10.0683857 | 10.2841908 | 41 |
| 20 | 9.7160168 | 9.9315374 | 9.7844794 | 10.2155206 | 10.0684626 | 10.2839832 | 40 |
| 21 | 9.7162243 | 9.9314605 | 9.7847638 | 10.2152362 | 10.0685395 | 10.2837757 | 39 |
| 22 | 9.7164316 | 9.9313835 | 9.7850481 | 10.2149519 | 10.0686165 | 10.2835684 | 38 |
| 23 | 9.7166387 | 9.9313065 | 9.7853323 | 10.2146677 | 10.0686935 | 10.2833613 | 37 |
| 24 | 9.7168458 | 9.9312294 | 9.7856164 | 10.2143836 | 10.0687706 | 10.2831542 | 36 |
| 25 | 9.7170526 | 9.9311522 | 9.7859004 | 10.2140996 | 10.0688478 | 10.2829474 | 35 |
| 26 | 9.7172594 | 9.9310750 | 9.7861844 | 10.2138156 | 10.0689250 | 10.2827406 | 34 |
| 27 | 9.7174660 | 9.9309978 | 9.7864682 | 10.2135318 | 10.0690022 | 10.2825340 | 33 |
| 28 | 9.7176725 | 9.9309205 | 9.7867520 | 10.2132480 | 10.0690795 | 10.2823275 | 32 |
| 29 | 9.7178789 | 9.9308432 | 9.7870357 | 10.2129643 | 10.0691568 | 10.2821211 | 31 |
| 30 | 9.7180851 | 9.9307658 | 9.7373193 | 10.2126807 | 10.0692342 | 10.2819149 | 30 |
| 31 | 9.7182912 | 9.9306883 | 9.7876028 | 10.2123972 | 10.0693117 | 10.2817088 | 29 |
| 32 | 9.7184971 | 9.9306109 | 9.7878863 | 10.2121137 | 10.0693891 | 10.2815029 | 28 |
| 33 | 9.7187030 | 9.9305333 | 9.7881696 | 10.2118304 | 10.0694667 | 10.2812970 | 27 |
| 34 | 9.7189086 | 9.9304557 | 9.7884529 | 10.2115471 | 10.0695443 | 10.2810914 | 26 |
| 35 | 9.7191142 | 9.9303781 | 9.7887361 | 10.2112639 | 10.0696219 | 10.2808858 | 25 |
| 36 | 9.7193196 | 9.9303004 | 9.7890192 | 10.2109808 | 10.0696996 | 10.2806804 | 24 |
| 37 | 9.7195249 | 9.9302226 | 9.7893023 | 10.2106977 | 10.0697774 | 10.2804751 | 23 |
| 38 | 9.7197300 | 9.9301448 | 9.7895852 | 10.2104148 | 10.0698552 | 10.2802700 | 22 |
| 39 | 9.7199350 | 9.9300670 | 9.7898681 | 10.2101319 | 10.0699330 | 10.2800650 | 21 |
| 40 | 9.7201399 | 9.9299891 | 9.7901508 | 10.2098492 | 10.0700109 | 10.2798601 | 20 |
| 41 | 9.7203447 | 9.9299112 | 9.7904335 | 10.2095665 | 10.0700888 | 10.2796553 | 19 |
| 42 | 9.7205493 | 9.9298332 | 9.7907161 | 10.2092839 | 10.0701668 | 10.2794507 | 18 |
| 43 | 9.7207538 | 9.9297551 | 9.7909987 | 10.2090013 | 10.0702449 | 10.2792462 | 17 |
| 44 | 9.7209581 | 9.9296770 | 9.7912811 | 10.2087189 | 10.0703230 | 10.2790419 | 16 |
| 45 | 9.7211623 | 9.9295989 | 9.7915635 | 10.2084365 | 10.0704011 | 10.2788377 | 15 |
| 46 | 9.7213664 | 9.9295207 | 9.7918458 | 10.2081542 | 10.0704793 | 10.2786336 | 14 |
| 47 | 9.7215704 | 9.9294424 | 9.7921280 | 10.2078720 | 10.0705576 | 10.2784296 | 13 |
| 48 | 9.7217742 | 9.9293641 | 9.7924101 | 10.2075899 | 10.0706359 | 10.2782258 | 12 |
| 49 | 9.7219779 | 9.9292857 | 9.7926921 | 10.2073079 | 10.0707143 | 10.2780221 | 11 |
| 50 | 9.7221814 | 9.9292073 | 9.7929741 | 10.2070259 | 10.0707927 | 10.2778186 | 10 |
| 51 | 9.7223848 | 9.9291289 | 9.7932560 | 10.2067440 | 10.0708711 | 10.2776152 | 9 |
| 52 | 9.7225881 | 9.9290504 | 9.7935378 | 10.2064622 | 10.0709496 | 10.2774119 | 8 |
| 53 | 9.7227913 | 9.9289718 | 9.7938195 | 10.2061805 | 10.0710283 | 10.2772087 | 7 |
| 54 | 9.7229943 | 9.9288932 | 9.7941011 | 10.2058989 | 10.0711068 | 10.2770057 | 6 |
| 55 | 9.7231972 | 9.9288145 | 9.7943827 | 10.2056173 | 10.0711855 | 10.2768028 | 5 |
| 56 | 9.7234000 | 9.9287358 | 9.7946641 | 10.2053359 | 10.0712643 | 10.2766030 | 4 |
| 57 | 9.7236026 | 9.9286571 | 9.7949455 | 10.2050545 | 10.0713429 | 10.2763974 | 3 |
| 58 | 9.7238051 | 9.9285783 | 9.7952268 | 10.2047732 | 10.0714217 | 10.2761949 | 2 |
| 59 | 9.7240075 | 9.9284994 | 9.7955081 | 10.2044919 | 10.0715006 | 10.2759925 | 1 |
| 60 | 9.7242097 | 9.9284205 | 9.7957892 | 10.2042108 | 10.0715795 | 10.2757903 | 0 |
| | *L. Co-Sine.* | *L Sine.* | *L. Co-Tang.* | *L. Tangent.* | *L. Co Secant* | *L. Secant.* | M |

58 DEGREES.

32 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5299193 | 8480481 | 6248694 | 16003345 | 11791784 | 18870799 | 60 |
| 1 | 5301659 | 8478939 | 6252739 | 15992991 | 11793928 | 18862019 | 59 |
| 2 | 5304125 | 8477376 | 6256786 | 15982647 | 11796074 | 18853249 | 58 |
| 3 | 5306591 | 8475853 | 6260834 | 15972312 | 11798222 | 18844489 | 57 |
| 4 | 5309056 | 8474309 | 6264884 | 15961987 | 11800372 | 18835738 | 56 |
| 5 | 5311521 | 8472764 | 6268935 | 15951672 | 11802523 | 18826997 | 55 |
| 6 | 5313986 | 8471219 | 6272988 | 15941366 | 11804676 | 18818266 | 54 |
| 7 | 5316450 | 8469673 | 6277042 | 15931070 | 11806831 | 18809545 | 53 |
| 8 | 5318913 | 8468126 | 6281098 | 15920783 | 11808988 | 18800833 | 52 |
| 9 | 5321376 | 8466578 | 6285156 | 15910505 | 11811147 | 18792131 | 51 |
| 10 | 5323839 | 8465030 | 6289215 | 15900238 | 11813307 | 18783438 | 50 |
| 11 | 5326301 | 8463481 | 6293275 | 15889979 | 11815469 | 18784755 | 49 |
| 12 | 5328763 | 8461931 | 6297336 | 15879730 | 11817633 | 18766082 | 48 |
| 13 | 5331224 | 8460381 | 6301399 | 15869491 | 11819799 | 18757418 | 47 |
| 14 | 5333685 | 8458830 | 6305464 | 15859261 | 11821966 | 18748764 | 46 |
| 15 | 5336145 | 8457278 | 6309530 | 15849041 | 11824135 | 18740120 | 45 |
| 16 | 5338605 | 8455725 | 6313598 | 15838830 | 11826306 | 18731485 | 44 |
| 17 | 5341064 | 8454172 | 6317667 | 15828628 | 11828479 | 18722859 | 43 |
| 18 | 5343522 | 8452618 | 6321738 | 15818436 | 11830654 | 18714243 | 42 |
| 19 | 5345982 | 8451063 | 6325810 | 15808253 | 11832830 | 18705637 | 41 |
| 20 | 5348440 | 8449508 | 6329883 | 15798079 | 11835008 | 18697040 | 40 |
| 21 | 5350898 | 8447952 | 6333958 | 15787915 | 11837188 | 18688453 | 39 |
| 22 | 5353355 | 8446395 | 6338035 | 15777760 | 11839370 | 18679875 | 38 |
| 23 | 5355812 | 8444837 | 6342113 | 15767615 | 11841554 | 18671306 | 37 |
| 24 | 5358268 | 8443279 | 6346193 | 15757479 | 11843740 | 18662747 | 36 |
| 25 | 5360724 | 8441720 | 6350274 | 15747352 | 11845927 | 18654197 | 35 |
| 26 | 5363179 | 8440160 | 6354357 | 15737234 | 11848116 | 18645657 | 34 |
| 27 | 5365634 | 8438600 | 6358441 | 15727126 | 11850307 | 18637126 | 33 |
| 28 | 5368088 | 8437039 | 6362527 | 15717026 | 11852500 | 18628605 | 32 |
| 29 | 5370542 | 8435477 | 6366614 | 15706936 | 11854694 | 18620093 | 31 |
| 30 | 5372996 | 8433914 | 6370703 | 15696856 | 11856891 | 18611590 | 30 |
| 31 | 5375449 | 8432351 | 6374793 | 15686784 | 11859089 | 18603096 | 29 |
| 32 | 5377902 | 8430787 | 6378885 | 15676722 | 11861289 | 18594612 | 28 |
| 33 | 5380354 | 8429222 | 6382978 | 15666669 | 11863491 | 18536138 | 27 |
| 34 | 5382806 | 8427657 | 6387073 | 15656625 | 11865695 | 18577672 | 26 |
| 35 | 5385257 | 8426091 | 6391169 | 15646590 | 11867900 | 18569216 | 25 |
| 36 | 5387708 | 8424524 | 6395267 | 15636564 | 11870107 | 18560769 | 24 |
| 37 | 5390158 | 8422956 | 6399366 | 15626548 | 11872316 | 18552331 | 23 |
| 38 | 5392608 | 8421388 | 6403467 | 15616540 | 11874527 | 18543903 | 22 |
| 39 | 5395058 | 8419819 | 6407569 | 15606542 | 11876740 | 18535483 | 21 |
| 40 | 5397507 | 8418249 | 6411673 | 15596552 | 11878955 | 18527073 | 20 |
| 41 | 5399955 | 8416679 | 6415779 | 15586572 | 11881171 | 18518672 | 19 |
| 42 | 5402403 | 8415108 | 6419886 | 15576601 | 11883389 | 18510281 | 18 |
| 43 | 5404851 | 8413536 | 6423995 | 15566639 | 11885609 | 18501898 | 17 |
| 44 | 5407298 | 8411963 | 6428105 | 15556685 | 11887831 | 18493525 | 16 |
| 45 | 5409745 | 8410390 | 6432216 | 15546741 | 11890055 | 18485161 | 15 |
| 46 | 5412191 | 8408816 | 6436329 | 15536806 | 11892281 | 18476805 | 14 |
| 47 | 5414637 | 8407341 | 6440444 | 15526880 | 11894508 | 18468459 | 13 |
| 48 | 5417082 | 8405666 | 6444560 | 15516963 | 11896737 | 18460123 | 12 |
| 49 | 5419527 | 8404090 | 6448678 | 15507054 | 11898968 | 18451795 | 11 |
| 50 | 5421971 | 8402513 | 6452797 | 15497155 | 11901201 | 18443476 | 10 |
| 51 | 5424415 | 8400935 | 6456918 | 15487264 | 11903436 | 18435166 | 9 |
| 52 | 5426859 | 8399357 | 6461041 | 15477383 | 11905673 | 18426866 | 8 |
| 53 | 5429302 | 8397778 | 6465165 | 15467510 | 11907912 | 18418574 | 7 |
| 54 | 5431744 | 8396198 | 6469290 | 15457646 | 11910151 | 18410292 | 6 |
| 55 | 5434186 | 8394618 | 6473417 | 15447792 | 11912394 | 18402018 | 5 |
| 56 | 5436628 | 8393037 | 6477546 | 15437946 | 11914638 | 18393753 | 4 |
| 57 | 5439069 | 8391455 | 6481676 | 15428108 | 11916884 | 18385498 | 3 |
| 58 | 5441510 | 8389873 | 6485808 | 15418280 | 11919132 | 18377251 | 2 |
| 59 | 5443950 | 8388290 | 6489941 | 15408460 | 11921382 | 18369013 | 1 |
| 60 | 5446390 | 8386706 | 6494076 | 15398650 | 11923633 | 18360784 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. CoSecant. | N. Secant. | M |

57 DEGREES.

32 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co Tang.* | *L. Secant.* | *L Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7242097 | 9.9284205 | 9.7957892 | 10.2042108 | 10.0715795 | 10.2757903 | 60 |
| 1 | 9.7244118 | 9.9283415 | 9.7960703 | 10.2039297 | 10.0716585 | 10.2755882 | 59 |
| 2 | 9.7246138 | 9.9282625 | 9.7963513 | 10.2036487 | 10.0717375 | 10.2753862 | 58 |
| 3 | 9.7248156 | 9.9281834 | 9.7966322 | 10.2033678 | 10.0718166 | 10.2751844 | 57 |
| 4 | 9.7250174 | 9.9281043 | 9.7969130 | 10.2030870 | 10.0718957 | 10.2749826 | 56 |
| 5 | 9.7252189 | 9.9280251 | 9.7971938 | 10,2028062 | 10.0719749 | 10.2747811 | 55 |
| 6 | 9.7254204 | 9.9279459 | 9.7974745 | 10.2025255 | 10.0720541 | 10.2745796 | 54 |
| 7 | 9.7256217 | 9.9278666 | 9.7977551 | 10.2022449 | 10.0721334 | 10.2743783 | 53 |
| 8 | 9.7258229 | 9.9277873 | 9.7980356 | 10.2019644 | 10.0722167 | 10.2741771 | 52 |
| 9 | 9.7260240 | 9.9277079 | 9.7983160 | 10.2016840 | 10.0722921 | 10.2739760 | 51 |
| 10 | 9.7262249 | 9.9276285 | 9.7985964 | 10.2014036 | 10.0723715 | 10.2737751 | 50 |
| 11 | 9.7264257 | 9.9275490 | 9.7988767 | 10.2011233 | 10.0724510 | 10.2735743 | 49 |
| 12 | 9.7266264 | 9.9274695 | 9.7991569 | 10.2008431 | 10.0725305 | 10.2733736 | 48 |
| 13 | 9.7268269 | 9.9273899 | 9.7994370 | 10.2005630 | 10.0726101 | 10.2731731 | 47 |
| 14 | 9.7270273 | 9.9273103 | 9.7997170 | 10.2002830 | 10.0726897 | 10.2729727 | 46 |
| 15 | 9.7272276 | 9.9272306 | 9.7999970 | 10.2000030 | 10.0727694 | 10.2727724 | 45 |
| 16 | 9.7274278 | 9.9271509 | 9.8002769 | 10,1997231 | 10.0728491 | 10.2725722 | 44 |
| 17 | 9.7276278 | 9.9270711 | 9.8005567 | 10.1994433 | 10.0729289 | 10.2723722 | 43 |
| 18 | 9.7278277 | 9.9269913 | 9.8008365 | 10.1991635 | 10.0730087 | 10.2721723 | 42 |
| 19 | 9.7280275 | 9.9269114 | 9.8011161 | 10.1988839 | 10.0730886 | 10.2719725 | 41 |
| 20 | 9.7282271 | 9.9268314 | 9.8013957 | 10.1986043 | 10.0731686 | 10.2717729 | 40 |
| 21 | 9.7284267 | 9.9267514 | 9.8016752 | 10.1983248 | 10.0732486 | 10.2715733 | 39 |
| 22 | 9.7286260 | 9.9266714 | 9.8019546 | 10.1980454 | 10.0733286 | 10.2713740 | 38 |
| 23 | 9.7288253 | 9.9265913 | 9.8022340 | 10.1977660 | 10.0734087 | 10.2711747 | 37 |
| 24 | 9.7290244 | 9.9265112 | 9.8025133 | 10.1974867 | 10.0734888 | 10.2709756 | 36 |
| 25 | 9.7292234 | 9.9264310 | 9.8027925 | 10.1972075 | 10.0735690 | 10.2707766 | 35 |
| 26 | 9.7294223 | 9.9263507 | 9.8030716 | 10.1969284 | 10.0736493 | 10.2705777 | 34 |
| 27 | 9.7296211 | 9.9262704 | 9.8033506 | 10.1966494 | 10.0737296 | 10.2703790 | 33 |
| 28 | 9.7298197 | 9.9261901 | 9.8036296 | 10.1963704 | 10.0738099 | 10.2701803 | 32 |
| 29 | 9.7300182 | 9.9261096 | 9.8039085 | 10.1960915 | 10.0738904 | 10.2699818 | 31 |
| 30 | 9.7302165 | 9.9260292 | 9.8041873 | 10.1958127 | 10.0739708 | 10.2697835 | 30 |
| 31 | 9.7304148 | 9.9259487 | 9.8044661 | 10.1955339 | 10.0740513 | 10.2695852 | 29 |
| 32 | 9.7306129 | 9.9258681 | 9.8047447 | 10.1952553 | 10.0741319 | 10.2693871 | 28 |
| 33 | 9.7308109 | 9.9257875 | 9.8050233 | 10.1949767 | 10.0742125 | 10.2691891 | 27 |
| 34 | 9.7310087 | 9.9257069 | 9.8053019 | 10.1946981 | 10.0742931 | 10.2689913 | 26 |
| 35 | 9.7312064 | 9.9256261 | 9.8055803 | 10.1944197 | 10.0743739 | 10.2687936 | 25 |
| 36 | 9.7314040 | 9.9255454 | 9.8058587 | 10.1941413 | 10.0744546 | 10.2685960 | 24 |
| 37 | 9.7316015 | 9.9254646 | 9.8061370 | 10.1938630 | 10.0745354 | 10.2683985 | 23 |
| 38 | 9.7317989 | 9.9253837 | 9.8064152 | 10.1935848 | 10.0746163 | 10.2682011 | 22 |
| 39 | 9.7319961 | 9.9253028 | 9.8066933 | 10.1933067 | 10.0746972 | 10.2680039 | 21 |
| 40 | 9.7321932 | 9.9252218 | 9.8069714 | 10.1930286 | 10.0747782 | 10.2678068 | 20 |
| 41 | 9.7323902 | 9.9251408 | 9.8072494 | 10.1927506 | 10.0748592 | 10.2676098 | 19 |
| 42 | 9.7322870 | 9.9250597 | 9.8075273 | 10.1924727 | 10.0749403 | 10.2674130 | 18 |
| 43 | 9.7327837 | 9.9249786 | 9.8078052 | 10.1921948 | 10.0750214 | 10.2672163 | 17 |
| 44 | 9.7329803 | 9.9248974 | 9.8080829 | 10.1919171 | 10.0751026 | 10.2670197 | 16 |
| 45 | 9.7331768 | 9.9248161 | 9.8083606 | 10.1916394 | 10.0751839 | 10.2665232 | 15 |
| 46 | 9.7333731 | 9.9247349 | 9.8086383 | 10.1913617 | 10.0752651 | 10.2666269 | 14 |
| 47 | 9.7335693 | 9.9246535 | 9.8089158 | 10,1910842 | 10.0753465 | 10,2664307 | 13 |
| 48 | 9.7337654 | 9.9245721 | 9 8091933 | 10 1908067 | 10.0754279 | 10.2662346 | 12 |
| 49 | 9.7339614 | 9.9244907 | 9.8094707 | 10.1905293 | 10.0755093 | 10.2660386 | 11 |
| 50 | 9.7341572 | 9.9244092 | 9.8097480 | 10.1902520 | 10.0755908 | 10.2658428 | 10 |
| 51 | 9.7343529 | 9.9243277 | 9.8100253 | 10.1899747 | 10.0756723 | 10.2656471 | 9 |
| 52 | 9.7345485 | 9.9242461 | 9.8103025 | 10.1896975 | 10.0757539 | 10.2654515 | 8 |
| 53 | 9.7347440 | 9.9241644 | 9.8105796 | 10.1894204 | 10.0758356 | 10.2652560 | 7 |
| 54 | 9.7349393 | 9.9240827 | 9.8108566 | 10.1891434 | 10.0759173 | 10.2650607 | 6 |
| 55 | 9.7351345 | 9.9240010 | 9.8111336 | 10.1888664 | 10.0759990 | 10.2648655 | 5 |
| 56 | 9.7353296 | 9.9239191 | 9.8114105 | 10.1885895 | 10.0760809 | 10.2646704 | 4 |
| 57 | 9.7355246 | 9.9238373 | 9.8116873 | 10.1883127 | 10.0761627 | 10.2644754 | 3 |
| 58 | 9.7357195 | 9.9237554 | 9.8119641 | 10.1880359 | 10.0762446 | 10.2642805 | 2 |
| 59 | 9.7359142 | 9.9236734 | 9.8122408 | 10.1877592 | 10.0763266 | 10.2640858 | 1 |
| 60 | 9.7361088 | 9.9235914 | 9.8125174 | 10.1874826 | 10.0764086 | 10.2638912 | 0 |
| | *L. Co-Sine.* | *L Sine.* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant* | *L. Secant.* | M |

57 DEGREES.

33 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5446390 | 8386706 | 6494076 | 15398650 | 11923633 | 18360784 | 60 |
| 1 | 5448830 | 8385121 | 6498212 | 15388848 | 11925886 | 18352564 | 59 |
| 2 | 5451269 | 8383536 | 6502350 | 15379055 | 11938141 | 18344353 | 58 |
| 3 | 5453707 | 8381950 | 6506490 | 15369270 | 11930398 | 18336151 | 57 |
| 4 | 5456145 | 8380263 | 6510631 | 15359494 | 11932657 | 18327958 | 56 |
| 5 | 5458583 | 8378775 | 6514774 | 15349727 | 11934918 | 18319774 | 55 |
| 6 | 5461020 | 8377187 | 6518918 | 15339969 | 11937181 | 18311599 | 54 |
| 7 | 5463456 | 8375598 | 6523064 | 15330220 | 11939446 | 18203432 | 53 |
| 8 | 5465892 | 8374008 | 6527211 | 15320479 | 11941712 | 18295274 | 52 |
| 9 | 5468328 | 8372418 | 6531360 | 15310747 | 11943980 | 18287125 | 51 |
| 10 | 5470763 | 8370827 | 6535511 | 15301023 | 11946250 | 18278985 | 50 |
| 11 | 5473198 | 8369235 | 6539663 | 15291308 | 11948522 | 18270854 | 49 |
| 12 | 5475632 | 8367634 | 6543817 | 15281602 | 11950796 | 18262731 | 48 |
| 13 | 5478066 | 8366050 | 6547972 | 15271904 | 11953072 | 18254617 | 47 |
| 14 | 5480499 | 8364456 | 6552129 | 15262215 | 11955350 | 18246512 | 46 |
| 15 | 5482932 | 8362861 | 6556287 | 15252535 | 11957630 | 18238416 | 45 |
| 16 | 5485365 | 8361266 | 6560447 | 15242863 | 11959911 | 18230328 | 44 |
| 17 | 5487797 | 8359670 | 6564609 | 15233200 | 11962194 | 18222249 | 43 |
| 18 | 5490228 | 8358073 | 6568772 | 15223545 | 11964479 | 18214179 | 42 |
| 19 | 5492659 | 8356476 | 6572937 | 15213899 | 11966766 | 18206118 | 41 |
| 20 | 5495090 | 8354878 | 6577103 | 15204261 | 11969055 | 18198065 | 40 |
| 21 | 5497520 | 8353279 | 6581271 | 15194632 | 11971346 | 18190021 | 39 |
| 22 | 5499950 | 8351680 | 6585441 | 15185012 | 11973639 | 18181985 | 38 |
| 23 | 5502379 | 8350080 | 6589612 | 15175400 | 11975934 | 18173958 | 37 |
| 24 | 5504808 | 8348479 | 6593785 | 15165796 | 11978231 | 18165940 | 36 |
| 25 | 5507236 | 8346877 | 6597959 | 15156201 | 11980529 | 18157930 | 35 |
| 26 | 5509664 | 8345275 | 6602135 | 15146614 | 11982829 | 18149929 | 34 |
| 27 | 5512091 | 8343672 | 6606313 | 15137036 | 11985131 | 18141937 | 33 |
| 28 | 5514518 | 8342068 | 6610492 | 15127466 | 11987435 | 18133953 | 32 |
| 29 | 5516944 | 8340463 | 6614673 | 15117905 | 11989741 | 18125977 | 31 |
| 30 | 5519370 | 8338858 | 6618856 | 15108352 | 11992049 | 18118010 | 30 |
| 31 | 5521795 | 8337252 | 6623040 | 15098807 | 11994359 | 18110052 | 29 |
| 32 | 5524220 | 8335645 | 6627226 | 15089271 | 11996671 | 18102102 | 28 |
| 33 | 5526645 | 8334038 | 6631413 | 15079743 | 11998985 | 18094161 | 27 |
| 34 | 5529069 | 8332430 | 6635602 | 15070224 | 12001301 | 18086228 | 26 |
| 35 | 5531492 | 8330821 | 6639792 | 15060713 | 12003619 | 18078304 | 25 |
| 36 | 5533915 | 8329212 | 6643984 | 15051210 | 12005938 | 18070388 | 24 |
| 37 | 5536338 | 8327692 | 6648178 | 15041716 | 12008259 | 18062481 | 23 |
| 38 | 5538760 | 8325991 | 6652373 | 15032230 | 12010582 | 18054582 | 22 |
| 39 | 5541182 | 8324380 | 6656570 | 15022752 | 12012907 | 18046691 | 21 |
| 40 | 5543603 | 8322768 | 6660769 | 15013282 | 12015234 | 18038809 | 20 |
| 41 | 5546024 | 8321155 | 6664969 | 15003820 | 12017563 | 18030935 | 19 |
| 42 | 5548444 | 8319541 | 6669171 | 14994367 | 12019894 | 18023070 | 18 |
| 43 | 5550864 | 8317927 | 6673375 | 14984922 | 12022227 | 18015213 | 17 |
| 44 | 5553283 | 8316312 | 6677580 | 14975486 | 12024562 | 18007365 | 16 |
| 45 | 5555702 | 8314696 | 6681787 | 14966058 | 12026899 | 17999525 | 15 |
| 46 | 5558121 | 8313079 | 6685995 | 14956638 | 12029237 | 17991693 | 14 |
| 47 | 5560539 | 8311462 | 6690205 | 14947226 | 12031577 | 17983869 | 13 |
| 48 | 5562956 | 8309844 | 6694417 | 14937822 | 12033919 | 17976054 | 12 |
| 49 | 5565373 | 8308226 | 6698630 | 14928426 | 12036264 | 17968247 | 11 |
| 50 | 5567790 | 8306607 | 6702845 | 14919038 | 12038610 | 17960448 | 10 |
| 51 | 5570206 | 8304987 | 6707062 | 14909659 | 12040958 | 17952658 | 9 |
| 52 | 5572621 | 8303366 | 6711280 | 14900288 | 12043308 | 17944876 | 8 |
| 53 | 5575036 | 8301745 | 6715500 | 14890925 | 12045660 | 17937102 | 7 |
| 54 | 5577451 | 8300123 | 6719721 | 14881570 | 12048014 | 17929337 | 6 |
| 55 | 5579865 | 8298500 | 6723944 | 14872223 | 12050370 | 17921580 | 5 |
| 56 | 5582279 | 8296876 | 6728169 | 14862884 | 12052728 | 17913831 | 4 |
| 57 | 5584692 | 8295252 | 6732396 | 14853553 | 12055088 | 17906090 | 3 |
| 58 | 5587105 | 8297627 | 6736624 | 14844230 | 12057450 | 17898358 | 2 |
| 59 | 5589517 | 8292002 | 6740854 | 14834916 | 12059814 | 17890633 | 1 |
| 60 | 5591929 | 8290376 | 6745085 | 14825610 | 12062180 | 17882916 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. CoSecant. | N. Secant. | M |

56 DEGREES.

33 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7361088 | 9.9235914 | 9.8125174 | 10.1874826 | 10.0764086 | 10.2638912 | 60 |
| 1 | 9.7363032 | 9.9235093 | 9.8127939 | 10.1872061 | 10.0764907 | 10.2636968 | 59 |
| 2 | 9.7364976 | 9.9234272 | 9.8130704 | 10.1869296 | 10.0765728 | 10.2635024 | 58 |
| 3 | 9.7366918 | 9.9233450 | 9.8133468 | 10.1866532 | 10.0766550 | 10.2633082 | 57 |
| 4 | 9.7368859 | 9.9232628 | 9.8136231 | 10.1863769 | 10.0767372 | 10.2631141 | 56 |
| 5 | 9.7370799 | 9.9231805 | 9.8138993 | 10.1861007 | 10.0768195 | 10.2629201 | 55 |
| 6 | 9.7372737 | 9.9230982 | 9.8141755 | 10.1858245 | 10.0769018 | 10.2627263 | 54 |
| 7 | 9.7374675 | 9.9230158 | 9.8144516 | 10.1855484 | 10.0769842 | 10.2625325 | 53 |
| 8 | 9.7376641 | 9 9229334 | 9.8147277 | 10.1852723 | 10.0770666 | 10.2623389 | 52 |
| 9 | 9.7378516 | 9.9228509 | 9.8150036 | 10.1849964 | 10.0771491 | 10.2621454 | 51 |
| 10 | 9.7380479 | 9.9227684 | 9.8152795 | 10.1847205 | 10.0772316 | 10.2619521 | 50 |
| 11 | 9.7382412 | 9.9226858 | 9.8155554 | 10.1844446 | 10.0773142 | 10.2617588 | 49 |
| 12 | 9.7384343 | 9.9226032 | 9.8158311 | 10.1841689 | 10.0773969 | 10.2615657 | 48 |
| 13 | 9.7386273 | 9.9225205 | 9.8161068 | 10.1838932 | 10.0774795 | 10.2613727 | 47 |
| 14 | 9.7388201 | 9.9224377 | 9.8163824 | 10.1836176 | 10.0775623 | 10.2611799 | 46 |
| 15 | 9.7390129 | 9.9223549 | 9.8166580 | 10.1833420 | 10.0776451 | 10.2609871 | 45 |
| 16 | 9.7392055 | 9.9222721 | 9.8169335 | 10.1830665 | 10.0777279 | 10.2607945 | 44 |
| 17 | 9.7393980 | 9.9221891 | 9.8172089 | 10.1827911 | 10.0778109 | 10.2606020 | 43 |
| 18 | 9.7395904 | 9.9221062 | 9.8174842 | 10.1825158 | 10.0778938 | 10.2604096 | 42 |
| 19 | 9.7397827 | 9.9220232 | 9.8177595 | 10.1822405 | 10.0779768 | 10.2602173 | 41 |
| 20 | 9.7399748 | 9.9219401 | 9.8180347 | 10.1819653 | 10.0780599 | 10.2600252 | 40 |
| 21 | 9.7401668 | 9.9218570 | 9.8183098 | 10.1816902 | 10.0781430 | 10.2598332 | 39 |
| 22 | 9.7403587 | 9.9217738 | 9.8185849 | 10.1814151 | 10.0782262 | 10.2596413 | 38 |
| 23 | 9.7405505 | 9.9216906 | 9 8188599 | 10.1811401 | 10.0783094 | 10.2594495 | 37 |
| 24 | 9.7407421 | 9.9216073 | 9.8191348 | 10.1808652 | 10.0783927 | 10.2592579 | 36 |
| 25 | 9.7409337 | 9.9215240 | 9.8194096 | 10.1805904 | 10.0784760 | 10.2590663 | 35 |
| 26 | 9.7411251 | 9.9214406 | 9.8196844 | 10.1803156 | 10.0785594 | 10.2588749 | 34 |
| 27 | 9.7413164 | 9.9213572 | 9.8199592 | 10.1800408 | 10.0786428 | 10.2586836 | 33 |
| 28 | 9.7415075 | 9.9212737 | 9.8202338 | 10.1797662 | 10.0787663 | 10.2584925 | 32 |
| 29 | 9.7416986 | 9.9211902 | 9.8205084 | 10.1794916 | 10.0788098 | 10.2583014 | 31 |
| 30 | 9.7418895 | 9.9211066 | 9.8207829 | 10.1792171 | 10 0788934 | 10.2581105 | 30 |
| 31 | 9.7420803 | 9.9210229 | 9.8210574 | 10.1789426 | 10.0789771 | 10.2579197 | 29 |
| 32 | 9.7422710 | 9.9209393 | 9.8213317 | 10.1786683 | 10.0790607 | 10.2577290 | 28 |
| 33 | 9.7424616 | 9.9208555 | 9.8216060 | 10.1783940 | 10.0791445 | 10.2575384 | 27 |
| 34 | 9.7426520 | 9.9207717 | 9.8218803 | 10.1781197 | 10.0792283 | 10.2573480 | 26 |
| 35 | 9.7428423 | 9.9206878 | 9.8221545 | 10.1778455 | 10.0793122 | 10.2571577 | 25 |
| 36 | 9.7430325 | 9.9206039 | 9.8224286 | 10.1775714 | 10.0793961 | 10.2569675 | 24 |
| 37 | 9.7432226 | 9 9205200 | 9.8227026 | 10.1772974 | 10 0794800 | 10.2567774 | 23 |
| 38 | 9.7434126 | 9.9204360 | 9.8229766 | 10.1770234 | 10.0795640 | 10.2565874 | 22 |
| 39 | 9.7436024 | 9.9203519 | 9.8232505 | 10.1767495 | 10.0796481 | 10.2563976 | 21 |
| 40 | 9.7437921 | 9.9202678 | 9.8235244 | 10.1764756 | 10.0797322 | 10.2562079 | 20 |
| 41 | 9.7439817 | 9.9201836 | 9.8237981 | 10.1762019 | 10.0798164 | 10.2560188 | 19 |
| 42 | 9.7441712 | 9.9200994 | 9.8240719 | 10.1759281 | 10.0799006 | 10.2558288 | 18 |
| 43 | 9.7443606 | 9.9200151 | 9.8243455 | 10.1756545 | 10.0799849 | 10.2556394 | 17 |
| 44 | 9.7445498 | 9.9199308 | 9.8246191 | 10.1753809 | 10.0800692 | 10.2554502 | 16 |
| 45 | 9.7447390 | 9.9198464 | 9.8248926 | 10.1751074 | 10.0801536 | 10.2552610 | 15 |
| 46 | 9.7449280 | 9.9197619 | 9.8251660 | 10.1748340 | 10.0802381 | 10.2550720 | 14 |
| 47 | 9.7451169 | 9.9196775 | 9.8254394 | 10.1745606 | 10.0803225 | 10.2548831 | 13 |
| 48 | 9.7453056 | 9.9195939 | 9.8257127 | 10.1742873 | 10.0804071 | 10.2546944 | 12 |
| 49 | 9.7454943 | 9.9195083 | 9.8259860 | 10.1740140 | 10.0804917 | 10.2545057 | 11 |
| 50 | 9.7456828 | 9.9194237 | 9.8262592 | 10.1737408 | 10.0805763 | 10.2543172 | 10 |
| 51 | 9.7458712 | 9.9193390 | 9.8265323 | 10.1734677 | 10.0806610 | 10.2541288 | 9 |
| 52 | 9.7460590 | 9.9192542 | 9.8268053 | 10.1731947 | 10.0807458 | 10.2539405 | 8 |
| 53 | 9.7462477 | 9.9191694 | 9.8270783 | 10.1729217 | 10.0808306 | 10.2537523 | 7 |
| 54 | 9.7464358 | 9.9190845 | 9.8273513 | 10.1726487 | 10.0809155 | 10.2535642 | 6 |
| 55 | 9.7466237 | 9.9189996 | 6.8276241 | 10.1723759 | 10.0810004 | 10.2533763 | 5 |
| 56 | 9.7468115 | 9.9189146 | 9.8278969 | 10.1721031 | 10.0810854 | 10.2531885 | 4 |
| 57 | 9.7469992 | 9.9188296 | 9.8281696 | 10.1718304 | 10.0811704 | 10.2530008 | 3 |
| 58 | 9.7471868 | 9.9187445 | 9.8284423 | 10.1715577 | 10.0812555 | 10.2528132 | 2 |
| 59 | 9.7473743 | 9.9186594 | 9.8287149 | 10.1712851 | 10-0813406 | 10.2526257 | 1 |
| 60 | 9.7475617 | 9.9185742 | 9.8289874 | 10.1710126 | 10.0814258 | 10.2524383 | 0 |
| | L Co-Sine. | L. Sine | L. Co Tang. | L. Tangent | L.Co-Secant | L. Secant. | M |

56 DEGREES.

34 DEGREES

| M | N. Sine | N.Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant | NCo-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5591929 | 8290376 | 6745085 | 14825610 | 12062180 | 17889916 | 60 |
| 1 | 5594340 | 8288749 | 6749318 | 14816311 | 12064548 | 17875208 | 59 |
| 2 | 5596751 | 8287121 | 6753553 | 14807011 | 12066918 | 17867508 | 58 |
| 3 | 5599161 | 8285493 | 6757790 | 14797738 | 12069289 | 17859817 | 57 |
| 4 | 5601571 | 8283864 | 6762028 | 14788463 | 12071662 | 17852133 | 56 |
| 5 | 5603981 | 8282234 | 6766268 | 14779197 | 12074037 | 17844457 | 55 |
| 6 | 5606390 | 8280603 | 6770509 | 41769938 | 12076414 | 17836790 | 54 |
| 7 | 5608798 | 8278972 | 6774752 | 14760688 | 12078793 | 17829131 | 53 |
| 8 | 5611206 | 8277340 | 6778997 | 14751445 | 12081175 | 17821479 | 52 |
| 9 | 5613614 | 8275707 | 6783244 | 14742210 | 12083559 | 17813836 | 51 |
| 10 | 5616021 | 8274074 | 6787492 | 14732983 | 12085944 | 17806201 | 50 |
| 11 | 5618428 | 8272440 | 6791742 | 14723764 | 12088331 | 17798574 | 49 |
| 12 | 5620834 | 8270805 | 6795993 | 14714553 | 12090720 | 17790955 | 48 |
| 13 | 5623239 | 8269170 | 6800246 | 14705350 | 12093112 | 17783343 | 47 |
| 14 | 5625644 | 8267534 | 6804501 | 14696155 | 12095505 | 17775740 | 46 |
| 15 | 5628049 | 8265897 | 6808758 | 14686967 | 12097900 | 17768145 | 45 |
| 16 | 5630453 | 8264260 | 6813016 | 14677787 | 12100297 | 17760558 | 44 |
| 17 | 5632857 | 8262622 | 6817276 | 14668616 | 12102696 | 17752979 | 43 |
| 18 | 5635260 | 8260983 | 6821538 | 14659452 | 12105097 | 17745408 | 42 |
| 19 | 5637663 | 8259343 | 6825801 | 14650296 | 12107500 | 17737845 | 41 |
| 20 | 5640065 | 8257703 | 6830066 | 14641147 | 12109905 | 17730290 | 40 |
| 21 | 5642467 | 8256062 | 6834333 | 14632007 | 12112312 | 17722743 | 39 |
| 22 | 5644869 | 8254420 | 6838601 | 14622874 | 12114721 | 17715204 | 38 |
| 23 | 5647270 | 8252778 | 6842871 | 14613749 | 12117132 | 17707673 | 37 |
| 24 | 5649670 | 8251135 | 6847143 | 14604632 | 12119545 | 17700149 | 36 |
| 25 | 5652070 | 8249491 | 6851417 | 14595522 | 12121960 | 17692633 | 35 |
| 26 | 5654469 | 8247847 | 6855692 | 14586420 | 12124377 | 17685125 | 34 |
| 27 | 5656868 | 8246202 | 6859969 | 14577326 | 12126796 | 17677625 | 33 |
| 28 | 5659267 | 8244556 | 6864247 | 14568240 | 12129217 | 17670133 | 32 |
| 29 | 5661665 | 8242909 | 6868527 | 14559161 | 12131640 | 17662649 | 31 |
| 30 | 5664062 | 8241262 | 6872810 | 14550090 | 12134064 | 17655173 | 30 |
| 31 | 5666459 | 8239614 | 6877094 | 14541027 | 12136491 | 17647704 | 29 |
| 32 | 5668856 | 8237965 | 6881379 | 14531971 | 12138920 | 17640243 | 28 |
| 33 | 5671252 | 8236316 | 6885666 | 14522923 | 12141351 | 17632791 | 27 |
| 34 | 5673648 | 8234666 | 6889955 | 14513883 | 12143783 | 17625345 | 26 |
| 35 | 5676043 | 8233015 | 6894246 | 14504850 | 12146218 | 17617908 | 25 |
| 36 | 5678437 | 8231364 | 6898538 | 14495825 | 12148655 | 17610478 | 24 |
| 37 | 5680831 | 8229712 | 6902832 | 14486808 | 12151094 | 17603056 | 23 |
| 38 | 5683225 | 8228059 | 6907128 | 14477798 | 12153535 | 17595642 | 22 |
| 39 | 5685618 | 8226405 | 6911425 | 14468796 | 12155978 | 17588236 | 21 |
| 40 | 5688011 | 8224751 | 6915724 | 14459801 | 12158423 | 17580837 | 20 |
| 41 | 5690403 | 8223096 | 6920025 | 14450814 | 12160870 | 17573446 | 19 |
| 42 | 5692795 | 8221440 | 6924328 | 14441834 | 12163319 | 17566063 | 18 |
| 43 | 5695186 | 8219784 | 6928633 | 14432862 | 12165770 | 17558687 | 17 |
| 44 | 5697577 | 8218127 | 6932939 | 14423897 | 12168223 | 17551319 | 16 |
| 45 | 5699968 | 8216469 | 6937247 | 14414940 | 12170678 | 17543959 | 15 |
| 46 | 5702358 | 8214811 | 6941557 | 14405951 | 12173135 | 17536607 | 14 |
| 47 | 5704747 | 8213152 | 6945868 | 14397049 | 12175594 | 17529262 | 13 |
| 48 | 5707136 | 8211492 | 6950181 | 14388114 | 12178055 | 17521924 | 12 |
| 49 | 5709524 | 8209831 | 6954496 | 14379187 | 12180518 | 17514594 | 11 |
| 50 | 5711912 | 8208170 | 6958813 | 14370268 | 12182983 | 17507273 | 10 |
| 51 | 5714299 | 8206508 | 6963131 | 14361356 | 12185450 | 17499958 | 9 |
| 52 | 5716686 | 8204846 | 6967451 | 14352451 | 12187919 | 17492651 | 8 |
| 53 | 5719073 | 8203183 | 6971773 | 14343554 | 12190390 | 17485352 | 7 |
| 54 | 5721459 | 8201519 | 6976097 | 14334664 | 12192864 | 17478060 | 6 |
| 55 | 5723844 | 8199854 | 6980422 | 14325781 | 12195339 | 17470776 | 5 |
| 56 | 5726229 | 8198189 | 6984749 | 14316906 | 12197816 | 17463499 | 4 |
| 57 | 5728614 | 8196523 | 6989078 | 14308039 | 12200296 | 17456230 | 3 |
| 58 | 5730998 | 8194856 | 6993409 | 14299178 | 12202777 | 17448969 | 2 |
| 59 | 5733381 | 8193189 | 6997741 | 14290326 | 12205260 | 17441715 | 1 |
| 60 | 5735764 | 8191521 | 7002075 | 14281480 | 12207746 | 17434468 | 0 |
| | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N.Co-Secant. | N. Secant | M |

55 DEGREES.

34 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co. Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7475617 | 9.9185742 | 9.8289874 | 10 1710126 | 10.0814258 | 10.2524383 | 60 |
| 1 | 9.7477489 | 9.9184890 | 9.8292599 | 10.1707401 | 10.0815110 | 10.2522511 | 59 |
| 2 | 9.7479360 | 9.9184037 | 9.8295323 | 10.1704677 | 10.0815963 | 10.2520640 | 58 |
| 3 | 9.7481230 | 9.9183183 | 9.8298047 | 10.1701953 | 10.0816817 | 10.2518770 | 57 |
| 4 | 9.7483099 | 9.9182329 | 9.8300769 | 10.1699231 | 10.0817671 | 10.2516901 | 56 |
| 5 | 9.7484967 | 9.9181475 | 9.8303492 | 10.1696508 | 10.0818525 | 10.2515033 | 55 |
| 6 | 9.7486833 | 9.9180620 | 9 8306213 | 10.1693787 | 10.0813380 | 10.2513167 | 54 |
| 7 | 9.7488698 | 9.9179764 | 9.8308934 | 10.1691066 | 10.0820236 | 10.2511302 | 53 |
| 8 | 9.7490562 | 9 9178908 | 9.8311654 | 10.1688346 | 10.0821092 | 10.2509438 | 52 |
| 9 | 9.7492425 | 9.9178051 | 9.8314374 | 10.1685626 | 10.0821949 | 10.2507575 | 51 |
| 10 | 9.7494287 | 9.9177194 | 9.8317093 | 10.1682907 | 10.0822806 | 10.2505713 | 50 |
| 11 | 9.7496148 | 9.9176336 | 9.8319811 | 10.1680189 | 10.0823664 | 10.2503852 | 49 |
| 12 | 9.7498007 | 9.9175478 | 9.8322529 | 10.1677471 | 10.0824522 | 10.2501993 | 48 |
| 13 | 9.7499866 | 9.9174619 | 9.8325246 | 10.1674754 | 10.0825381 | 10.2500134 | 47 |
| 14 | 9.7501723 | 9.9173760 | 9.8327963 | 10.1672037 | 10.0826240 | 10.2498277 | 46 |
| 15 | 9.7503579 | 9.9172900 | 9.8330679 | 10.1669321 | 10.0827100 | 10.2496421 | 45 |
| 16 | 9.7505434 | 9.9172040 | 9.8333394 | 10.1666606 | 10.0827960 | 10.2494566 | 44 |
| 17 | 9.7507287 | 9.9171179 | 9.8336109 | 10.1663891 | 10.0828821 | 10.2492713 | 43 |
| 18 | 9.7509140 | 9.9170317 | 9.8338823 | 10.1661177 | 10.0829683 | 10.2490860 | 42 |
| 19 | 9.7510991 | 9.9169455 | 9.8341536 | 10.1658464 | 10.0830545 | 10.2489009 | 41 |
| 20 | 9.7512842 | 9.9168593 | 9.8344249 | 10.1655751 | 10.0831407 | 10.2487158 | 40 |
| 21 | 9.7514691 | 9.9167730 | 9.8346961 | 10.1653039 | 10.0832270 | 10.2485309 | 39 |
| 22 | 9.7516538 | 9.9166866 | 9.8349673 | 10.1650327 | 10.0833134 | 10.2483462 | 38 |
| 23 | 9.7518385 | 9.9166002 | 9 8352384 | 10.1647616 | 10.0833998 | 10.2481615 | 37 |
| 24 | 9.7520231 | 9.9165137 | 9.8355094 | 10.1644906 | 10.0834863 | 10.2479769 | 36 |
| 25 | 9.7522075 | 9.9164272 | 9.8357804 | 10.1642196 | 10.0835728 | 10.2477925 | 35 |
| 26 | 9.7523919 | 9.9163406 | 9.8360513 | 10.1639487 | 10.0836594 | 10.2476081 | 34 |
| 27 | 9.7525761 | 9.9162539 | 9.8363221 | 10.1636779 | 10.0837461 | 10.2474239 | 33 |
| 28 | 9.7527602 | 9.9161673 | 9 8365929 | 10.1634071 | 10.0838327 | 10.2472398 | 32 |
| 29 | 9 7529442 | 9.9160805 | 9.8368636 | 10.1631364 | 10.0839195 | 10.2470558 | 31 |
| 30 | 9.7531280 | 9.9159937 | 9.8371343 | 10.1628657 | 10 0840063 | 10.2468720 | 30 |
| 31 | 9.7533118 | 9.9159069 | 9.8374049 | 10.1625951 | 10.0840931 | 10.2466882 | 29 |
| 32 | 9.7534954 | 9.9158200 | 9.8376755 | 10.1623245 | 10.0841800 | 10.2465046 | 28 |
| 33 | 9.7536790 | 9.9157330 | 9.8379460 | 10.1620540 | 10.0842670 | 10.2463210 | 27 |
| 34 | 9.7538624 | 9.9156460 | 9.8382164 | 10.1617836 | 10.0843540 | 10.2461376 | 26 |
| 35 | 9.7540457 | 9.9155589 | 9.8384867 | 10.1615133 | 10.0844412 | 10.2459343 | 25 |
| 36 | 9.7542288 | 9.9154718 | 9.8387571 | 10.1612429 | 10.0845282 | 10.2457712 | 24 |
| 37 | 9.7544119 | 9 9153846 | 9.8390273 | 10.1609727 | 10 0846154 | 10.2455881 | 23 |
| 38 | 9.7545949 | 9.9152974 | 9.8392975 | 10.1607025 | 10.0847026 | 10.2454051 | 22 |
| 39 | 9.7547777 | 9.9152101 | 9.8395676 | 10.1604324 | 10.0847899 | 10.2452223 | 21 |
| 40 | 9.7549604 | 9.9151228 | 9.8398377 | 10.1601623 | 10.0848772 | 10.2450396 | 20 |
| 41 | 9.7551431 | 9.9150354 | 9.8401077 | 10.1598923 | 10.0849646 | 10.2448569 | 19 |
| 42 | 9.7553256 | 9.9149479 | 9.8403776 | 10.1596224 | 10.0850521 | 10.2446744 | 18 |
| 43 | 9.7555080 | 9.9148604 | 9.8406475 | 10.1593525 | 10.0851396 | 10.2444920 | 17 |
| 44 | 9.7556902 | 9.9147729 | 9.8409174 | 10.1590826 | 10.0852271 | 10 2443098 | 16 |
| 45 | 9.7558724 | 9.9146852 | 9.8411871 | 10.1588129 | 10.0853148 | 10.2441276 | 15 |
| 46 | 9.7560544 | 9.9145976 | 9.8414569 | 10.1585431 | 10.0854024 | 10.2439456 | 14 |
| 47 | 9.7562364 | 9.9145099 | 9.8417265 | 10.1582735 | 10.0854901 | 10.2437636 | 13 |
| 48 | 9.7564182 | 9.9144221 | 9.8419961 | 10.1580039 | 10.0855779 | 10.2435818 | 12 |
| 49 | 9.7565999 | 9.9143342 | 9.8422657 | 10.1577343 | 10.0856658 | 10.2434001 | 11 |
| 50 | 9.7567815 | 9.9142464 | 9.8425351 | 10.1574645 | 10.0857536 | 10.2432185 | 10 |
| 51 | 9.7569630 | 9.9141584 | 9.8428046 | 10.1571954 | 10.0858416 | 10.2430370 | 9 |
| 52 | 9.7571444 | 9.9140704 | 9.8430739 | 10.1569261 | 10.0859296 | 10.2428556 | 8 |
| 53 | 9.7573256 | 9 9139824 | 9.8433432 | 10.1566568 | 10.0860176 | 10.2426744 | 7 |
| 54 | 9.7575068 | 9.9138943 | 9.8436125 | 10.1563875 | 10.0861057 | 10.2424932 | 6 |
| 55 | 9.7576878 | 9 9138061 | 6.8438817 | 10.1561183 | 10.0861939 | 10.2423122 | 5 |
| 56 | 9.7578687 | 9.9137179 | 9.8441508 | 10.1558492 | 10.0862821 | 10.2421313 | 4 |
| 57 | 9.7580495 | 9.9136296 | 9.8444199 | 10.1555801 | 10.0863704 | 10.2419505 | 3 |
| 58 | 9.7582302 | 9.9135413 | 9.8446889 | 10.1553111 | 10.0864587 | 10.2417698 | 2 |
| 59 | 9.7584108 | 9.9134530 | 9.8449579 | 10.1550421 | 10.0865471 | 10.2415892 | 1 |
| 60 | 9.7585913 | 9.9133645 | 9.8452268 | 10.1547732 | 10.0866355 | 10.2414087 | 0 |
| | L Co-Tang | L. Sine | L.Co-Sine. | L. Tangent. | L.Co-Secant | L. Secant. | M |

55 DEGREES.

35 DEGREES

| M | N. Sine | N.Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant. | NCo-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5735764 | 8191521 | 7002075 | 14281480 | 12207746 | 17434468 | 60 |
| 1 | 5738147 | 8189852 | 7006411 | 14272642 | 12210233 | 17427229 | 59 |
| 2 | 5740529 | 8188182 | 7010749 | 14263811 | 12212723 | 17419997 | 58 |
| 3 | 5742911 | 8186512 | 7015089 | 14254987 | 12215215 | 17412773 | 57 |
| 4 | 5245292 | 8184841 | 7019430 | 14246171 | 12217708 | 17405556 | 56 |
| 5 | 5747672 | 8183169 | 7023773 | 14237362 | 12220204 | 17398347 | 55 |
| 6 | 5750052 | 8181497 | 7028118 | 14228561 | 12222702 | 17391145 | 54 |
| 7 | 5752432 | 8179824 | 7032465 | 14219766 | 12225202 | 17383951 | 53 |
| 8 | 5754811 | 8178150 | 7036813 | 14210979 | 12227703 | 17376764 | 52 |
| 9 | 5757190 | 8176476 | 7041163 | 14202200 | 12230207 | 17369585 | 51 |
| 10 | 5759568 | 8174801 | 7045515 | 14193422 | 12232713 | 17362413 | 50 |
| 11 | 5761946 | 8173125 | 7049869 | 14184662 | 12235221 | 17355247 | 49 |
| 12 | 5764323 | 8171449 | 7054224 | 14175904 | 12237732 | 17348090 | 48 |
| 13 | 5766700 | 8169772 | 7058581 | 14167153 | 12240244 | 17340941 | 47 |
| 14 | 5769076 | 8168094 | 7062940 | 14158409 | 12242758 | 17333798 | 46 |
| 15 | 5771452 | 8166415 | 7067301 | 14149673 | 12245274 | 17326663 | 45 |
| 16 | 5773827 | 8164736 | 7071664 | 14140943 | 12247793 | 17319535 | 44 |
| 17 | 5776202 | 8163056 | 7076029 | 14132221 | 12250313 | 17312414 | 43 |
| 18 | 5778576 | 8161376 | 7080395 | 14123506 | 12252836 | 17305301 | 42 |
| 19 | 5780950 | 8159695 | 7084763 | 14114799 | 12255361 | 17298195 | 41 |
| 20 | 5783323 | 8158013 | 7089133 | 14106098 | 12257887 | 17291096 | 40 |
| 21 | 5785696 | 8156330 | 7093505 | 14097405 | 12260416 | 17284005 | 39 |
| 22 | 5788068 | 8154647 | 7097878 | 14088718 | 12262947 | 17276921 | 38 |
| 23 | 5790440 | 8152963 | 7102253 | 14080039 | 12265480 | 17269844 | 37 |
| 24 | 5792852 | 8151278 | 7106630 | 14071367 | 12268015 | 17262774 | 36 |
| 25 | 5795183 | 8149593 | 7111009 | 14062702 | 12270552 | 17255712 | 35 |
| 26 | 5797553 | 8147906 | 7115390 | 14054944 | 12273091 | 17248657 | 34 |
| 27 | 5799923 | 8146219 | 7119773 | 14045393 | 12275633 | 17241609 | 33 |
| 28 | 5802292 | 8144532 | 7124157 | 14036749 | 12278176 | 17234568 | 32 |
| 29 | 5804661 | 8142844 | 7128543 | 14028113 | 12280721 | 17227534 | 31 |
| 30 | 5807030 | 8141155 | 7132931 | 14019483 | 12283269 | 17220508 | 30 |
| 31 | 5809398 | 8139465 | 7137321 | 14010860 | 12285819 | 17213489 | 29 |
| 32 | 5811765 | 8137775 | 7141713 | 14002245 | 12288371 | 17206477 | 28 |
| 33 | 5814132 | 8136084 | 7146106 | 13993636 | 12290925 | 17199472 | 27 |
| 34 | 5816498 | 8134393 | 7150501 | 13985034 | 12293481 | 17192475 | 26 |
| 35 | 5819864 | 8132701 | 7154898 | 13976440 | 12296039 | 17185484 | 25 |
| 36 | 5821230 | 8131008 | 7159297 | 13967852 | 12298599 | 17178501 | 24 |
| 37 | 5823595 | 8129314 | 7163698 | 13959272 | 12301161 | 17171525 | 23 |
| 38 | 5825959 | 8127620 | 7168101 | 13950698 | 12303725 | 17164556 | 22 |
| 39 | 5828323 | 8125925 | 7172505 | 13942131 | 12306292 | 17157594 | 21 |
| 40 | 5830687 | 8124229 | 7176911 | 13933571 | 12308861 | 17150639 | 20 |
| 41 | 5833050 | 8122532 | 7181319 | 13925018 | 12311431 | 17143691 | 19 |
| 42 | 5835412 | 8120835 | 7185729 | 13916473 | 12314005 | 17136750 | 18 |
| 43 | 5837774 | 8119137 | 7190141 | 13907934 | 12316580 | 17129817 | 17 |
| 44 | 5840136 | 8117439 | 7194551 | 13899401 | 12319157 | 17122890 | 16 |
| 45 | 5842497 | 8115740 | 7198970 | 13890876 | 12321736 | 17115970 | 15 |
| 46 | 5844857 | 8114040 | 7203387 | 13882358 | 12324317 | 17109058 | 14 |
| 47 | 5847217 | 8112339 | 7207806 | 13873846 | 12326900 | 17102152 | 13 |
| 48 | 5849577 | 8110638 | 7212227 | 13865342 | 12329486 | 17095254 | 12 |
| 49 | 5851936 | 8108936 | 7216650 | 13856844 | 12332074 | 17088362 | 11 |
| 50 | 5854394 | 8107233 | 7221075 | 13848353 | 12334664 | 17081478 | 10 |
| 51 | 5856652 | 8105530 | 7225502 | 13839869 | 12337256 | 17074600 | 9 |
| 52 | 5859010 | 8103826 | 7229931 | 13831392 | 12339850 | 17067730 | 8 |
| 53 | 5861367 | 8102121 | 7234361 | 13822922 | 12342446 | 17060866 | 7 |
| 54 | 5863724 | 8100416 | 7238793 | 13814458 | 12345044 | 17054010 | 6 |
| 55 | 5866080 | 8098710 | 7243227 | 13806001 | 12347645 | 17047160 | 5 |
| 56 | 5868435 | 8097003 | 7247663 | 13797551 | 12350248 | 17040318 | 4 |
| 57 | 5870790 | 8095296 | 7252101 | 13789108 | 12352852 | 17033482 | 3 |
| 58 | 5873145 | 8093588 | 7256541 | 13780672 | 12355459 | 17026653 | 2 |
| 59 | 5875499 | 8091870 | 7260983 | 13772242 | 12358068 | 17019831 | 1 |
| 60 | 5877853 | 8090170 | 7265426 | 13763819 | 12360680 | 17013016 | 0 |
| M | N. Co-Sine | N. Sine. | N Co Tang. | N. Tangent. | N.Co-Secant. | N. Secant | M |

54 DEGREES.

35 DEGREES.

| M | *L. Sine.* | *L. Co. Sine.* | *L. Tangent* | *L. Co-Tang.* | *L. Secant.* | *L Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7585913 | 9.9133645 | 9.8452268 | 10.1547732 | 10.0866353 | 10.2414087 | 60 |
| 1 | 9.7587717 | 9.9132760 | 9.8454956 | 10.1545044 | 10.0867240 | 10.2412283 | 59 |
| 2 | 9.7589519 | 9.9131875 | 9.8457644 | 10.1542356 | 10.0868125 | 10.2410481 | 58 |
| 3 | 9.7591321 | 9.9130989 | 9.8460332 | 10.1539668 | 10.0869011 | 10.2408679 | 57 |
| 4 | 9.7593121 | 9.9130102 | 9.8463018 | 10.1536982 | 10.0869898 | 10.2406879 | 56 |
| 5 | 9.7594920 | 9.9129215 | 9.8465705 | 10.1534295 | 10.0870785 | 10.2405080 | 55 |
| 6 | 9.7596718 | 9.9128328 | 9.8468390 | 10.1531610 | 10.0871672 | 10.2403282 | 54 |
| 7 | 9.7598515 | 9.9127440 | 9.8471075 | 10.1528925 | 10.0872560 | 10.2401485 | 53 |
| 8 | 9.7600311 | 9.9126551 | 9.8473760 | 10.1526240 | 10.0873449 | 10.2399689 | 52 |
| 9 | 9.7602106 | 9.9125662 | 9.8476444 | 10.1523556 | 10.0874338 | 10.2397894 | 51 |
| 10 | 9.7603899 | 9.9124772 | 9.8479127 | 10.1520873 | 10.0875228 | 10.2396101 | 50 |
| 11 | 9.7605692 | 9.9123882 | 9.8481810 | 10.1518190 | 10.0876118 | 10.2394308 | 49 |
| 12 | 9.7607483 | 9.9122991 | 9.8484492 | 10.1515508 | 10.0877009 | 10.2392517 | 48 |
| 13 | 9.7609274 | 9.9122099 | 9.8487174 | 10.1512826 | 10.0877901 | 10.2390726 | 47 |
| 14 | 9.7611063 | 9.9121207 | 9.8489855 | 10.1510145 | 10.0878793 | 10.2388937 | 46 |
| 15 | 9.7612851 | 9.9120315 | 9.8492536 | 10.1507464 | 10.0879685 | 10.2387149 | 45 |
| 16 | 9.7614638 | 9.9119422 | 9.8495216 | 10.1504784 | 10.0880578 | 10.2385362 | 44 |
| 17 | 9.7616424 | 9.9118528 | 9.8497896 | 10.1502104 | 10.0881472 | 10.2383576 | 43 |
| 18 | 9.7618208 | 9.9117634 | 9.8500575 | 10.1499424 | 10.0882366 | 10.2381792 | 42 |
| 19 | 9.7619992 | 9.9116739 | 9.8503253 | 10.1496747 | 10.0883261 | 10.2380008 | 41 |
| 20 | 9.7621775 | 9.9115844 | 9.8505931 | 10.1494069 | 10.0884156 | 10.2378225 | 40 |
| 21 | 9.7623556 | 9.9114948 | 9.8508608 | 10.1491392 | 10.0885052 | 10.2376444 | 39 |
| 22 | 9.7625337 | 9.9114051 | 9.8511285 | 10.1488715 | 10.0885949 | 10.2374663 | 38 |
| 23 | 9.7627116 | 9.9113155 | 9.8513961 | 10.1486039 | 10.0886845 | 10.2372884 | 37 |
| 24 | 9.7628894 | 9.9112257 | 9.8516637 | 10.1483363 | 10.0887743 | 10.2371106 | 36 |
| 25 | 9.7630671 | 9.9111359 | 9.8519312 | 10.1480688 | 10.0888641 | 10.2369329 | 35 |
| 26 | 9.7632447 | 9.9110460 | 9.8521987 | 10.1478013 | 10.0889540 | 10.2367553 | 34 |
| 27 | 9.7634222 | 9.9109561 | 9.8524661 | 10.1475339 | 10.0890439 | 10.2365778 | 33 |
| 28 | 9.7635996 | 9.9108661 | 9.8527335 | 10.1472665 | 10.0891339 | 10.2364004 | 32 |
| 29 | 9.7637769 | 9.9107761 | 9.8530008 | 10.1469992 | 10.0892239 | 10.2362231 | 31 |
| 30 | 9.7639540 | 9.9106860 | 9.8532680 | 10.1467320 | 10.0893140 | 10.2360460 | 30 |
| 31 | 9.7641311 | 9.9105959 | 9.8535352 | 10.1464648 | 10.0894041 | 10.2358689 | 29 |
| 32 | 9.7643080 | 9.9105057 | 9.8538023 | 10.1461977 | 10.0894943 | 10.2356920 | 28 |
| 33 | 9.7644849 | 9.9104155 | 9.8540694 | 10.1459306 | 10.0895846 | 10.2355151 | 27 |
| 34 | 9.7646616 | 9.9103255 | 9.8543365 | 10.1456635 | 10.0896749 | 10.2353384 | 26 |
| 35 | 9.7648382 | 9.9102348 | 9.8546034 | 10.1453966 | 10.0897652 | 10.2351618 | 25 |
| 36 | 9.7650147 | 9.9101444 | 9.8548704 | 10.1451296 | 10.0898556 | 10.2349853 | 24 |
| 37 | 9.7651911 | 9.9100539 | 9.8551372 | 10.1448638 | 10.0899461 | 10.2348089 | 23 |
| 38 | 9.7653674 | 9.9099634 | 9.8554041 | 10.1445959 | 10.0900366 | 10.2346326 | 22 |
| 39 | 9.7655436 | 9.9098728 | 9.8556708 | 10.1443292 | 10.0901272 | 10.2344964 | 21 |
| 40 | 9.7657197 | 9.9097821 | 9.8559376 | 10.1440624 | 10.0902179 | 10.2342803 | 20 |
| 41 | 9.7658957 | 9.9096915 | 9.8562042 | 10.1437958 | 10.0903085 | 10.2341043 | 19 |
| 42 | 9.7660715 | 9.9096007 | 9.8564708 | 10.1435292 | 10.0903993 | 10.2339285 | 18 |
| 43 | 9.7662473 | 9.9095099 | 9.8567374 | 10.1432626 | 10.0904901 | 10.2337527 | 17 |
| 44 | 9.7664229 | 9.9094190 | 9.8570039 | 10.1429961 | 10.0905810 | 10.2335771 | 16 |
| 45 | 9.7665985 | 9.9093281 | 9.8572704 | 10.1427296 | 10.0906719 | 10.2334015 | 15 |
| 46 | 9.7667739 | 9.9092371 | 9.8575368 | 10.1424632 | 10.0907629 | 10.2332261 | 14 |
| 47 | 9.7669492 | 9.9091461 | 9.8578031 | 10.1421969 | 10.0908539 | 10.2330508 | 13 |
| 48 | 9.7671244 | 9.9090550 | 9.8580694 | 10.1419306 | 10.0909450 | 10.2328756 | 12 |
| 49 | 9.7672996 | 9.9089639 | 9.8583357 | 10.1416643 | 10.0910361 | 10.2327004 | 11 |
| 50 | 9.7674746 | 9.9088727 | 9.8586019 | 10.1413981 | 10.0911273 | 10.2325254 | 10 |
| 51 | 9.7676494 | 9.9087814 | 9.8588680 | 10.1411320 | 10.0912186 | 10.2323506 | 9 |
| 52 | 9.7678242 | 9.9086901 | 9.8591341 | 10.1408659 | 10.0913099 | 10.2321758 | 8 |
| 53 | 9.7679989 | 9.9085988 | 9.8594002 | 10.1405998 | 10.0914012 | 10.2320011 | 7 |
| 54 | 9.7681735 | 9.9085073 | 9.8596661 | 10.1403339 | 10.0914927 | 10.2318265 | 6 |
| 55 | 9.7683480 | 9.9084159 | 9.8599321 | 10.1400679 | 10.0915841 | 10.2316520 | 5 |
| 56 | 9.7685223 | 9.9083243 | 9.8601980 | 10.1398020 | 10.0916757 | 10.2314777 | 4 |
| 57 | 9.7686966 | 9.9082327 | 9.8604638 | 10.1395362 | 10.0917673 | 10.2313034 | 3 |
| 58 | 9.7688707 | 9.9081411 | 9.8607296 | 10.1392704 | 10.0918589 | 10.2311293 | 2 |
| 59 | 9.7690448 | 9.9080494 | 9.8609954 | 10.1390046 | 10.0919506 | 10.2309553 | 1 |
| 60 | 9.7692187 | 9.9089576 | 9.8612610 | 10.1387390 | 10.0920424 | 10.2307813 | 0 |
| | *L. Co-Sine.* | *L Sine.* | *L. Co-Tang.* | *L. Tangent.* | *L. Co-Secant* | *L. Secant.* | M |

54 DEGREES.

36 DEGREES

| M | N. Sine | N.Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant | NCo-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 5877853 | 8090170 | 7265426 | 13763819 | 12300680 | 17013015 | 60 |
| 1 | 5880206 | 8088460 | 7269871 | 13755403 | 12363294 | 17006205 | 59 |
| 2 | 5882558 | 8086749 | 7274318 | 13746994 | 12365909 | 16999407 | 58 |
| 3 | 5884910 | 8085037 | 7278767 | 13738591 | 12368526 | 16992612 | 57 |
| 4 | 5887262 | 8083325 | 7283218 | 13730195 | 12371148 | 16985825 | 56 |
| 5 | 5889613 | 8081612 | 7287671 | 13721805 | 12373768 | 16979044 | 55 |
| 6 | 5891964 | 8079899 | 7292126 | 13713422 | 12376393 | 16972271 | 54 |
| 7 | 5894314 | 8078185 | 7296582 | 13705047 | 12379019 | 16965504 | 53 |
| 8 | 5896663 | 8076470 | 7301040 | 13696678 | 12381647 | 16958743 | 52 |
| 9 | 5899012 | 8074754 | 7305501 | 13688315 | 12384278 | 16951990 | 51 |
| 10 | 5901361 | 8073038 | 7309963 | 13679959 | 12386911 | 16945244 | 50 |
| 11 | 5903709 | 8071321 | 7314427 | 13671610 | 12389546 | 16938504 | 49 |
| 12 | 5906057 | 8069603 | 7318894 | 13663267 | 12392183 | 16931771 | 48 |
| 13 | 5908404 | 8067885 | 7323362 | 13654931 | 12394822 | 16925045 | 47 |
| 14 | 5910750 | 8066166 | 7327831 | 13646602 | 12397464 | 16918326 | 46 |
| 15 | 5913096 | 8064446 | 7332303 | 13638279 | 12400108 | 16911613 | 45 |
| 16 | 5915442 | 8062726 | 7336777 | 13629963 | 12402754 | 16904907 | 44 |
| 17 | 5917787 | 8061005 | 7341253 | 13621653 | 12405402 | 16898208 | 43 |
| 18 | 5920132 | 8059283 | 7345730 | 13613350 | 12408052 | 16891516 | 42 |
| 19 | 5922476 | 8057560 | 7350210 | 13605054 | 12410704 | 16884830 | 41 |
| 20 | 5924819 | 8055837 | 7354691 | 13596764 | 12413359 | 16878151 | 40 |
| 21 | 5927162 | 8054113 | 7359174 | 13588481 | 12416016 | 16871479 | 39 |
| 22 | 5929505 | 8052389 | 7363660 | 13580204 | 12418675 | 16864814 | 38 |
| 23 | 5931847 | 8050664 | 7368147 | 13571934 | 12421336 | 16858155 | 37 |
| 24 | 6934189 | 8048938 | 7372636 | 13563670 | 12423999 | 16851503 | 36 |
| 25 | 5936530 | 8047211 | 7377127 | 13555413 | 12426665 | 16844857 | 35 |
| 26 | 5938871 | 8045484 | 7381620 | 13547162 | 12429333 | 16838218 | 34 |
| 27 | 5941211 | 8043756 | 7386115 | 13538918 | 12432003 | 16831586 | 33 |
| 28 | 5943550 | 8042028 | 7390611 | 13530680 | 12434675 | 16824961 | 32 |
| 29 | 5945889 | 8040299 | 7395110 | 13522449 | 12437349 | 16818342 | 31 |
| 30 | 5948228 | 8038569 | 7399611 | 13514224 | 12440026 | 16811730 | 30 |
| 31 | 5950566 | 8036838 | 7404114 | 13506006 | 12442705 | 16805124 | 29 |
| 32 | 5952903 | 8035107 | 7408618 | 13497794 | 12445386 | 16798525 | 28 |
| 33 | 5955240 | 8033375 | 7413124 | 13489589 | 12448069 | 16791933 | 27 |
| 34 | 5957577 | 8031642 | 7417633 | 13481390 | 12450754 | 16785347 | 26 |
| 35 | 5959913 | 8029909 | 7422143 | 13473197 | 12453442 | 16778768 | 25 |
| 36 | 5962249 | 8028175 | 7426655 | 13465011 | 12456131 | 16772195 | 24 |
| 37 | 5964584 | 8026440 | 7431170 | 13456832 | 12458823 | 16765629 | 23 |
| 38 | 5966918 | 8024705 | 7435686 | 13448658 | 12461518 | 16759070 | 22 |
| 39 | 5969252 | 8022969 | 7440204 | 13440492 | 12464214 | 16752517 | 21 |
| 40 | 5971586 | 8021232 | 7444724 | 13432331 | 12466913 | 16745970 | 20 |
| 41 | 5973919 | 8019494 | 7449246 | 13424177 | 12469614 | 16739430 | 19 |
| 42 | 5976251 | 8017756 | 7453770 | 13416029 | 12472317 | 16732897 | 18 |
| 43 | 5978583 | 8016017 | 7458296 | 13407888 | 12475022 | 16726370 | 17 |
| 44 | 5980915 | 8014278 | 7462824 | 13399753 | 12477730 | 16719850 | 16 |
| 45 | 5983246 | 8012538 | 7467354 | 13391624 | 12480440 | 16713336 | 15 |
| 46 | 5985576 | 8010797 | 7471886 | 13383502 | 12483152 | 16706828 | 14 |
| 47 | 5987906 | 8009056 | 7476420 | 13375386 | 12485866 | 16700328 | 13 |
| 48 | 5990236 | 8007314 | 7480956 | 13367276 | 12488583 | 16693833 | 12 |
| 49 | 5992565 | 8005571 | 7485494 | 13359172 | 12491302 | 16687345 | 11 |
| 50 | 5994893 | 8003827 | 7490033 | 13351075 | 12494023 | 16680864 | 10 |
| 51 | 5997221 | 8002083 | 7494575 | 13342984 | 12496746 | 16674389 | 9 |
| 52 | 5999549 | 8000338 | 7499119 | 13334900 | 12499471 | 16667920 | 8 |
| 53 | 6001876 | 7998593 | 7503665 | 13326822 | 12502199 | 16661458 | 7 |
| 54 | 6004202 | 7996847 | 7508212 | 13318749 | 12504929 | 16655002 | 6 |
| 55 | 6006528 | 7995100 | 7512762 | 13310684 | 12507661 | 16648552 | 5 |
| 56 | 6008853 | 7993352 | 7517314 | 13302624 | 12510396 | 16642109 | 4 |
| 57 | 6011178 | 7991604 | 7521867 | 13294571 | 12513133 | 16635673 | 3 |
| 58 | 6013503 | 7989855 | 7526423 | 13286524 | 12515872 | 16629243 | 2 |
| 59 | 6015827 | 7988105 | 7530981 | 13278483 | 12518513 | 16622819 | 1 |
| 60 | 6018150 | 7986355 | 7535540 | 13270448 | 12521357 | 16616401 | 0 |
| | N Co-Sine. | N. Sine. | N. Co Tang | N. Tangent. | N. Co-Secant. | N. Secant | M |

53 DEGREES.

36 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co.Tang.* | *L. Secant.* | *L Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7692187 | 9.9079576 | 9.8612610 | 10.1387390 | 10.0920424 | 10.2307813 | 60 |
| 1 | 9.7693925 | 9.9078658 | 9.8615267 | 10.1384733 | 10.0921342 | 10.2306075 | 59 |
| 2 | 9.7695662 | 9.9077740 | 9.8617923 | 10.1382077 | 10.0922260 | 10.2304338 | 58 |
| 3 | 9.7697398 | 9.9076820 | 9.8620578 | 10.1379422 | 10.0923180 | 10.2302602 | 57 |
| 4 | 9.7699134 | 9.9075901 | 9.8623233 | 10.1376767 | 10.0924099 | 10.2300866 | 56 |
| 5 | 9.7700868 | 9.9074980 | 9.8625887 | 10.1374113 | 10.0925020 | 10.2299130 | 55 |
| 6 | 9.7702601 | 9.9074059 | 9.8628541 | 10.1371459 | 10.0925941 | 10.2297399 | 54 |
| 7 | 9.7704332 | 9.9073138 | 9.8631195 | 10.1368805 | 10.0926862 | 10.2295668 | 53 |
| 8 | 9.7706063 | 9.9072216 | 9.8633848 | 10.1366152 | 10.0927784 | 10.2293937 | 52 |
| 9 | 9.7707793 | 9.9071293 | 9.8636500 | 10.1363500 | 10.0928707 | 10.2292207 | 51 |
| 10 | 9.7709522 | 9.9070370 | 9.8639152 | 10.1360848 | 10.0929630 | 10.2290478 | 50 |
| 11 | 9.7711249 | 9.9069446 | 9.8641803 | 10.1358197 | 10.0930554 | 10.2288751 | 49 |
| 12 | 9.7712976 | 9.9068522 | 9.8644454 | 10.1355546 | 10.0931478 | 10.2287024 | 48 |
| 13 | 9.7714702 | 9.9067597 | 9.8647105 | 10.1352895 | 10.0932403 | 10.2285298 | 47 |
| 14 | 9.7716426 | 9.9066671 | 9.8649755 | 10.1350245 | 10.0933329 | 10.2283574 | 46 |
| 15 | 9.7718150 | 9.9065745 | 9.8652404 | 10.1347596 | 10.0934255 | 10.2281850 | 45 |
| 16 | 9.7719872 | 9.9064819 | 9.8655053 | 10.1344947 | 10.0935181 | 10.2280128 | 44 |
| 17 | 9.7721593 | 9.9063892 | 9.8657702 | 10.1342298 | 10.0936108 | 10.2278407 | 43 |
| 18 | 9.7723314 | 9.9062964 | 9.8660350 | 10.1339650 | 10.0937036 | 10.2276686 | 42 |
| 19 | 9.7725033 | 9.9062036 | 9.8662997 | 10.1337003 | 10.0937964 | 10.2274967 | 41 |
| 20 | 9.7726751 | 9.9061107 | 9.8665644 | 10.1334356 | 10.0938893 | 10.2273249 | 40 |
| 21 | 9.7728468 | 9.9060177 | 9.8668291 | 10.1331709 | 10.0939823 | 10.2271532 | 39 |
| 22 | 9.7730185 | 9.9059247 | 9.8670937 | 10.1329063 | 10.0940753 | 10.2269815 | 38 |
| 23 | 9.7731990 | 9.9058317 | 9.8673583 | 10.1326417 | 10.0941683 | 10.2268100 | 37 |
| 24 | 9.7733614 | 9.9057386 | 9.8676228 | 10.1323772 | 10.0942614 | 10.2266386 | 36 |
| 25 | 9.7735327 | 9.9056454 | 9.8678873 | 10.1321127 | 10.0943546 | 10.2264673 | 35 |
| 26 | 9.7737039 | 9.9055522 | 9.8681517 | 10.1318483 | 10.0944478 | 10.2262961 | 34 |
| 27 | 9.7738749 | 9.9054589 | 9.8684160 | 10.1315840 | 10.0945411 | 10.2261251 | 33 |
| 28 | 9.7740459 | 9.9053656 | 9.8686804 | 10.1313196 | 10.0946344 | 10.2259541 | 32 |
| 29 | 9.7742168 | 9.9052722 | 9.8689446 | 10.1310554 | 10.0947278 | 10.2257832 | 31 |
| 30 | 9.7743876 | 9.9051787 | 9.8692089 | 10.1307911 | 10.0948213 | 10.2256124 | 30 |
| 31 | 9.7745583 | 9.9050852 | 9.8694731 | 10.1305269 | 10.0949148 | 10.2254417 | 29 |
| 32 | 9.7747288 | 9.9049916 | 9.8697372 | 10.1302628 | 10.0950084 | 10.2252712 | 28 |
| 33 | 9.7748993 | 9.9048980 | 9.8700013 | 10.1299987 | 10.0951020 | 10.2251007 | 27 |
| 34 | 9.7750697 | 9.9048043 | 9.8702653 | 10.1297347 | 10.0951957 | 10.2249303 | 26 |
| 35 | 9.7752399 | 9.9047106 | 9.8705293 | 10.1294707 | 10.0952894 | 10.2247601 | 25 |
| 36 | 9.7754101 | 9.9046168 | 9.8707933 | 10.1292067 | 10.0953832 | 10.2245899 | 24 |
| 37 | 9.7755801 | 9.9045230 | 9.8710572 | 10.1289428 | 10.0954770 | 10.2244199 | 23 |
| 38 | 9.7757501 | 9.9044291 | 9.8713210 | 10.1286790 | 10.0955709 | 10.2242499 | 22 |
| 39 | 9.7759199 | 9.9043351 | 9.8715848 | 10.1284152 | 10.0956649 | 10.2240801 | 21 |
| 40 | 9.7760897 | 9.9042411 | 9.8718486 | 10.1281514 | 10.0957589 | 10.2239103 | 20 |
| 41 | 9.7762593 | 9.9041470 | 9.8721123 | 10.1278877 | 10.0958530 | 10.2237407 | 19 |
| 42 | 9.7764289 | 9.9040529 | 9.8723760 | 10.1276240 | 10.0959471 | 10.2235711 | 18 |
| 43 | 9.7765983 | 9.9039587 | 9.8726396 | 10.1273604 | 10.0960413 | 10.2234017 | 17 |
| 44 | 9.7767676 | 9.9038644 | 9.8729032 | 10.1270968 | 10.0961356 | 10.2232324 | 16 |
| 45 | 9.7769369 | 9.9037701 | 9.8731668 | 10.1268332 | 10.0962299 | 10.2230631 | 15 |
| 46 | 9.7771060 | 9.9036757 | 9.8734332 | 10.1265698 | 10.0963243 | 10.2228940 | 14 |
| 47 | 9.7772750 | 9.9035813 | 9.8736937 | 10.1263063 | 10.0964187 | 10.2227250 | 13 |
| 48 | 9.7774439 | 9.9034868 | 9.8739571 | 10.1260429 | 10.0965132 | 10.2225561 | 12 |
| 49 | 9.7776128 | 9.9033923 | 9.8742204 | 10.1257796 | 10.0966077 | 10.2223872 | 11 |
| 50 | 9.7777815 | 9.9032977 | 9.8744838 | 10.1255162 | 10.0967023 | 10.2222185 | 10 |
| 51 | 9.7779501 | 9.9032030 | 9.8747470 | 10.1252530 | 10.0967969 | 10.2220499 | 9 |
| 52 | 9.7781186 | 9.9031084 | 9.8750102 | 10.1249898 | 10.0968916 | 10.2218814 | 8 |
| 53 | 9.7782870 | 9.9030136 | 9.8752734 | 10.1247266 | 10.0969864 | 10.2217130 | 7 |
| 54 | 9.7784553 | 9.9029188 | 9.8755365 | 10.1244635 | 10.0970812 | 10.2215447 | 6 |
| 55 | 9.7786235 | 9.9028239 | 9.8757996 | 10.1242004 | 10.0971761 | 10.2213756 | 5 |
| 56 | 9.7787916 | 9.9027289 | 9.8760627 | 10.1239373 | 10.0972711 | 10.2212084 | 4 |
| 57 | 9.7789596 | 9.9026339 | 9.8763257 | 10.1236743 | 10.0973661 | 10.2210404 | 3 |
| 58 | 9.7791275 | 9.9025389 | 9.8765886 | 10.1234114 | 10.0974611 | 10.2208725 | 2 |
| 59 | 9.7792953 | 9.9024438 | 9.8768515 | 10.1231485 | 10.0975562 | 10.2207047 | 1 |
| 60 | 9.7794630 | 9.9023486 | 9.8771144 | 10.1228856 | 10.0976514 | 10.2205370 | 0 |
| | *L. Co-Sine* | *L. Sine* | *L. Co-Tang.* | *L. Tangent* | *L.Co-Secant* | *L. Secant.* | M |

53 DEGREES.

37 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6018150 | 7986355 | 7535540 | 13270418 | 12521357 | 16016401 | 60 |
| 1 | 6020473 | 7984604 | 7540102 | 13262420 | 12524102 | 16609990 | 59 |
| 2 | 6022795 | 7982852 | 7544666 | 13254397 | 12526850 | 16603585 | 58 |
| 3 | 6025117 | 7981100 | 7549232 | 13246381 | 12539601 | 16597187 | 57 |
| 4 | 6027439 | 7979347 | 7553799 | 13238371 | 12532353 | 16590795 | 56 |
| 5 | 6029760 | 7977593 | 7558569 | 13230368 | 12535108 | 16584409 | 55 |
| 6 | 6032080 | 7975839 | 7562941 | 13222370 | 12537865 | 16578030 | 54 |
| 7 | 6034400 | 7974084 | 7567514 | 13214379 | 12540625 | 16571657 | 53 |
| 8 | 6036719 | 7972328 | 7572090 | 13206393 | 12543387 | 16565290 | 52 |
| 9 | 6039038 | 7970572 | 7576668 | 13198414 | 12546151 | 16558929 | 51 |
| 10 | 6041356 | 7968815 | 7581248 | 13190441 | 12548917 | 16552575 | 50 |
| 11 | 6043674 | 7967057 | 7585824 | 13182471 | 12551685 | 16546227 | 49 |
| 12 | 6045991 | 7965299 | 7590413 | 13174513 | 12554456 | 16539885 | 48 |
| 13 | 6048308 | 7963540 | 7594999 | 13166559 | 12557229 | 16533550 | 47 |
| 14 | 6050624 | 7961780 | 7599587 | 13158610 | 12560005 | 16527221 | 46 |
| 15 | 6052940 | 7960020 | 7604177 | 13150668 | 12562782 | 16520898 | 45 |
| 16 | 6055255 | 7958259 | 7608769 | 13142731 | 12565562 | 16514581 | 44 |
| 17 | 6057570 | 7956497 | 7613363 | 13134801 | 12568345 | 16508270 | 43 |
| 18 | 6059884 | 7954735 | 7617959 | 13126876 | 12571129 | 16501966 | 42 |
| 19 | 6062198 | 7952972 | 7622557 | 13118958 | 12573916 | 15495668 | 41 |
| 20 | 6064511 | 7951208 | 7627157 | 13111046 | 12576705 | 16489376 | 40 |
| 21 | 6066823 | 7949443 | 7631759 | 13103140 | 12579497 | 16483090 | 39 |
| 22 | 6069135 | 7947678 | 7636363 | 13095239 | 12582291 | 16476811 | 38 |
| 23 | 6071447 | 7945912 | 7640969 | 13087345 | 12585087 | 16470537 | 37 |
| 24 | 6073758 | 7944146 | 7645577 | 13079457 | 12587885 | 16464270 | 36 |
| 25 | 6076069 | 7942379 | 7650188 | 13071575 | 12590686 | 16458009 | 35 |
| 26 | 6078379 | 7940611 | 7654800 | 13063699 | 12593489 | 16451754 | 34 |
| 27 | 6080689 | 7938843 | 7659414 | 13055828 | 12596294 | 16445506 | 33 |
| 28 | 6082998 | 7937074 | 7664031 | 13047964 | 12599102 | 16439263 | 32 |
| 29 | 6085306 | 7935304 | 7668649 | 13040106 | 12601912 | 16433027 | 31 |
| 30 | 6087614 | 7933533 | 7673270 | 13032254 | 12604724 | 16426796 | 30 |
| 31 | 6089922 | 7931762 | 7677893 | 13024407 | 12607539 | 16420572 | 29 |
| 32 | 6092229 | 7929990 | 7682517 | 13016567 | 12610356 | 16414354 | 28 |
| 33 | 6094535 | 7928218 | 7687144 | 13008732 | 12613175 | 16408142 | 27 |
| 34 | 6096841 | 7926445 | 7691773 | 13000904 | 12615997 | 16401936 | 26 |
| 35 | 6099147 | 7924671 | 7696404 | 12993081 | 12618820 | 16395736 | 25 |
| 36 | 6101452 | 7922896 | 7701037 | 12985265 | 12621646 | 16389542 | 24 |
| 37 | 6103756 | 7921121 | 7705672 | 12977454 | 12624475 | 19383355 | 23 |
| 38 | 6106060 | 7919345 | 7710309 | 12969649 | 12627306 | 16377173 | 22 |
| 39 | 6108363 | 7917569 | 7714948 | 12961850 | 12630140 | 16370997 | 21 |
| 40 | 6110666 | 7915792 | 7719589 | 12954057 | 12932975 | 16364828 | 20 |
| 41 | 6112968 | 7914014 | 7724233 | 12946269 | 12635813 | 16358664 | 19 |
| 42 | 6115270 | 7912235 | 7728879 | 12938483 | 12638653 | 16352507 | 18 |
| 43 | 6117572 | 7910456 | 7733526 | 12930712 | 12641496 | 16346355 | 17 |
| 44 | 6119873 | 7908676 | 7738175 | 12922943 | 12644341 | 16340210 | 16 |
| 45 | 6122173 | 7906896 | 7742827 | 12915179 | 12647188 | 16334070 | 15 |
| 46 | 6124473 | 7905115 | 7747481 | 12907421 | 12650037 | 16327937 | 14 |
| 47 | 6126772 | 7903333 | 7752137 | 12898629 | 12652890 | 16321809 | 13 |
| 48 | 6129071 | 7901550 | 7756795 | 12891922 | 12655745 | 16315688 | 12 |
| 49 | 6131369 | 7899767 | 7761455 | 12884182 | 12658601 | 16309572 | 11 |
| 50 | 6133666 | 7897983 | 7766117 | 12876447 | 12661460 | 16303462 | 10 |
| 51 | 6135963 | 7896198 | 7770782 | 12868718 | 12664322 | 16297359 | 9 |
| 52 | 6138260 | 7894413 | 7775448 | 12860995 | 12667186 | 16291261 | 8 |
| 53 | 6140556 | 7892627 | 7780117 | 12853277 | 12670052 | 16285169 | 7 |
| 54 | 6142852 | 7890841 | 7784788 | 12845565 | 12672021 | 16279083 | 6 |
| 55 | 6145147 | 7889054 | 7789460 | 12837860 | 12675792 | 16273003 | 5 |
| 56 | 6147442 | 7887266 | 7794135 | 12830160 | 12678665 | 16266929 | 4 |
| 57 | 6149736 | 7885477 | 7798812 | 12822466 | 12681541 | 16260861 | 3 |
| 58 | 6152029 | 7883688 | 7803492 | 12814776 | 12684419 | 16254799 | 2 |
| 59 | 6154322 | 7881898 | 7808173 | 12807093 | 12687299 | 16248743 | 1 |
| 60 | 6156615 | 7880107 | 7812856 | 12799416 | 12690182 | 16242692 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. CoSecant. | N. Secant. | M |

52 DEGREES.

37 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co. Tang.* | *L. Secant.* | *L Co-Secant* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7794630 | 9.9023486 | 9.8771144 | 10.1228856 | 10.0976514 | 10.2205370 | 60 |
| 1 | 9.7796306 | 9.9022534 | 9.8773772 | 10.1226228 | 10.0977466 | 10.2203694 | 59 |
| 2 | 9.7797981 | 9.9021581 | 9.8776400 | 10.1223600 | 10.0978419 | 10.2201019 | 58 |
| 3 | 9.7799655 | 9.9020628 | 9.8779027 | 10.1220973 | 10.0979372 | 10.2200345 | 57 |
| 4 | 9.7801328 | 9.9019674 | 9.8781654 | 10.1218346 | 10.0980326 | 10.2198672 | 56 |
| 5 | 9.7803000 | 9.9018719 | 9.8784281 | 10.1215719 | 10.0981281 | 10.2197000 | 55 |
| 6 | 9.7804671 | 9.9017764 | 9.8786907 | 10.1213093 | 10.0982236 | 10.2195329 | 54 |
| 7 | 9.7806341 | 9.9016808 | 9.8789533 | 10.1210467 | 10.0983192 | 10.2193659 | 53 |
| 8 | 9.7808010 | 9.9015852 | 9.8792158 | 10.1207842 | 10.0984148 | 10.2191990 | 52 |
| 9 | 9.7809677 | 9.9014895 | 9.8794782 | 10.1205218 | 10.0985105 | 10.2190323 | 51 |
| 10 | 9.7811344 | 9.9013938 | 9.8797407 | 10.1202593 | 10.0986062 | 10.2188656 | 50 |
| 11 | 9.7813010 | 9.9012980 | 9.8800031 | 10.1199969 | 10.0987020 | 10.2186990 | 49 |
| 12 | 9.7814675 | 9.9012021 | 9.8802654 | 10.1197346 | 10.0987979 | 10.2185325 | 48 |
| 13 | 9.7816339 | 9.9011062 | 9.8805277 | 10.1194723 | 10.0988938 | 10.2183661 | 47 |
| 14 | 9.7818002 | 9.9010102 | 9.8807900 | 10.1192100 | 10.0989898 | 10.2181998 | 46 |
| 15 | 9.7819664 | 9.9009142 | 9.8810522 | 10.1189478 | 10.0990858 | 10.2180336 | 45 |
| 16 | 9.7821324 | 9.9008181 | 9.8813144 | 10.1186856 | 10.0991819 | 10.2178676 | 44 |
| 17 | 9.7822984 | 9.9007219 | 9.8815765 | 10.1184235 | 10.0992781 | 10.2177016 | 43 |
| 18 | 9.7824643 | 9.9006257 | 9.8818386 | 10.1181614 | 10.0993743 | 10.2175357 | 42 |
| 19 | 9.7826301 | 9.9005294 | 9.8821007 | 10.1178993 | 10.0994708 | 10.2173699 | 41 |
| 20 | 9.7827958 | 9.9004331 | 9.8823627 | 10.1176373 | 10.0995669 | 10.2172042 | 40 |
| 21 | 9.7829614 | 9.9003367 | 9.8826246 | 10.1173754 | 10.0996633 | 10.2170386 | 39 |
| 22 | 9.7831268 | 9.9002403 | 9.8828866 | 10.1171134 | 10.0997597 | 10.2168732 | 38 |
| 23 | 9.7832922 | 9.9001438 | 9.8831484 | 10.1168516 | 10.0998562 | 10.2167078 | 37 |
| 24 | 9.7834575 | 9.9000472 | 9.8834103 | 10.1165897 | 10.0999528 | 10.2165425 | 36 |
| 25 | 9.7836227 | 9.8999506 | 9.8836721 | 10.1163279 | 10.1000494 | 10.2163773 | 35 |
| 26 | 9.7837878 | 9.8998539 | 9.8839338 | 10.1160662 | 10.1001461 | 10.2162122 | 34 |
| 27 | 9.7839528 | 9.8997572 | 9.8841956 | 10.1158044 | 10.1002428 | 10.2160472 | 33 |
| 28 | 9.7841177 | 9.8996604 | 9.8844572 | 10.1155428 | 10.1003396 | 10.2158823 | 32 |
| 29 | 9.7842824 | 9.8995636 | 9.8847189 | 10.1152811 | 10.1004364 | 10.2157176 | 31 |
| 30 | 9.7844471 | 9.8994667 | 9.8849805 | 10.1150195 | 10.1005333 | 10.2155529 | 30 |
| 31 | 9.7846117 | 9.8993697 | 9.8852420 | 10.1147580 | 10.1006303 | 10.2153883 | 29 |
| 32 | 9.7847762 | 9.8992727 | 9.8855035 | 10.1144965 | 10.1007273 | 10.2152238 | 28 |
| 33 | 9.7849406 | 9.8991756 | 9.8857650 | 10.1142350 | 10.1008244 | 10.2150594 | 27 |
| 34 | 9.7851049 | 9.8990784 | 9.8860264 | 10.1139736 | 10.1009216 | 10.2148951 | 26 |
| 35 | 9.7852691 | 9.8989812 | 9.8862878 | 10.1137122 | 10.1010188 | 10.2147309 | 25 |
| 36 | 9.7854232 | 9.8988840 | 9.8865492 | 10.1134508 | 10.1011160 | 10.2145668 | 24 |
| 37 | 9.7855972 | 9.8987867 | 9.8868105 | 10.1131895 | 10.1012133 | 10.2144023 | 23 |
| 38 | 9.7857611 | 9.8986893 | 9.8870718 | 10.1129282 | 10.1013107 | 10.2142389 | 22 |
| 39 | 9.7859249 | 9.8985919 | 9.8873330 | 10.1126670 | 10.1014081 | 10.2140752 | 21 |
| 40 | 9.7860886 | 9.8984944 | 9.8875942 | 10.1124058 | 10.1015056 | 10.2139114 | 20 |
| 41 | 9.7862522 | 9.8983968 | 9.8878554 | 10.1121446 | 10.1016032 | 10.2137478 | 19 |
| 42 | 9.7864157 | 9.8982992 | 9.8881165 | 10.1118835 | 10.1017008 | 10.2135843 | 18 |
| 43 | 9.7865791 | 9.8982015 | 9.8883775 | 10.1116225 | 10.1017985 | 10.2134209 | 17 |
| 44 | 9.7867424 | 9.8981038 | 9.8886386 | 10.1113614 | 10.1018962 | 10.2132576 | 16 |
| 45 | 9.7869056 | 9.8980060 | 9.8888996 | 10.1111004 | 10.1019940 | 10.2130944 | 15 |
| 46 | 9.7870687 | 9.8979082 | 9.8891605 | 10.1108395 | 10.1020918 | 10.2129313 | 14 |
| 47 | 9.7872317 | 9.8978103 | 9.8894214 | 10.1105786 | 10.1021897 | 10.2127683 | 13 |
| 48 | 9.7873946 | 9.8977123 | 9.8896823 | 10.1103177 | 10.1022877 | 10.2126054 | 12 |
| 49 | 9.7875574 | 9.8976143 | 9.8899432 | 10.1100568 | 10.1023857 | 10.2124426 | 11 |
| 50 | 9.7877202 | 9.8975162 | 9.8902040 | 10.1097960 | 10.1024838 | 10.2122798 | 10 |
| 51 | 9.7878828 | 9.8974181 | 9.8904647 | 10.1095353 | 10.1025819 | 10.2121172 | 9 |
| 52 | 9.7880453 | 9.8973199 | 9.8907254 | 10.1092746 | 10.1026801 | 10.2119547 | 8 |
| 53 | 9.7882077 | 9.8972216 | 9.8909861 | 10.1090139 | 10.1027784 | 10.2117923 | 7 |
| 54 | 9.7883701 | 9.8971233 | 9.8912468 | 10.1087532 | 10.1028767 | 10.2116299 | 6 |
| 55 | 9.7885323 | 9.8970249 | 9.8915074 | 10.1084926 | 10.1029751 | 10.2114677 | 5 |
| 56 | 9.7886944 | 9.8969265 | 9.8917679 | 10.1082321 | 10.1030735 | 10.2113056 | 4 |
| 57 | 9.7888565 | 9.8968280 | 9.8920285 | 10.1079715 | 10.1031720 | 10.2111435 | 3 |
| 58 | 9.7890184 | 9.8967294 | 9.8922890 | 10.1077110 | 10.1032706 | 10.2109816 | 2 |
| 59 | 9.7891802 | 9.8966308 | 9.8925495 | 10.1074505 | 10.1033692 | 10.2108198 | 1 |
| 60 | 9.7893420 | 9.8965321 | 9.8928099 | 10.1071902 | 10.1034679 | 10.2106580 | 0 |
| | *L Co-Sine* | *L. Sine* | *L. Co-Tang.* | *L Tangent* | *L. Co-Secant* | *L. Secant.* | M |

52 DEGREES.

38 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6156615 | 7880107 | 7812856 | 12799416 | 12690182 | 16242692 | 60 |
| 1 | 6158967 | 7878316 | 7817542 | 12791745 | 12693067 | 16236648 | 59 |
| 2 | 6161198 | 7876523 | 7822229 | 12784079 | 12695955 | 16230609 | 58 |
| 3 | 6163489 | 7874732 | 7826919 | 12776419 | 12698845 | 16224576 | 57 |
| 4 | 6165779 | 7872939 | 7831611 | 12768764 | 12701737 | 16218549 | 56 |
| 5 | 6168069 | 7871145 | 7836305 | 12761116 | 12704632 | 16212528 | 55 |
| 6 | 6170359 | 7869350 | 7841002 | 12753473 | 12707529 | 16206513 | 54 |
| 7 | 6172648 | 7867555 | 7845700 | 12745836 | 12710429 | 16200504 | 53 |
| 8 | 6174936 | 7865759 | 7850400 | 12738204 | 12713331 | 16194500 | 52 |
| 9 | 6177224 | 7863962 | 7855103 | 12730578 | 12716235 | 16188502 | 51 |
| 10 | 6179511 | 7862165 | 7859808 | 12722957 | 12719142 | 16182510 | 50 |
| 11 | 6181798 | 7860367 | 7864515 | 12715342 | 12722051 | 16176524 | 49 |
| 12 | 6184084 | 7858569 | 7869224 | 12707733 | 12724963 | 16170544 | 48 |
| 13 | 6186370 | 7856770 | 7873935 | 12700130 | 12727877 | 16164569 | 47 |
| 14 | 6188655 | 7854970 | 7878649 | 12692532 | 12730794 | 16158600 | 46 |
| 15 | 6190940 | 7853169 | 7883364 | 12684939 | 12733712 | 16152637 | 45 |
| 16 | 6193224 | 7851368 | 7888082 | 12677353 | 12736634 | 16146680 | 44 |
| 17 | 6195507 | 7849566 | 7892802 | 12669772 | 12739557 | 16140728 | 43 |
| 18 | 6197790 | 7847764 | 7897524 | 12662196 | 12742484 | 16134783 | 42 |
| 19 | 6200073 | 7845961 | 7902248 | 12654626 | 12745412 | 16128843 | 41 |
| 20 | 6202355 | 7844157 | 7906975 | 12647062 | 12748343 | 16122908 | 40 |
| 21 | 6204636 | 7842352 | 7911703 | 12639503 | 12751276 | 16116980 | 39 |
| 22 | 6206917 | 7840547 | 7916434 | 12631950 | 12754212 | 16111057 | 38 |
| 23 | 6209198 | 7838741 | 7921167 | 12624402 | 12757150 | 16105140 | 37 |
| 24 | 6211478 | 7836935 | 7925902 | 12615860 | 12760091 | 16099228 | 36 |
| 25 | 6213757 | 7835128 | 7930640 | 12609323 | 12763034 | 16093323 | 35 |
| 26 | 6216036 | 7833320 | 7935379 | 12601792 | 12765980 | 16087423 | 34 |
| 27 | 6218314 | 7831511 | 7940121 | 12594267 | 12768928 | 16081528 | 33 |
| 28 | 6220592 | 7829702 | 7944865 | 12586747 | 12771878 | 16075640 | 32 |
| 29 | 6222869 | 7827892 | 7949611 | 12579232 | 12774831 | 16069757 | 31 |
| 30 | 6225146 | 7826082 | 7954359 | 12571723 | 12777787 | 16063879 | 30 |
| 31 | 6227422 | 7824271 | 7959110 | 12564219 | 12780745 | 16058008 | 29 |
| 32 | 6229698 | 7822459 | 7963862 | 12556721 | 12783705 | 16052142 | 28 |
| 33 | 6231973 | 7820646 | 7968617 | 12549229 | 12786667 | 16046281 | 27 |
| 34 | 6234248 | 7818833 | 7973374 | 12541742 | 12789632 | 16040426 | 26 |
| 35 | 6236522 | 7817019 | 7978134 | 12534260 | 12792600 | 16034577 | 25 |
| 36 | 6238796 | 7815205 | 7982895 | 12526784 | 12795570 | 16028734 | 24 |
| 37 | 6241069 | 7813390 | 7987659 | 12519313 | 12798543 | 16022896 | 23 |
| 38 | 6243342 | 7811574 | 7992425 | 12511848 | 12801518 | 16017064 | 22 |
| 39 | 6245614 | 7809757 | 7997193 | 12504388 | 12804495 | 16011237 | 21 |
| 40 | 6247885 | 7807940 | 8001963 | 12496932 | 12807475 | 16005416 | 20 |
| 41 | 6250156 | 7806122 | 8006736 | 12481484 | 12810457 | 15999600 | 19 |
| 42 | 6252426 | 7804304 | 8011511 | 12482040 | 12813442 | 15993790 | 18 |
| 43 | 6254696 | 7802485 | 8016288 | 12474602 | 12816430 | 15987986 | 17 |
| 44 | 6256966 | 7800665 | 8021067 | 12467169 | 12810420 | 15982187 | 16 |
| 45 | 6259235 | 7798845 | 8025848 | 12459742 | 12822412 | 15976394 | 15 |
| 46 | 6261503 | 7797024 | 8030632 | 12452320 | 12825407 | 15970606 | 14 |
| 47 | 6263771 | 7795202 | 8035418 | 12444903 | 12828404 | 15964824 | 13 |
| 48 | 6266038 | 7793380 | 8040206 | 12437492 | 12831404 | 15959047 | 12 |
| 49 | 6268305 | 7791557 | 8044997 | 12430086 | 12834406 | 15953276 | 11 |
| 50 | 6270571 | 7789733 | 8049790 | 12422685 | 12837411 | 15947511 | 10 |
| 51 | 6272837 | 7787908 | 8054585 | 12415290 | 12840418 | 15941751 | 9 |
| 52 | 6275102 | 7786083 | 8059382 | 12407900 | 12843428 | 15935996 | 8 |
| 53 | 6277366 | 7784257 | 8064181 | 12400515 | 12846440 | 15930247 | 7 |
| 54 | 6279630 | 7782431 | 8068983 | 12393136 | 12849455 | 15924504 | 6 |
| 55 | 6281894 | 7780604 | 8073787 | 12385762 | 12852472 | 15918766 | 5 |
| 56 | 6284157 | 7778777 | 8078593 | 12378393 | 12855492 | 15913033 | 4 |
| 57 | 6286420 | 7776949 | 8083401 | 12371030 | 12858514 | 15907306 | 3 |
| 58 | 6288682 | 7775120 | 8088212 | 12363672 | 12861539 | 15901584 | 2 |
| 59 | 6290943 | 7773290 | 8093025 | 12356319 | 12864566 | 15895868 | 1 |
| 60 | 6293204 | 7771460 | 8097840 | 12348972 | 12867596 | 15890157 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. CoSecant. | N. Secant. | M |

51 DEGREES.

38 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.7893420 | 9.8965321 | 9.8928098 | 10.1071902 | 10.1034679 | 10.2106580 | 60 |
| 1 | 9.7895036 | 9.8964334 | 9.8930702 | 10.1069298 | 10.1035666 | 10.2104964 | 59 |
| 2 | 9.7896652 | 9.8963346 | 9.8933306 | 10.1066694 | 10.1036654 | 10.2103348 | 58 |
| 3 | 9.7898266 | 9.8962358 | 9.8935909 | 10.1064091 | 10.1037642 | 10.2101734 | 57 |
| 4 | 9.7899880 | 9.8961369 | 9.8938511 | 10.1061489 | 10.1038631 | 10.2100120 | 56 |
| 5 | 9.7901493 | 9.8960379 | 9.8941114 | 10.1058886 | 10.1039621 | 10.2098507 | 55 |
| 6 | 9.7903104 | 9.8959389 | 9.8943715 | 10.1056285 | 10.1040611 | 10.2096896 | 54 |
| 7 | 9.7904715 | 9.8958398 | 9.8946317 | 10.1053683 | 10.1041602 | 10.2095285 | 53 |
| 8 | 9.7906325 | 9.8957406 | 9.8948918 | 10.1051082 | 10.1042594 | 10.2093675 | 52 |
| 9 | 9.7907933 | 9.8956414 | 9.8951519 | 10.1048481 | 10.1043586 | 10.2092067 | 51 |
| 10 | 9.7909541 | 9.8955422 | 9.8954119 | 10.1045881 | 10.1044578 | 10.2090459 | 50 |
| 11 | 9.7911148 | 9.8954429 | 9.8956719 | 10.1043281 | 10.1045572 | 10.2088852 | 49 |
| 12 | 9.7912754 | 9.2953435 | 9.8959319 | 10.1040681 | 10.1046565 | 10.2087246 | 48 |
| 13 | 9.7914359 | 9.8952440 | 9.8961918 | 10.1038082 | 10.1047560 | 10.2085641 | 47 |
| 14 | 9.7915963 | 9.8951445 | 9.8964517 | 10.1035483 | 10.1048555 | 10.2084037 | 46 |
| 15 | 9.7917566 | 9.8950450 | 9.8967116 | 10.1032884 | 10.1049550 | 10.2082434 | 45 |
| 16 | 9.7919168 | 9.8949453 | 9.8969714 | 10.1030286 | 10.1050547 | 10.2080832 | 44 |
| 17 | 9.7920769 | 9.8948457 | 9.8972312 | 10.1027688 | 10.1051543 | 10.2079231 | 43 |
| 18 | 9.7922369 | 9.8947459 | 9.8974910 | 10.1025090 | 10.1052541 | 10.2077631 | 42 |
| 19 | 9.7923968 | 9.8946461 | 9.8977507 | 10.1022493 | 10.1053539 | 10.2076032 | 41 |
| 20 | 9.7925560 | 9.8945463 | 9.8980104 | 10.1019896 | 10.1054537 | 10.2074434 | 40 |
| 21 | 9.7927163 | 9.8944461 | 9.8982700 | 10.1017300 | 10.1054537 | 10.2072837 | 39 |
| 22 | 9.7928760 | 9.8943464 | 9.8985296 | 10.1014704 | 10.1056536 | 10.2071240 | 38 |
| 23 | 9.7930355 | 9.8942463 | 9.8984892 | 10.1012108 | 10.1057537 | 10.2069645 | 37 |
| 24 | 9.7931949 | 9.8941462 | 9.8990487 | 10.1009513 | 10.1058538 | 10.2068051 | 36 |
| 25 | 9.7933543 | 9.8940461 | 9.8993082 | 10.1006918 | 10.1059539 | 10.2056457 | 35 |
| 26 | 9.7935135 | 9.8939458 | 9.8995677 | 10.1004323 | 10.1060542 | 10.2064865 | 34 |
| 27 | 9.7936727 | 9.8938456 | 9.8998271 | 10.1001729 | 10.1051544 | 10.2063273 | 33 |
| 28 | 9.7938317 | 9.8937452 | 9.9000865 | 10.0999135 | 10.1062548 | 10.2061683 | 32 |
| 29 | 9.7939907 | 9.8936448 | 9.9003459 | 10.0996541 | 10.1063552 | 10.2060093 | 31 |
| 30 | 9.7941496 | 9.8935444 | 9.9006052 | 10.0993948 | 10.1064556 | 10.2058504 | 30 |
| 31 | 9.7943083 | 9.8934439 | 9.9008645 | 10.0991355 | 10.1065561 | 10.2056917 | 29 |
| 32 | 9.7944670 | 9.8933433 | 9.9011237 | 10.0988763 | 10.1066567 | 10.2055330 | 28 |
| 33 | 9.7946250 | 9.8932426 | 9.9013830 | 10.0986170 | 10.1067574 | 10.2053744 | 27 |
| 34 | 9.7947841 | 9.8931419 | 9.9016422 | 10.0983578 | 10.1068581 | 10.2052159 | 26 |
| 35 | 9.7949425 | 9.8930412 | 9.9019013 | 10.0980987 | 10.1069588 | 10.2050575 | 25 |
| 36 | 9.7951008 | 9.8929404 | 9.9021604 | 10.0978396 | 10.1070596 | 10.2048992 | 24 |
| 37 | 9.7952590 | 9.8928395 | 9.9024195 | 10.0975805 | 10.1071605 | 10.2047410 | 23 |
| 38 | 9.7954171 | 9.8927385 | 9.9026786 | 10.0973214 | 10.1072615 | 10.2045829 | 22 |
| 39 | 9.7955751 | 9.8926375 | 9.9029376 | 10.0970624 | 10.1073625 | 10.2044249 | 21 |
| 40 | 9.7957330 | 9.8925365 | 9.9031966 | 10.0968034 | 10.1074635 | 10.2042670 | 20 |
| 41 | 9.7958909 | 9.8924354 | 9.9034555 | 10.0965445 | 10.1075646 | 10.2041091 | 19 |
| 42 | 9.7960486 | 9.8923342 | 9.9037144 | 10.0962856 | 10.1076658 | 10.2039514 | 18 |
| 43 | 9.7962062 | 9.8922329 | 9.9039733 | 10.0960267 | 10.1077671 | 10.2037638 | 17 |
| 44 | 9.7963638 | 9.8921316 | 9.9042321 | 10.0957679 | 10.1078684 | 10.2036362 | 16 |
| 45 | 9.7965212 | 9.8920303 | 9.9044910 | 10.0955090 | 10.1079697 | 10.2034788 | 15 |
| 46 | 9.7966786 | 9.8919289 | 9.9047497 | 10.0952503 | 10.1080711 | 10.2033214 | 14 |
| 47 | 9.7968359 | 9.8918274 | 9.9050085 | 10.0949915 | 10.1081726 | 10.2031641 | 13 |
| 48 | 9.7969930 | 9.8917258 | 9.9052672 | 10.0947328 | 10.1082742 | 10.2030070 | 12 |
| 49 | 9.7971501 | 9.8916242 | 9.9055259 | 10.0944741 | 10.1083758 | 10.2028499 | 11 |
| 50 | 9.7973071 | 9.8915226 | 9.9057845 | 10.0942155 | 10.1084774 | 10.2026929 | 10 |
| 51 | 9.7974640 | 9.8914208 | 9.9060431 | 10.0939569 | 10.1085792 | 10.2025360 | 9 |
| 52 | 9.7976208 | 9.8913191 | 9.9063017 | 10.0936983 | 10.1086809 | 10.2023792 | 8 |
| 53 | 9.7977775 | 9.8912172 | 9.9065603 | 10.0934397 | 10.1087828 | 10.2022225 | 7 |
| 54 | 9.7979341 | 9.8911153 | 9.9068188 | 10.0931812 | 10.1088847 | 10.2020659 | 6 |
| 55 | 9.7980906 | 9.8910133 | 9.9070773 | 10.0929227 | 10.1089867 | 10.2019094 | 5 |
| 56 | 9.7982470 | 9.8909113 | 9.9073357 | 10.0926643 | 10.1090887 | 10.2017530 | 4 |
| 57 | 9.7984034 | 9.8908092 | 9.9075941 | 10.0924059 | 10.1091908 | 10.2015966 | 3 |
| 58 | 9.7985596 | 9.8907071 | 9.9078525 | 10.0921475 | 10.1092929 | 10.2014404 | 2 |
| 59 | 9.7987158 | 9.8906049 | 9.9081109 | 10.0918891 | 10.1093951 | 10.2012842 | 1 |
| 60 | 9.7988718 | 9.8905026 | 9.9083692 | 10.0916308 | 10.1094974 | 10.2011282 | 0 |
| | L. Co-Sine. | L Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L- Secant. | M |

51 DEGREES.

39 DEGREES

| M | N. Sine | N.Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant | NCo-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6293204 | 7771460 | 8097840 | 12348972 | 12807596 | 15890125 | 60 |
| 1 | 6295464 | 7769629 | 8102658 | 12341629 | 12870628 | 15884452 | 59 |
| 2 | 6297724 | 7767797 | 8107478 | 12334292 | 12873663 | 15878752 | 58 |
| 3 | 6299983 | 7765965 | 8112300 | 12326961 | 12876700 | 15873058 | 57 |
| 4 | 6302242 | 7764132 | 8117124 | 12319634 | 12879740 | 15867369 | 56 |
| 5 | 6304500 | 7762298 | 8121951 | 12312313 | 12882782 | 15861685 | 55 |
| 6 | 6306758 | 7760464 | 8126780 | 12304997 | 12885827 | 15856007 | 54 |
| 7 | 6309015 | 7758629 | 8131611 | 12297687 | 12888875 | 15850334 | 53 |
| 8 | 6311272 | 7756794 | 8136444 | 12290381 | 12891925 | 15844667 | 52 |
| 9 | 6313528 | 7754958 | 8141280 | 12283081 | 12894977 | 15839005 | 51 |
| 10 | 6315784 | 7753121 | 8146118 | 12275786 | 12898032 | 15833348 | 50 |
| 11 | 6318039 | 7751283 | 8150958 | 12268496 | 12901090 | 15827697 | 49 |
| 12 | 6320293 | 7749445 | 8155801 | 12261211 | 12904150 | 15822051 | 48 |
| 13 | 6322547 | 7747606 | 8160646 | 12253932 | 12907213 | 15816411 | 47 |
| 14 | 6324800 | 7745767 | 8165493 | 12246658 | 12910278 | 15810776 | 46 |
| 15 | 6327053 | 7743927 | 8170343 | 12239389 | 12913346 | 15805146 | 45 |
| 16 | 6329305 | 7742086 | 8175195 | 12232125 | 12916416 | 15799521 | 44 |
| 17 | 6331557 | 7740244 | 8180049 | 12224866 | 12919489 | 15793902 | 43 |
| 18 | 6333808 | 7738402 | 8184905 | 12217613 | 12922564 | 15788289 | 42 |
| 19 | 6336059 | 7736559 | 8189764 | 12210364 | 12924642 | 15782680 | 41 |
| 20 | 6338309 | 7734716 | 8194625 | 12203121 | 12928723 | 15777077 | 40 |
| 21 | 6340559 | 7732872 | 8199488 | 12195883 | 12931806 | 15771479 | 39 |
| 22 | 6342808 | 7731027 | 8204354 | 12188650 | 12934892 | 15765887 | 38 |
| 23 | 6345057 | 7729182 | 8209222 | 12181422 | 12937980 | 15760300 | 37 |
| 24 | 6347305 | 7727336 | 8214093 | 12174199 | 12941071 | 15754718 | 36 |
| 25 | 6349553 | 7725489 | 8218965 | 12166982 | 12944164 | 15749141 | 35 |
| 26 | 6351800 | 7723642 | 8223840 | 12159769 | 12947260 | 15743570 | 34 |
| 27 | 6354046 | 7721794 | 8228718 | 12152562 | 12950359 | 15738004 | 33 |
| 28 | 6356292 | 7719945 | 8233597 | 12145359 | 12953460 | 15732443 | 32 |
| 29 | 6358537 | 7718096 | 8238479 | 12138162 | 12956564 | 15726887 | 31 |
| 30 | 6360782 | 7716246 | 8243364 | 12130970 | 12959670 | 15721337 | 30 |
| 31 | 6363026 | 7714395 | 8248251 | 12123783 | 12962779 | 15715792 | 29 |
| 32 | 6365270 | 7712544 | 8253140 | 12116601 | 12965890 | 15710252 | 28 |
| 33 | 6367513 | 7710692 | 8258030 | 12109424 | 12969004 | 15704717 | 27 |
| 34 | 6369756 | 7708839 | 8262925 | 12102252 | 12972121 | 15699188 | 26 |
| 35 | 6371998 | 7706986 | 8267821 | 12095085 | 12975240 | 15693664 | 25 |
| 36 | 6374240 | 7705132 | 8272719 | 12087923 | 12978362 | 15688145 | 24 |
| 37 | 6376481 | 7703278 | 8277620 | 12080767 | 12981487 | 15682631 | 23 |
| 38 | 6378721 | 7701423 | 8282523 | 12073615 | 12984614 | 15677123 | 22 |
| 39 | 6380961 | 7699567 | 8287429 | 12066465 | 12987744 | 15671619 | 21 |
| 40 | 6383201 | 7697710 | 8292337 | 12059327 | 12990876 | 15666121 | 20 |
| 41 | 6385440 | 7695853 | 8297247 | 12052190 | 12994011 | 15660628 | 19 |
| 42 | 6387678 | 7693995 | 8302160 | 12045058 | 12997148 | 15655141 | 18 |
| 43 | 6389916 | 7692137 | 8307075 | 12037931 | 13000288 | 15649658 | 17 |
| 44 | 6392153 | 7690278 | 8311992 | 12030810 | 13003431 | 15644181 | 16 |
| 45 | 6394390 | 7688418 | 8316912 | 12023693 | 13006576 | 15638708 | 15 |
| 46 | 6396626 | 7686558 | 8321834 | 12016581 | 13009724 | 15633241 | 14 |
| 47 | 6398862 | 7684697 | 8326759 | 12009475 | 13012875 | 15627779 | 13 |
| 48 | 6401097 | 7682835 | 8331686 | 12002373 | 13016028 | 15622322 | 12 |
| 49 | 6403332 | 7680973 | 8336615 | 11995276 | 13019184 | 15616870 | 11 |
| 50 | 6405566 | 7679110 | 8341547 | 11988184 | 13022343 | 15611424 | 10 |
| 51 | 6407799 | 7677246 | 8346481 | 11981097 | 13025504 | 15605982 | 9 |
| 52 | 6410032 | 7675382 | 8351418 | 11974015 | 13028668 | 15600546 | 8 |
| 53 | 6412264 | 7673517 | 8356357 | 11966938 | 13031834 | 15595115 | 7 |
| 54 | 6414496 | 7671651 | 8361298 | 11959866 | 13035003 | 15589689 | 6 |
| 55 | 6416727 | 7669785 | 8366242 | 11952799 | 13038175 | 15584267 | 5 |
| 56 | 6418958 | 7667918 | 8371188 | 11945736 | 13041349 | 15578851 | 4 |
| 57 | 6421188 | 7666051 | 8376136 | 11938679 | 13044526 | 15573441 | 3 |
| 58 | 6423418 | 7664183 | 8381087 | 11931626 | 13047706 | 15568035 | 2 |
| 59 | 6425647 | 7662314 | 8386040 | 11924179 | 13050888 | 15562634 | 1 |
| 60 | 6427876 | 7660444 | 8390996 | 11917536 | 13054073 | 15557238 | 0 |
| | N'Co-Sine. | N. Sine. | N Co Tang. | N. Tangent. | N Co-Secant. | N. Secant | M |

50 DEGREES.

39 DEGREES.

| M | L. Sine. | L. Co-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Sec.ant | |
|---|---|---|---|---|---|---|---|
| 0 | 9 7988718 | 9.8905026 | 9 9083629 | 10.0916308 | 10.1094974 | 10.2011282 | 60 |
| 1 | 9.7990278 | 9.8904033 | 9 9086275 | 10.0913725 | 10.1095997 | 10.2009722 | 59 |
| 2 | 9.7991836 | 9.8902979 | 9.9088858 | 10.0911142 | 10.1097021 | 10.2008164 | 58 |
| 3 | 9.7993394 | 9.8901954 | 9.9091440 | 10.0908560 | 10.1098046 | 10.2006606 | 57 |
| 4 | 9.7994951 | 9.8900929 | 9 9094022 | 10.0905978 | 10.1099071 | 10.2005049 | 56 |
| 5 | 9.7996507 | 9.8899903 | 9.9096603 | 10.0903397 | 10 1100097 | 10.2003493 | 55 |
| 6 | 9.7998062 | 9.8898877 | 9.9099185 | 10.0900815 | 10.1101123 | 10.2001938 | 54 |
| 7 | 9.7999616 | 9.8897850 | 9.9101766 | 10.0898234 | 10.1102150 | 10.2000384 | 53 |
| 8 | 9.8001169 | 9.8896822 | 9.9104347 | 10.0895653 | 10.1103178 | 10.1998831 | 52 |
| 9 | 9.8002721 | 9.8895794 | 9.9106927 | 10.0893073 | 10.1104206 | 10.1997279 | 51 |
| 10 | 9.8004272 | 9.8894765 | 9.9109507 | 10.0890493 | 10.1105235 | 10 1995728 | 50 |
| 11 | 9.8005823 | 9 8893736 | 9.9112087 | 10.0887913 | 10. 1106264 | 10.1994177 | 49 |
| 12 | 9.8007372 | 9.8892706 | 9.9114666 | 10.0885334 | 10.1107294 | 10.1992628 | 48 |
| 13 | 9.8008921 | 9.8891675 | 9.9117245 | 10.0882755 | 10.1108325 | 10.1991079 | 47 |
| 14 | 9.8010468 | 9.8890644 | 9.9119824 | 10 0880176 | 10.1109356 | 10.1989532 | 46 |
| 15 | 9.8012015 | 9.8889612 | 9.9122403 | 10.0877597 | 10.1110388 | 10 1987985 | 45 |
| 16 | 9.8013561 | 9.8888580 | 9.9124981 | 10.0875019 | 10.1111420 | 10.1986439 | 44 |
| 17 | 9.8013106 | 9.8887547 | 9.9127559 | 10.0872441 | 10.1112453 | 10.1984894 | 43 |
| 18 | 9 8016649 | 9.8886513 | 9.9130137 | 10.0869863 | 10.1113487 | 10.1983351 | 42 |
| 19 | 9.8018192 | 9.8885479 | 9.9132714 | 10.0867286 | 10.1114521 | 10.1981808 | 41 |
| 20 | 9.8019735 | 9.8884444 | 9.9135291 | 10.0864709 | 10.1115556 | 10.1980265 | 40 |
| 21 | 9.8021276 | 9.8883408 | 9.9137868 | 10.0862132 | 10.1116592 | 10.1978724 | 39 |
| 22 | 9.8022816 | 9.8882372 | 9.9140444 | 10.0859556 | 10.1117627 | 10.1977184 | 38 |
| 23 | 9.8024355 | 9.8881335 | 9.9143070 | 10.0856980 | 10.1118665 | 10.1975645 | 37 |
| 24 | 9.8025894 | 9.8880298 | 9.9145596 | 10.0854404 | 10.1119702 | 10.1974106 | 36 |
| 25 | 9.8027431 | 9.8879260 | 9.9148171 | 10.0851829 | 10.1120740 | 10.1972569 | 35 |
| 26 | 9.8028968 | 9.8878221 | 9.9150747 | 10.0849253 | 10.1121779 | 10.1971032 | 34 |
| 27 | 9.8030504 | 9.8877182 | 9.9153322 | 10.0846678 | 10.1122818 | 10.1969496 | 33 |
| 28 | 9.8032038 | 9.8876142 | 9.9155896 | 10.0844104 | 10.1123858 | 10.1967962 | 32 |
| 29 | 9 8033572 | 9.8875102 | 9 9158471 | 10.0841529 | 10 1124898 | 10.1966428 | 31 |
| 30 | 9.8035105 | 9.8874061 | 9.9161045 | 10.0838955 | 10.1125939 | 10.1964895 | 30 |
| 31 | 9.8036637 | 9.8873019 | 9.9163618 | 10.0836382 | 10.1126981 | 10.1963363 | 29 |
| 32 | 9 8038168 | 9.8871977 | 9.9166192 | 10.0833808 | 10.1128023 | 10.1961832 | 28 |
| 33 | 9.8039699 | 9.8870934 | 9.9168765 | 10.0831239 | 10.1129066 | 10.1960301 | 27 |
| 34 | 9.8041228 | 9.8869890 | 9.9171338 | 10.0828662 | 10.1130110 | 10.1958772 | 26 |
| 35 | 9-8042757 | 9 8868846 | 9.9173911 | 10.0826089 | 10.1131154 | 10.1957243 | 25 |
| 36 | 9.8044284 | 9 8867801 | 9.9176483 | 10.0823517 | 10.1132199 | 10.1955716 | 24 |
| 37 | 9.8045811 | 9.8866756 | 9.9179055 | 10.0820945 | 10.1133244 | 10.1954189 | 23 |
| 38 | 9.8047336 | 9.8865710 | 9.9181627 | 10.0818373 | 10.1134290 | 10.1952664 | 22 |
| 39 | 9.8048861 | 9.8864663 | 9.9184198 | 10.0815802 | 10.1135337 | 10.1951139 | 21 |
| 40 | 9.8050385 | 9.8863616 | 9.9186769 | 10.0813231 | 10.1136384 | 10.1949615 | 20 |
| 41 | 9.8051908 | 9.8862568 | 9 9189340 | 10.0810660 | 10.1137432 | 10.1948092 | 19 |
| 42 | 9.8053430 | 9.8861519 | 9.9191911 | 10.0808089 | 10.1138481 | 10.5946570 | 18 |
| 43 | 9.8054951 | 9.8860470 | 9.9194481 | 10.0805519 | 10.1139530 | 10.1945049 | 17 |
| 44 | 9.8056472 | 9.8859420 | 9.9197051 | 10.0802949 | 10.1140580 | 10.1943528 | 16 |
| 45 | 9.8057991 | 9.8858370 | 9 9199621 | 10.0800379 | 10.1141630 | 10.1942008 | 15 |
| 46 | 9.8059510 | 9.8857319 | 9.9202191 | 10.0797809 | 10.1142681 | 10.1940490 | 14 |
| 47 | 9.8061027 | 9.8856267 | 9.9204760 | 10.0795240 | 10.1143733 | 10.1938973 | 13 |
| 48 | 9.8062544 | 9.8855215 | 9.9207329 | 10.0792671 | 10.1144785 | 10.1937456 | 12 |
| 49 | 9 8064060 | 9.8854162 | 9.9209898 | 10.0790102 | 10.1145838 | 10.1935940 | 11 |
| 50 | 9.8065575 | 9 8853109 | 9.9212466 | 10.0787534 | 10.1146891 | 10.1934425 | 10 |
| 51 | 9.8067089 | 9.8852055 | 9.9215034 | 10 0784966 | 10.1147945 | 10.1932911 | 9 |
| 52 | 9.8068602 | 9.8851000 | 9.9217602 | 10.0782398 | 10.1149000 | 10.1931398 | 8 |
| 53 | 9.8070114 | 9.8849945 | 9.9220170 | 10 0779830 | 10.1150055 | 10.1929886 | 7 |
| 54 | 9.8071626 | 9.8848889 | 9.9222737 | 10.0777263 | 10.1151111 | 10.1928374 | 6 |
| 55 | 9.8073136 | 9.8847832 | 9.9225304 | 10.0774696 | 10.1152168 | 10.1926864 | 5 |
| 56 | 9.8074646 | 9.8846775 | 9.9227871 | 10.0772129 | 10.1153225 | 10.1925354 | 4 |
| 57 | 9.8076154 | 9.8845717 | 9.9230437 | 10.0769563 | 10.1154283 | 10.1923846 | 3 |
| 58 | 9.8077662 | 9.8844659 | 9.9233004 | 10.0766996 | 10.1155341 | 10.1922338 | 2 |
| 59 | 9.8079169 | 9.8843599 | 9.9235570 | 10.0764430 | 10.1156401 | 10.1920831 | 1 |
| 60 | 9.8080675 | 9.8842540 | 9.9238135 | 10.0761865 | 10.1157460 | 10.1919325 | 0 |
| | L Co-Sine | L. Sine | L. Co-Tang. | L. Tangent | L.Co-Secant | L. Secant. | M |

50 DEGREES.

40 DEGREES

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6427876 | 7660444 | 8390996 | 11917536 | 13054073 | 15557238 | 60 |
| 1 | 6430104 | 7658574 | 8395954 | 11910498 | 13057261 | 15551848 | 59 |
| 2 | 6432332 | 7656703 | 8400915 | 11903465 | 13060451 | 15546462 | 58 |
| 3 | 6434559 | 7654832 | 8405878 | 11896437 | 13063644 | 15541081 | 57 |
| 4 | 6436785 | 7652960 | 8410844 | 11889414 | 13066839 | 15535706 | 56 |
| 5 | 6439011 | 7651087 | 8415812 | 11882395 | 13070037 | 15530335 | 55 |
| 6 | 6441236 | 7649214 | 8420782 | 11875382 | 13073238 | 1552497° | 54 |
| 7 | 6443461 | 7647340 | 8425755 | 11868373 | 13076442 | 15519609 | 53 |
| 8 | 6445685 | 7645465 | 8430730 | 11861369 | 13079649 | 15514254 | 52 |
| 9 | 6447909 | 7643590 | 8435708 | 11854370 | 13082858 | 15508904 | 51 |
| 10 | 6450132 | 7641714 | 8440688 | 11847376 | 13086070 | 15503558 | 50 |
| 11 | 6452355 | 7639837 | 8445670 | 11840387 | 13089284 | 15498218 | 49 |
| 12 | 6454577 | 7637960 | 8450655 | 11833402 | 13092501 | 15492882 | 48 |
| 13 | 6456798 | 7636082 | 8455643 | 11826422 | 13095721 | 15487552 | 47 |
| 14 | 6459019 | 7634204 | 8460633 | 11819447 | 13098943 | 15482226 | 46 |
| 15 | 6461240 | 7632325 | 8465625 | 11812477 | 13102168 | 15476906 | 45 |
| 16 | 6463460 | 7630445 | 8470620 | 11805512 | 13105396 | 15471590 | 44 |
| 17 | 6465679 | 7628564 | 8475617 | 11798551 | 13108626 | 15466280 | 43 |
| 18 | 6467898 | 7626683 | 8480617 | 11791595 | 13111859 | 15460974 | 42 |
| 19 | 6470116 | 7624801 | 8485619 | 11784644 | 13115095 | 15455673 | 41 |
| 20 | 6472334 | 7622919 | 8490624 | 11777698 | 13118334 | 15450378 | 40 |
| 21 | 6474551 | 7621036 | 8495631 | 11770756 | 13121575 | 15445087 | 39 |
| 22 | 6476767 | 7619152 | 8500640 | 11763820 | 13124819 | 15439801 | 38 |
| 23 | 6478983 | 7617268 | 8505652 | 11756888 | 13128066 | 15434520 | 37 |
| 24 | 6481199 | 7615383 | 8510667 | 11749960 | 13131316 | 15429244 | 36 |
| 25 | 6483414 | 7613497 | 8515684 | 11743038 | 13134568 | 15423973 | 35 |
| 26 | 6485628 | 7611611 | 8520704 | 11736120 | 13137823 | 15418706 | 34 |
| 27 | 6487842 | 7609724 | 8525726 | 11729207 | 13141081 | 15413445 | 33 |
| 28 | 6490055 | 7607837 | 8530750 | 11722298 | 13144341 | 15408189 | 32 |
| 29 | 6492268 | 7605949 | 8535777 | 11715395 | 13147604 | 15402937 | 31 |
| 30 | 6494480 | 7604060 | 8540807 | 11708496 | 13150870 | 15397690 | 30 |
| 31 | 6496692 | 7602170 | 8545839 | 11701601 | 13154139 | 15392449 | 29 |
| 32 | 6498903 | 7600280 | 8550873 | 11694712 | 13157410 | 15387212 | 28 |
| 33 | 6501114 | 7598389 | 8555910 | 11687827 | 13160684 | 15381980 | 27 |
| 34 | 6503324 | 7596498 | 8560950 | 11680947 | 13163961 | 15376752 | 26 |
| 35 | 6505533 | 7594606 | 8565992 | 11674071 | 13167241 | 15371530 | 25 |
| 36 | 6507742 | 7592713 | 8571037 | 11667200 | 13170523 | 15366312 | 24 |
| 37 | 6509950 | 7590820 | 8576084 | 11660334 | 13173808 | 15361100 | 23 |
| 38 | 6512158 | 7588926 | 8581133 | 11653472 | 13177096 | 15355892 | 22 |
| 39 | 6518365 | 7587031 | 8586185 | 11646615 | 13180386 | 15350689 | 21 |
| 40 | 6516572 | 7585136 | 8591240 | 11639763 | 13183679 | 15345491 | 20 |
| 41 | 6518778 | 7583240 | 8596297 | 11632916 | 13186975 | 15340297 | 19 |
| 42 | 6520984 | 7581343 | 8601357 | 11626073 | 13190274 | 15335109 | 18 |
| 43 | 6523189 | 7579446 | 8606419 | 11619234 | 13193576 | 15229925 | 17 |
| 44 | 6525394 | 7577548 | 8611484 | 11612400 | 13196881 | 15324746 | 16 |
| 45 | 6527598 | 7575650 | 8611551 | 11605571 | 13200188 | 15319572 | 15 |
| 46 | 6529801 | 7573751 | 8621621 | 11598747 | 13203498 | 15314403 | 14 |
| 47 | 6532004 | 7571851 | 8626693 | 11591927 | 13206811 | 15309238 | 13 |
| 48 | 6534206 | 7569950 | 8631768 | 11585111 | 13210126 | 15304078 | 12 |
| 49 | 6536408 | 7568049 | 8636846 | 11578401 | 13213444 | 15298923 | 11 |
| 50 | 6538609 | 7566147 | 8641926 | 11571495 | 13216765 | 15293773 | 10 |
| 51 | 6540810 | 7564245 | 8647009 | 11564693 | 13220089 | 15288627 | 9 |
| 52 | 6543010 | 7562342 | 8652094 | 11557896 | 13223416 | 15283487 | 8 |
| 53 | 6545209 | 7560439 | 8657181 | 11551104 | 13226745 | 15278351 | 7 |
| 54 | 6547408 | 7558535 | 8662271 | 11544316 | 13230077 | 15273219 | 6 |
| 55 | 6549606 | 7556630 | 8667364 | 11537532 | 13233412 | 15268093 | 5 |
| 56 | 6551804 | 7554724 | 8673460 | 11530754 | 13236750 | 15262971 | 4 |
| 57 | 6554001 | 7552818 | 8677558 | 11523979 | 13240091 | 15257854 | 3 |
| 58 | 6556198 | 7550911 | 8682659 | 11517210 | 13243435 | 15252741 | 2 |
| 59 | 6558294 | 7549004 | 8687762 | 11510445 | 13246781 | 15247634 | 1 |
| 60 | 6560590 | 7547096 | 8692868 | 11503684 | 13250130 | 15242531 | 0 |
| | N. Co-Sine | N. Sine. | N. Co-Tang. | N. Tangent. | N. Co Secant. | N. Secant. | M |

40 DEGREES.

| M | *L. Sine.* | *L. Co-Sine* | *L. Tangent* | *L. Co.Tang.* | *L. Secant.* | *Lo C-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 9.8080675 | 9.8842540 | 9.9228135 | 10.0761807 | 10.1157460 | 10.1919325 | 60 |
| 1 | 9.8082180 | 9.8841479 | 9 9240701 | 10.0759299 | 10.1158521 | 10.1917820 | 59 |
| 2 | 9.8083684 | 9.8840418 | 9.9243266 | 10.0756734 | 10.1159582 | 10.1916316 | 58 |
| 3 | 9.8085188 | 9.8839357 | 9.9245831 | 10.0754169 | 10.1160643 | 10 1914812 | 57 |
| 4 | 9.0086690 | 8.8838294 | 9 9248396 | 10.0751604 | 10.1161706 | 10.1913310 | 56 |
| 5 | 9.8088192 | 9.8837232 | 9.9250960 | 10.0749040 | 10 1162768 | 10.1911808 | 55 |
| 6 | 9.8089692 | 9.8836168 | 9.9253524 | 10.0746476 | 10.1163832 | 10.1910308 | 54 |
| 7 | 9.8091192 | 9.8835104 | 9.9256088 | 10.0743912 | 10.1164896 | 10.1908808 | 53 |
| 8 | 9.8092691 | 9.8834039 | 9.9258652 | 10.0741348 | 10.1165961 | 10.1907309 | 52 |
| 9 | 9.8094189 | 9.8832974 | 9.9261215 | 10.0738785 | 10.1167026 | 10.1905811 | 51 |
| 10 | 9.8095686 | 9.8831908 | 9.9263778 | 10.0736222 | 10.1168092 | 10.1904314 | 50 |
| 11 | 9.8097182 | 9.8830841 | 9.9266341 | 10.0733659 | 10.1169159 | 10.1902818 | 49 |
| 12 | 9.8098678 | 9.8829774 | 9.9268904 | 10.0731096 | 10.1170226 | 10.1901322 | 48 |
| 13 | 9.8100172 | 9.8828706 | 9.9271466 | 10.0728534 | 10.1171294 | 10.1899828 | 47 |
| 14 | 9.8101666 | 9.8827638 | 9.9274028 | 10 0725972 | 10.1172362 | 10.1898334 | 46 |
| 15 | 9.8103159 | 9.8826568 | 9.9276599 | 10.0723410 | 10.1173432 | 10.1896841 | 45 |
| 16 | 9.8104650 | 9.8825499 | 9.9279152 | 10.0720848 | 10.1174501 | 10.1895350 | 44 |
| 17 | 9.8106141 | 9.8824428 | 9.9281713 | 10.0718287 | 10.1175572 | 10.1893859 | 43 |
| 18 | 9.8107631 | 9.8823357 | 9.9284274 | 10.0715726 | 10.1176643 | 10.1892369 | 42 |
| 19 | 9.8109121 | 9.8822285 | 9.9286835 | 10.0713165 | 10.1177715 | 10.1890879 | 41 |
| 20 | 9.8110609 | 9.8821213 | 9.9289396 | 10.0710604 | 10.1178787 | 10.1889391 | 40 |
| 21 | 9.8112096 | 9.8820140 | 9.9291956 | 10.0708044 | 10.1179860 | 10.1887904 | 39 |
| 22 | 9.8113583 | 9.8819067 | 9.9294516 | 10.0705484 | 10.1180933 | 10 1886417 | 38 |
| 23 | 9.8115069 | 9.8817992 | 9.9297076 | 10.0702924 | 10 1182008 | 10.1884931 | 37 |
| 24 | 9.8116554 | 9.8816918 | 9.9299636 | 10.0700364 | 10.1183082 | 10.1883446 | 36 |
| 25 | 9.8118038 | 9.8815842 | 9.9302195 | 10.0697805 | 10.1184158 | 10.1881962 | 35 |
| 26 | 9.8119521 | 9.8814766 | 9.9304755 | 10.0695245 | 10.1185234 | 10.1880479 | 34 |
| 27 | 9.8121003 | 9.8813689 | 9.9307314 | 10.0692686 | 10.1186311 | 10.1878997 | 33 |
| 28 | 9.8122484 | 9.8812612 | 9.9309872 | 10.0690128 | 10.1187388 | 10.1877516 | 32 |
| 29 | 9.8123965 | 9.8811534 | 9.9312431 | 10.0687569 | 10.1188466 | 10.1876035 | 31 |
| 30 | 9.8125444 | 9.8810455 | 9.9314989 | 10.0685011 | 10.1189545 | 10.1874556 | 30 |
| 31 | 9.8126923 | 9.8809376 | 9.9317547 | 10.0682453 | 10.1190624 | 10.1873077 | 29 |
| 32 | 9.8128401 | 9.8808296 | 9.9320105 | 10.0679895 | 10.1191704 | 10.1871599 | 28 |
| 33 | 9.8129878 | 9.8807215 | 9.9322662 | 10.0677338 | 10.1192785 | 10.1870122 | 27 |
| 34 | 9.8131354 | 9.8806134 | 9.9325220 | 10.0674780 | 10.1193866 | 10.1868646 | 26 |
| 35 | 9.8132829 | 9.8805052 | 9.9327777 | 10.0672223 | 10.1194948 | 10.1867171 | 25 |
| 36 | 9.8134303 | 9 8803970 | 9.9330334 | 10.0669666 | 10.1196030 | 10.1865697 | 24 |
| 37 | 9.8135777 | 9.8802887 | 9.9332890 | 10.0667110 | 10.1197113 | 10.1864223 | 23 |
| 38 | 9.8137250 | 9.8801803 | 9.9335446 | 10.0664554 | 10.1198197 | 10.1862750 | 22 |
| 39 | 9.8138721 | 9.8800719 | 9.9338003 | 10.0661997 | 10.1199281 | 10.1861279 | 21 |
| 40 | 9.8140192 | 9.8799634 | 9 9340559 | 10.0659441 | 10.1200366 | 10.1859804 | 20 |
| 41 | 9.8141662 | 9.8798548 | 9.9343114 | 10.0656886 | 10.1201452 | 10.1858338 | 19 |
| 42 | 9.8143131 | 9.8797462 | 9.9345670 | 10.0654330 | 10.1202538 | 10.1856869 | 18 |
| 43 | 9.8144600 | 9.8796375 | 9.9348225 | 10.0651775 | 10.1203625 | 10.1855400 | 17 |
| 44 | 9.8146067 | 9.8795287 | 9.9350780 | 10.0649220 | 10.1204713 | 10.1853933 | 16 |
| 45 | 9.8147534 | 9.8794199 | 9.9353335 | 10.0646665 | 10.1205801 | 10.1852466 | 15 |
| 46 | 9.8148999 | 9.8793110 | 9.9355889 | 10.0644111 | 10.1206890 | 10.1851001 | 14 |
| 47 | 9.8150464 | 9.8792021 | 9.9358444 | 10.0641556 | 10.1207979 | 10.1849536 | 13 |
| 48 | 9.8151928 | 9.8790930 | 9.9360996 | 10.0639004 | 10.1209070 | 10.1848072 | 12 |
| 49 | 9.8153391 | 9.8789840 | 9.9363552 | 10.0636448 | 10.1210160 | 10.1846609 | 11 |
| 50 | 9.8154854 | 9 8788748 | 9.9366105 | 10.0633895 | 10.1211252 | 10.1845146 | 10 |
| 51 | 9.8156315 | 9.8787656 | 9.9368659 | 10.0631341 | 10.1212344 | 10.1843685 | 9 |
| 52 | 9.8157776 | 9.8786563 | 9.9371212 | 10.0628788 | 10.1213437 | 10.1842224 | 8 |
| 53 | 9.8159235 | 9.8785470 | 9.9373765 | 10.0626235 | 10.1214530 | 10.1840765 | 7 |
| 54 | 9.8160694 | 9.8784376 | 9.9376318 | 10.0623682 | 10.1215624 | 10.1839306 | 6 |
| 55 | 9.8162152 | 9.8783282 | 9.9378871 | 10.0621129 | 10.1216719 | 10.1837848 | 5 |
| 56 | 9.8163609 | 9.8782189 | 9.9381423 | 10.0618577 | 10.1217814 | 10.1836391 | 4 |
| 57 | 9.8165066 | 9.8781090 | 9 9383975 | 10.0616025 | 10.1218910 | 10.1834934 | 3 |
| 58 | 9.8166521 | 9.8779994 | 9.9386527 | 10.0613473 | 10.1220006 | 10.1833479 | 2 |
| 59 | 9.8167975 | 9.8778896 | 9.9389079 | 10.0610921 | 10.1221104 | 10.1832025 | 1 |
| 60 | 9.8169429 | 9.8777799 | 9.9391631 | 10.0608369 | 10.1222301 | 10.1830571 | 0 |
| | *L. Co-Sine* | *L. Sine* | *L. Co-Tang* | *L. Tangent* | *L. Co-Secant* | *L. Secant.* | M |

49 DEGREES.

41 DEGREES.

| M | N. Sine. | N. Co-Sine | N. Tangent. | N. Co-Tang. | N. Secant. | N Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6560590 | 7547096 | 8692868 | 11503684 | 13250130 | 15242531 | 60 |
| 1 | 6562785 | 7545187 | 8697976 | 11496928 | 13253402 | 15237433 | 59 |
| 2 | 6564980 | 7543278 | 8703087 | 11490176 | 13256837 | 15232339 | 58 |
| 3 | 6567174 | 7541368 | 8708200 | 11483429 | 13260194 | 15227250 | 57 |
| 4 | 6569367 | 7539457 | 8713316 | 11476687 | 13263554 | 15222165 | 56 |
| 5 | 6571560 | 7537546 | 8718435 | 11469949 | 13266918 | 15217087 | 55 |
| 6 | 6573752 | 7535634 | 8723556 | 11463215 | 13270284 | 15212012 | 54 |
| 7 | 6575944 | 7533721 | 8728680 | 11456486 | 13273653 | 15206942 | 53 |
| 8 | 6578135 | 7531808 | 8733806 | 11449762 | 13277025 | 15201876 | 52 |
| 9 | 6580326 | 7529894 | 8738935 | 11443041 | 13280399 | 15196815 | 51 |
| 10 | 6582516 | 7527980 | 8744067 | 11436326 | 13283776 | 15191759 | 50 |
| 11 | 6584706 | 7526065 | 8749201 | 11429615 | 13287156 | 15186708 | 49 |
| 12 | 6586895 | 7524149 | 8754338 | 11422908 | 13290539 | 15181661 | 48 |
| 13 | 6589083 | 7522233 | 8759478 | 11416206 | 13293925 | 15176619 | 47 |
| 14 | 6591271 | 7520316 | 8764620 | 11409508 | 13297314 | 15171581 | 46 |
| 15 | 6593458 | 7518398 | 8769765 | 11402815 | 13300706 | 15166548 | 45 |
| 16 | 6595645 | 7516480 | 8774912 | 11396126 | 13304100 | 15161520 | 44 |
| 17 | 6597831 | 7514561 | 8780062 | 11389441 | 13307497 | 15156496 | 43 |
| 18 | 6600017 | 7512641 | 8785215 | 11382761 | 13310897 | 15151477 | 42 |
| 19 | 6602202 | 7510721 | 8790370 | 11376085 | 13314300 | 15146462 | 41 |
| 20 | 6604386 | 7508800 | 8795528 | 11369414 | 13317706 | 15141452 | 40 |
| 21 | 6606570 | 7506879 | 8800689 | 11362747 | 13321115 | 15136447 | 39 |
| 22 | 6608753 | 7504950 | 8805852 | 11356085 | 13324527 | 15131446 | 38 |
| 23 | 6610936 | 7503034 | 8811018 | 11349427 | 13327942 | 15126450 | 37 |
| 24 | 6613118 | 7501111 | 8816186 | 11342773 | 13331359 | 15121459 | 36 |
| 25 | 6615300 | 7499187 | 8821357 | 11336124 | 13334779 | 15116472 | 35 |
| 26 | 6617481 | 7497262 | 8826531 | 11329479 | 13338202 | 15111489 | 34 |
| 27 | 6619662 | 7495337 | 8831707 | 11322839 | 13341628 | 15106511 | 33 |
| 28 | 6621842 | 7493411 | 3836886 | 11316203 | 13345057 | 15101538 | 32 |
| 29 | 6624022 | 7491484 | 8842068 | 11309571 | 13348489 | 15096569 | 31 |
| 30 | 6626201 | 7489557 | 8847253 | 11302944 | 13351924 | 15091605 | 30 |
| 31 | 6628379 | 7487629 | 8852440 | 11296321 | 13355362 | 15086645 | 29 |
| 32 | 6630557 | 7485781 | 8857630 | 11289702 | 13358803 | 15081690 | 28 |
| 33 | 6632734 | 7483772 | 8862822 | 11283088 | 13362246 | 15076739 | 27 |
| 34 | 6634911 | 7481842 | 8868017 | 11276478 | 13365692 | 15071793 | 26 |
| 35 | 6637087 | 7479912 | 8873215 | 11269872 | 13369141 | 15066852 | 25 |
| 36 | 6639262 | 7477981 | 8878416 | 11263271 | 13372594 | 15061915 | 24 |
| 37 | 6641437 | 7476049 | 8883620 | 11256674 | 13376049 | 15056982 | 23 |
| 38 | 6643611 | 7474117 | 8888826 | 11250081 | 13379507 | 15052054 | 22 |
| 39 | 6645785 | 7472184 | 8894034 | 11243493 | 13382968 | 15047131 | 21 |
| 40 | 6647959 | 7470251 | 8899245 | 11236909 | 13386432 | 15042211 | 20 |
| 41 | 6650132 | 7468317 | 8904459 | 11230329 | 13389899 | 15037297 | 19 |
| 42 | 6652304 | 7466382 | 8909675 | 11223754 | 13393369 | 15032387 | 18 |
| 43 | 6654475 | 7464446 | 8914894 | 11217183 | 13396842 | 15027481 | 17 |
| 44 | 6656646 | 7462510 | 8920116 | 11210616 | 13400317 | 15022580 | 16 |
| 45 | 6658817 | 7460574 | 8925341 | 11204053 | 13403795 | 15017683 | 15 |
| 46 | 6660987 | 7458637 | 8930569 | 11197495 | 13407276 | 15012791 | 14 |
| 47 | 6663156 | 7456699 | 8935799 | 11190941 | 13410761 | 15007903 | 13 |
| 48 | 6665325 | 7454760 | 8941032 | 11184391 | 13414248 | 15003020 | 12 |
| 49 | 6667493 | 7452821 | 8946268 | 11177846 | 13417738 | 14998141 | 11 |
| 50 | 6669661 | 7450881 | 8951506 | 11171305 | 13421232 | 14993267 | 10 |
| 51 | 6671828 | 7448940 | 8956747 | 11164768 | 13424728 | 14988397 | 9 |
| 52 | 6673994 | 7446999 | 8961991 | 11158235 | 13428227 | 14983531 | 8 |
| 53 | 6676160 | 7445057 | 8967238 | 11151706 | 13431729 | 14978670 | 7 |
| 54 | 6678326 | 7443115 | 8972487 | 11145182 | 13435234 | 14973813 | 6 |
| 55 | 6680491 | 7441172 | 8977739 | 11138662 | 13438742 | 14968961 | 5 |
| 56 | 6682655 | 7439229 | 8982994 | 11132146 | 13442253 | 14964113 | 4 |
| 57 | 6684818 | 7437285 | 8988252 | 11125635 | 13445767 | 14959270 | 3 |
| 58 | 6686981 | 7435340 | 8993512 | 11119127 | 13449284 | 14954430 | 2 |
| 59 | 6689144 | 7433394 | 8998775 | 11112624 | 13452804 | 14949596 | 1 |
| 60 | 6691306 | 7431448 | 9004041 | 11106125 | 13456327 | 14944765 | 0 |
| | N. Co-Sine. | N. Sine. | N. Co-Tang. | N. Tangent | N. Co Secant. | N. Secant. | M |

48 DEGREES.

41 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.8169429 | 9.8777799 | 9.9391631 | 10.0608369 | 10.1222201 | 10.1830571 | 60 |
| 1 | 9.8170882 | 9.8776700 | 9.9394182 | 10.0605818 | 10.1223300 | 10.1829118 | 59 |
| 2 | 9.8172334 | 9.8775601 | 9.9396733 | 10.0603267 | 10.1224399 | 10.1827666 | 58 |
| 3 | 9.8173785 | 9.8774501 | 9.9399284 | 10.0600716 | 10.1225499 | 10.1826215 | 57 |
| 4 | 9.8175235 | 9.8773401 | 9.9401835 | 10.0598165 | 10.1226599 | 10.1824765 | 56 |
| 5 | 9.8176685 | 9.8772300 | 9.9404385 | 10.0595615 | 10.1227700 | 10.1823315 | 55 |
| 6 | 9.8178133 | 9.8771198 | 9.9406936 | 10.0593064 | 10.1228802 | 10.1821867 | 54 |
| 7 | 9.8179581 | 9.8770096 | 9.9409486 | 10.0590514 | 10.1229904 | 10.1820419 | 53 |
| 8 | 9.8181028 | 9.8768993 | 9.9412036 | 10.0587964 | 10.1231007 | 10.1818972 | 52 |
| 9 | 9.8182474 | 9.8767889 | 9.9414585 | 10.0585415 | 10.1232111 | 10.1817526 | 51 |
| 10 | 9.8183919 | 9.8766785 | 9.9417135 | 10.0582865 | 10.1233215 | 10.1816081 | 50 |
| 11 | 9.8185364 | 9.8765680 | 9.9419684 | 10.0580316 | 10.1234320 | 10.1814636 | 49 |
| 12 | 9.8186807 | 9.8764574 | 9.9422233 | 10.0577767 | 10.1235426 | 10.1813193 | 48 |
| 13 | 9.8188250 | 9.8763468 | 9.9424782 | 10.0575218 | 10.1236532 | 10.1811750 | 47 |
| 14 | 9.8189692 | 9.8762361 | 9.9427331 | 10.0572669 | 10.1237639 | 10.1810308 | 46 |
| 15 | 9.8191133 | 9.8761253 | 9.9429879 | 10.0570121 | 10.1238747 | 10.1808867 | 45 |
| 16 | 9.8192573 | 9.8760145 | 9.9432428 | 10.0567572 | 10.1239855 | 10.1807427 | 44 |
| 17 | 9.8194012 | 9.8759036 | 9.9434976 | 10.0565024 | 10.1240964 | 10.1805988 | 43 |
| 18 | 9.8195450 | 9.8757927 | 9.9437524 | 10.0562476 | 01.1242073 | 10.1804550 | 42 |
| 19 | 9.8196888 | 9.8756816 | 9.9440072 | 10.0559928 | 10.1243184 | 10.1803112 | 41 |
| 20 | 9.8198325 | 9.8755706 | 9.9442619 | 10.0557381 | 10.1244294 | 10.1801675 | 40 |
| 21 | 9.8199761 | 9.8754594 | 9.9445166 | 10.0554834 | 10.1245406 | 10.1800239 | 39 |
| 22 | 9.8201196 | 9.8753482 | 9.9447714 | 10.0552286 | 10.1246518 | 10.1798804 | 38 |
| 23 | 9.8202630 | 9.8752369 | 9.9450261 | 10.0549739 | 10.1247631 | 10.1797370 | 37 |
| 24 | 9.8204063 | 9.8751256 | 9.9452807 | 10.0547193 | 10.1248744 | 10.1795937 | 36 |
| 25 | 9.8205496 | 9.8750142 | 9.9455354 | 10.0544646 | 10.1249858 | 10.1794504 | 35 |
| 26 | 9.8206927 | 9.8749027 | 9.9457900 | 10.0542100 | 10.1250973 | 10.1793073 | 34 |
| 27 | 9.8208358 | 9.8747912 | 9.9460447 | 10.0539553 | 10.1252088 | 10.1791642 | 33 |
| 28 | 9.8209788 | 9.8746795 | 9.9462993 | 10.0537007 | 10.1253205 | 10.1790212 | 32 |
| 29 | 9.8211217 | 9.8745679 | 9.9465539 | 10.0534461 | 10.1254321 | 10.1788783 | 31 |
| 30 | 9.8212646 | 9.8744561 | 9.9468084 | 10.0531916 | 10.1255439 | 10.1787354 | 30 |
| 31 | 9.8214073 | 9.8743443 | 9.9470630 | 10.0529370 | 10.1256557 | 10.1785927 | 29 |
| 32 | 9.8215500 | 9.8742325 | 9.9473175 | 10.0526825 | 10.1257675 | 10.1784500 | 28 |
| 33 | 9.8216926 | 9.8741205 | 9.9475720 | 10.0524280 | 10.1258795 | 10.1783074 | 27 |
| 34 | 9.8218351 | 9.8740095 | 9.9478265 | 10.0521735 | 10.1259915 | 10.1781649 | 26 |
| 35 | 9.8219775 | 9.8738963 | 9.9480810 | 10.0519190 | 10.1261035 | 10.1780225 | 25 |
| 36 | 9.3221198 | 9.8737844 | 9.9483355 | 10.0516645 | 10.1262156 | 10.1778802 | 24 |
| 37 | 9.8222621 | 9.8736722 | 9.9485899 | 10.0514101 | 10.1263278 | 10.1777379 | 23 |
| 38 | 9.8224042 | 9.8735599 | 9.9488443 | 10.0511557 | 10.1264401 | 10.1775958 | 22 |
| 39 | 9.8225463 | 9.8734476 | 9.9490987 | 10.0509013 | 10.1265524 | 10.1774537 | 21 |
| 40 | 9.8226883 | 9.8733352 | 9.9493531 | 10.0506469 | 10.1266648 | 10.1773117 | 20 |
| 41 | 9.8228302 | 9.8732227 | 9.9496075 | 10.0503925 | 10.1267773 | 10.1771698 | 19 |
| 42 | 9.8229721 | 9.8731102 | 9.9498619 | 10.0501381 | 10.1268898 | 10.1770279 | 18 |
| 43 | 9.8231138 | 9.8729976 | 9.9501162 | 10.0498838 | 10.1270024 | 10.1776862 | 17 |
| 44 | 9.8232555 | 9.8728849 | 9.9503705 | 10.0496295 | 10.1271151 | 10.1767445 | 16 |
| 45 | 9.8233971 | 9.8727722 | 9.9506248 | 10.0493752 | 10.1272278 | 10.1766025 | 15 |
| 46 | 9.8235386 | 9.8726594 | 9.9508791 | 10.0491209 | 10.1273406 | 10.1764614 | 14 |
| 47 | 9.8236800 | 9.8725466 | 9.9511334 | 10.0488666 | 10.1274534 | 10.1763200 | 13 |
| 48 | 9.8238213 | 9.8724337 | 9.9513876 | 10.0486124 | 10.1275663 | 10.1761787 | 12 |
| 49 | 9.8239626 | 9.8723207 | 9.9516419 | 10.0483581 | 10.1276793 | 10.1760374 | 11 |
| 50 | 9.8241037 | 9.8722076 | 9.9518961 | 10.0481039 | 10.1277924 | 10.1758963 | 10 |
| 51 | 9.8242448 | 9.8720945 | 9.9521503 | 10.0478497 | 10.1279055 | 10.1757552 | 9 |
| 52 | 9.8243858 | 9.8719813 | 9.9524045 | 10.0475955 | 10.1280187 | 10.1756142 | 8 |
| 53 | 9.8245267 | 9.8718681 | 9.9526587 | 10.0473413 | 10.1281319 | 10.1754733 | 7 |
| 54 | 9.8246676 | 9.8717548 | 9.9529128 | 10.0470872 | 10.1282452 | 10.1753324 | 6 |
| 55 | 9.8248083 | 9.8716414 | 9.9531670 | 10.0468330 | 10.1283586 | 10.1751917 | 5 |
| 56 | 9.8249490 | 9.8715279 | 9.9534211 | 10.0465789 | 10.1284721 | 10.1750510 | 4 |
| 57 | 9.8250896 | 9.8714144 | 9.9536752 | 10.0463248 | 10.1285856 | 10.1749104 | 3 |
| 58 | 9.8252301 | 9.8713008 | 9.9539293 | 10.0460707 | 10.1286992 | 10.1747699 | 2 |
| 59 | 9.8253705 | 9.8711872 | 9.9541834 | 10.0458166 | 10.1288128 | 10.1746295 | 1 |
| 60 | 9.8255109 | 9.8710735 | 9.9544374 | 10.0455626 | 10.1289265 | 10.1744891 | 0 |
| | L. Co-Sine. | L. Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L. Secant. | M |

48 DEGREES.

42 DEGREES

| M | N. Sine | N.Co-Sine. | N. Tangent. | N. Co-Tang. | N. Secant | NCo-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6691306 | 7431148 | 9004041 | 11106121 | 13456327 | 14944765 | 60 |
| 1 | 6692467 | 7429501 | 9009309 | 11099630 | 13459853 | 14639940 | 59 |
| 2 | 6695628 | 7427554 | 9014580 | 11093140 | 13463382 | 14635118 | 58 |
| 3 | 6697788 | 7425606 | 9019854 | 11086653 | 13466914 | 14630301 | 57 |
| 4 | 6699948 | 7423657 | 9025131 | 11080171 | 13470449 | 14625488 | 56 |
| 5 | 6702107 | 7421708 | 9030411 | 11073693 | 13473987 | 14625680 | 55 |
| 6 | 6704266 | 7419758 | 9035694 | 11067219 | 13477528 | 14615875 | 54 |
| 7 | 6706424 | 7417808 | 9040979 | 11060750 | 13481072 | 14911076 | 53 |
| 8 | 6708582 | 7415857 | 9046267 | 11054284 | 13484619 | 14906280 | 52 |
| 9 | 6710739 | 7413905 | 9051558 | 11047823 | 13488169 | 14901489 | 51 |
| 10 | 6712895 | 7411953 | 9056851 | 11041365 | 13491721 | 14896703 | 50 |
| 11 | 6715051 | 7410000 | 9062147 | 11034912 | 13495277 | 14891920 | 49 |
| 12 | 6717206 | 7408046 | 9067446 | 11028463 | 13498836 | 14887142 | 48 |
| 13 | 6719361 | 7406092 | 9072748 | 11022019 | 13502398 | 14882369 | 47 |
| 14 | 6721515 | 7404137 | 9078053 | 11015578 | 13505963 | 14877599 | 46 |
| 15 | 6723668 | 7402181 | 9083360 | 11009141 | 13509531 | 14872834 | 45 |
| 16 | 6725821 | 7400225 | 9088671 | 11002709 | 13513102 | 14868073 | 44 |
| 17 | 6727973 | 7398268 | 9093984 | 10996281 | 13516676 | 14863317 | 43 |
| 18 | 6730125 | 7396311 | 9099300 | 10989856 | 13520254 | 14858565 | 42 |
| 19 | 6732276 | 7394353 | 9104619 | 10983436 | 13523834 | 14853817 | 41 |
| 20 | 6734427 | 7392394 | 9109941 | 10977020 | 13527417 | 14849073 | 40 |
| 21 | 6736577 | 7390435 | 9115265 | 10970608 | 13531003 | 14844334 | 39 |
| 22 | 6738727 | 7388475 | 9120592 | 10964201 | 13534593 | 14839599 | 38 |
| 23 | 6740876 | 7386515 | 9125922 | 10957797 | 13538186 | 14834868 | 37 |
| 24 | 6743024 | 7384554 | 9131255 | 10951397 | 13541781 | 14830142 | 36 |
| 25 | 6745172 | 7382592 | 9136591 | 10945002 | 13545379 | 14825420 | 35 |
| 26 | 6747319 | 7380629 | 9141929 | 10938610 | 13548980 | 14820702 | 34 |
| 27 | 6749466 | 7378665 | 9147270 | 10932223 | 13552585 | 14815988 | 33 |
| 28 | 6751612 | 7376702 | 9152615 | 10925840 | 13556193 | 14811278 | 32 |
| 29 | 6753757 | 7374738 | 9157962 | 10919460 | 13559803 | 14806573 | 31 |
| 30 | 6755902 | 7372773 | 9163312 | 10913085 | 13563417 | 14801872 | 30 |
| 31 | 6758046 | 7370808 | 9168665 | 10906714 | 13567034 | 14797176 | 29 |
| 32 | 6760190 | 7368842 | 9174020 | 10900347 | 13570654 | 14792483 | 28 |
| 33 | 6762333 | 7366875 | 9179379 | 10893983 | 13574277 | 14787795 | 27 |
| 34 | 6764476 | 7364907 | 9184740 | 10887624 | 13577903 | 14783111 | 26 |
| 35 | 6766618 | 7362939 | 9190104 | 10881269 | 13581532 | 14778431 | 25 |
| 36 | 6768760 | 7360971 | 9195471 | 10874918 | 13585164 | 14773755 | 24 |
| 37 | 6770901 | 7359002 | 9200841 | 10868571 | 13588800 | 14769084 | 23 |
| 38 | 6773041 | 7357032 | 9206214 | 10862228 | 13592438 | 14764417 | 22 |
| 39 | 6775181 | 7355061 | 9211590 | 10855889 | 13596080 | 14759754 | 21 |
| 40 | 6777320 | 7353090 | 9216968 | 10849554 | 13599725 | 14755095 | 20 |
| 41 | 6779459 | 7351118 | 9222350 | 10843223 | 13603372 | 14750440 | 19 |
| 42 | 6781597 | 7349146 | 9227734 | 10836896 | 13607023 | 14745790 | 18 |
| 43 | 6783734 | 7347173 | 9233122 | 10830573 | 13610677 | 14741144 | 17 |
| 44 | 6785871 | 7345199 | 9238512 | 10824254 | 13614334 | 14736501 | 16 |
| 45 | 6788007 | 7343225 | 9243905 | 10817939 | 13617995 | 14731864 | 15 |
| 46 | 6790143 | 7341250 | 9249301 | 10811628 | 13621658 | 14727230 | 14 |
| 47 | 6792278 | 7339275 | 9254700 | 10805321 | 13625324 | 14722600 | 13 |
| 48 | 6794413 | 7337299 | 9260101 | 10799018 | 13628994 | 14717975 | 12 |
| 49 | 6796547 | 7335322 | 9265506 | 10792718 | 13632667 | 14713353 | 11 |
| 50 | 6798681 | 7333345 | 9270914 | 10786423 | 13636343 | 14708736 | 10 |
| 51 | 6800814 | 7331367 | 9276324 | 10780132 | 13640022 | 14704123 | 9 |
| 52 | 6802946 | 7329388 | 9281738 | 10773844 | 13643704 | 14699514 | 8 |
| 53 | 6805078 | 7327409 | 9287154 | 10767561 | 13647389 | 14694910 | 7 |
| 54 | 6807209 | 7325429 | 9292573 | 10761282 | 13651078 | 14690309 | 6 |
| 55 | 6809339 | 7323448 | 9297996 | 10755006 | 13654770 | 14685713 | 5 |
| 56 | 6811469 | 7321467 | 9303421 | 10748734 | 13658464 | 14681120 | 4 |
| 57 | 6813599 | 7319485 | 9308846 | 10742467 | 13662162 | 14676532 | 3 |
| 58 | 6815728 | 7317503 | 9314280 | 10736203 | 13665863 | 14671948 | 2 |
| 59 | 6817856 | 7315520 | 9319714 | 10729943 | 13669567 | 14667368 | 1 |
| 60 | 6819984 | 7313537 | 9325151 | 10723687 | 13673275 | 14662792 | 0 |
| | N Co. Sine. | N. Sine. | N.Co Tang | N. Tangent | N. Co-Secant | N. Secant. | M |

47 DEGREES.

42 DEGREES.

| M | L. Sine. | L. Co. Sine. | L. Tangent | L. Co Tang. | L. Secant. | L Co-Secant. | |
|---|---|---|---|---|---|---|---|
| 0 | 9.8255109 | 9.8710735 | 9.9544374 | 10.0455626 | 10.1289265 | 10.1744891 | 60 |
| 1 | 9.8256512 | 9.8709597 | 9.9546915 | 10.0453085 | 10.1290403 | 10.1743498 | 59 |
| 2 | 9.8257913 | 9.8708458 | 9.9549455 | 10.0450545 | 10.1291542 | 10.1742087 | 58 |
| 3 | 9.8259314 | 9.8707319 | 9.9551995 | 10.0448005 | 10.1292681 | 10.1740686 | 57 |
| 4 | 9.8260715 | 9.8706179 | 9.9554535 | 10.0445465 | 10.1293821 | 10.1739285 | 56 |
| 5 | 9.8262114 | 9.8705039 | 9.9557075 | 10.0442925 | 10.1294961 | 10.1737886 | 55 |
| 6 | 9.8263512 | 9.8703898 | 9.9559615 | 10.0440385 | 10.1296102 | 10.1736488 | 54 |
| 7 | 9.8264910 | 9.8702756 | 9.9562154 | 10.0437846 | 10.1297244 | 10.1735090 | 53 |
| 8 | 9.8266307 | 9.8701613 | 9.9564694 | 10.0435306 | 10.1298387 | 10.1733693 | 52 |
| 9 | 9.8267703 | 9.8700470 | 9.9567233 | 10.0432767 | 10.1299530 | 10.1732297 | 51 |
| 10 | 9.8269098 | 9.8699326 | 9.9569772 | 10.0430228 | 10.1300674 | 10.1730902 | 50 |
| 11 | 9.8270493 | 9.8698182 | 9.9572311 | 10.0427689 | 10.1301818 | 10.1729507 | 49 |
| 12 | 9.8271887 | 9.8697037 | 9.9574850 | 10.0425150 | 10.1302963 | 10.1728113 | 48 |
| 13 | 9.8273279 | 9.8695891 | 9.9577389 | 10.0422611 | 10.1304109 | 10.1726721 | 47 |
| 14 | 9.8274671 | 9.8694744 | 9.9579927 | 10.0420073 | 10.1305256 | 10.1725329 | 46 |
| 15 | 9.8276063 | 9.8693597 | 9.9582465 | 10.0417535 | 10.1306403 | 10.1723937 | 45 |
| 16 | 9.8277453 | 9.8692449 | 9.9585004 | 10.0414996 | 10.1307551 | 10.1722547 | 44 |
| 17 | 9.8278843 | 9.8691301 | 9.9587542 | 10.0412458 | 10.1308699 | 10.1721157 | 43 |
| 18 | 9.8280231 | 9.8690152 | 9.9590080 | 10.0409920 | 10.1309848 | 10.1719769 | 42 |
| 19 | 9.8281619 | 9.8689002 | 9.9592618 | 10.0407382 | 10.1310998 | 10.1718381 | 41 |
| 20 | 9.8283006 | 9.8687851 | 9.9595155 | 10.0404845 | 10.1312149 | 10.1716994 | 40 |
| 21 | 9.8284393 | 9.8686700 | 9.9597693 | 10.0402307 | 10.1313300 | 10.1715607 | 39 |
| 22 | 9.8285778 | 9.8685548 | 9.9600230 | 10.0399770 | 10.1314452 | 10.1714222 | 38 |
| 23 | 9.8287163 | 9.8684396 | 9.9602767 | 10.0397233 | 10.1315604 | 10.1712837 | 37 |
| 24 | 9.8288547 | 9.8682242 | 9.9605305 | 10.0394695 | 10.1316758 | 10.1711453 | 36 |
| 25 | 9.8289930 | 9.8682088 | 9.9607842 | 10.0392158 | 10.1317912 | 10.1710070 | 35 |
| 26 | 9.8291312 | 9.8680934 | 9.9610378 | 10.0389622 | 10.1319066 | 10.1708688 | 34 |
| 27 | 9.8292694 | 9.8679779 | 9.9612915 | 10.0387085 | 10.1320221 | 10.1707306 | 33 |
| 28 | 9.8294075 | 9.8678623 | 9.9615452 | 10.0384548 | 10.1321377 | 10.1705925 | 32 |
| 29 | 9.8295454 | 9.8677466 | 9.9617988 | 10.0382012 | 10.1322534 | 10.1704546 | 31 |
| 30 | 9.8296833 | 9.8676309 | 9.9620525 | 10.0379475 | 10.1323691 | 10.1703167 | 30 |
| 31 | 9.8298212 | 9.8675151 | 9.9623061 | 10.0376939 | 10.1324849 | 10.1701788 | 29 |
| 32 | 9.8299589 | 9.8673992 | 9.9625597 | 10.0374403 | 10.1326008 | 10.1700411 | 28 |
| 33 | 9.8300966 | 9.8672833 | 9.9628133 | 10.0371867 | 10.1327167 | 10.1699034 | 27 |
| 34 | 9.8302342 | 9.8671673 | 9.9630669 | 10.0369331 | 10.1328327 | 10.1697658 | 26 |
| 35 | 9.8303717 | 9.8670512 | 9.9633204 | 10.0366796 | 10.1329488 | 10.1696283 | 25 |
| 36 | 9.8305091 | 9.8669351 | 9.9635740 | 10.0364260 | 10.1330649 | 10.1694909 | 24 |
| 37 | 9.8306464 | 9.8668189 | 9.9638275 | 10.0361725 | 10.1331811 | 10.1693536 | 23 |
| 38 | 9.8307837 | 9.8667026 | 9.9640811 | 10.0359189 | 10.1332974 | 10.1692163 | 22 |
| 39 | 9.8309209 | 9.8665863 | 9.9643346 | 10.0356654 | 10.1334137 | 10.1690791 | 21 |
| 40 | 9.8310580 | 9.8664699 | 9.9645881 | 10.0354119 | 10.1335301 | 10.1689420 | 20 |
| 41 | 9.8311950 | 9.8663534 | 9.9648416 | 10.0351584 | 10.1336466 | 10.1688050 | 19 |
| 42 | 9.8313320 | 9.8662369 | 9.9650951 | 10.0349049 | 10.1337631 | 10.1686680 | 18 |
| 43 | 9.8314688 | 9.8661203 | 9.9653486 | 10.0346514 | 10.1338797 | 10.1685312 | 17 |
| 44 | 9.8316056 | 9.8660036 | 9.9656020 | 10.0343980 | 10.1339964 | 10.1683944 | 16 |
| 45 | 9.8317423 | 9.8658868 | 9.9658555 | 10.0341445 | 10.1341132 | 10.1682577 | 15 |
| 46 | 9.8318789 | 9.8657700 | 9.9661089 | 10.0338911 | 10.1342300 | 10.1681211 | 14 |
| 47 | 9.8320155 | 9.8656531 | 9.9663623 | 10.0336377 | 10.1343469 | 10.1679845 | 13 |
| 48 | 9.8321519 | 9.8655362 | 9.9666157 | 10.0333843 | 10.1344638 | 10.1678481 | 12 |
| 49 | 9.8322883 | 9.8654192 | 9.9668692 | 10.0331308 | 10.1345808 | 10.1677117 | 11 |
| 50 | 9.8324246 | 9.8653021 | 9.9671225 | 10.0328775 | 10.1346979 | 10.1675754 | 10 |
| 51 | 9.8325609 | 9.8651849 | 9.9673759 | 10.0326241 | 10.1348151 | 10.1674391 | 9 |
| 52 | 9.8326970 | 9.8650677 | 9.9676293 | 10.0323707 | 10.1349323 | 10.1673030 | 8 |
| 53 | 9.8328321 | 9.8649504 | 9.9678827 | 10.0321173 | 10.1350496 | 10.1671669 | 7 |
| 54 | 9.8329691 | 9.8648331 | 9.9681360 | 10.0318640 | 10.1351669 | 10.1670309 | 6 |
| 55 | 9.8331050 | 9.8647156 | 9.9683893 | 10.0316107 | 10.1352844 | 10.1668950 | 5 |
| 56 | 9.8332408 | 9.8645981 | 9.9686427 | 10.0313573 | 10.1354019 | 10.1667592 | 4 |
| 57 | 9.8333766 | 9.8644806 | 9.9688960 | 10.0311040 | 10.1355194 | 10.1666234 | 3 |
| 58 | 9.8335122 | 9.8643629 | 9.9691493 | 10.0308507 | 10.1356371 | 10.1664878 | 2 |
| 59 | 9.8336478 | 9.8642452 | 9.9694026 | 10.0305974 | 10.1357548 | 10.1663522 | 1 |
| 60 | 9.8337833 | 9.8641275 | 9.9696559 | 10.0303441 | 10.1358725 | 10.1662167 | 0 |
| | L. Co-Sine. | L Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L. Secant. | M |

47 DEGREES.

43 DEGREES

| M. | N. Sine | N. Co-Sine | N. Tangent | N. Co-Tang. | N. Secant | N. Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 6819984 | 7313537 | 9325151 | 10723687 | 13673275 | 14562792 | 60 |
| 1 | 6822111 | 7311553 | 9330591 | 10717435 | 13676985 | 14658220 | 59 |
| 2 | 6824237 | 7309568 | 9336034 | 10711187 | 13680699 | 14653652 | 58 |
| 3 | 6826363 | 7307583 | 9341479 | 10704943 | 13684416 | 14649088 | 57 |
| 4 | 6828488 | 7305597 | 9346928 | 10698702 | 13688136 | 14644529 | 56 |
| 5 | 6830613 | 7303610 | 9352380 | 10692466 | 13691859 | 14639973 | 55 |
| 6 | 6832737 | 7301623 | 9357834 | 10686233 | 13695586 | 14635422 | 54 |
| 7 | 6834861 | 7299635 | 9363292 | 10680004 | 13699316 | 14630875 | 53 |
| 8 | 6836984 | 7297646 | 9368753 | 10673779 | 13703048 | 14626331 | 52 |
| 9 | 6839107 | 7295657 | 9374216 | 10667558 | 13706784 | 14621792 | 51 |
| 10 | 6841229 | 7293667 | 9379683 | 10661341 | 13710523 | 14617257 | 50 |
| 11 | 6843350 | 7291677 | 9385152 | 10655128 | 13714266 | 14612726 | 49 |
| 12 | 6845471 | 7289686 | 9390625 | 10648918 | 13718011 | 14608198 | 48 |
| 13 | 6847591 | 7287694 | 9396101 | 10642713 | 13721760 | 14603675 | 47 |
| 14 | 6849711 | 7285702 | 9401579 | 10636511 | 13725512 | 14599156 | 46 |
| 15 | 6851830 | 7283709 | 9407061 | 10630313 | 13729268 | 14594641 | 45 |
| 16 | 6853948 | 7281716 | 9412545 | 10624119 | 13733026 | 14590130 | 44 |
| 17 | 6856066 | 7279722 | 9418033 | 10617929 | 13736788 | 14585623 | 43 |
| 18 | 6858183 | 7277727 | 9423523 | 10611742 | 13740553 | 14581120 | 42 |
| 19 | 6860300 | 7275732 | 9429017 | 10605560 | 13744321 | 14576621 | 41 |
| 20 | 6862416 | 7273736 | 9434513 | 10599381 | 13748092 | 14572127 | 40 |
| 21 | 6864532 | 7271740 | 9440013 | 10593206 | 13751867 | 14567636 | 39 |
| 22 | 6866647 | 7269743 | 9445516 | 10587034 | 13755645 | 14563149 | 38 |
| 23 | 6868761 | 7267745 | 9451021 | 10580867 | 13759426 | 14558666 | 37 |
| 24 | 6870875 | 7265747 | 9456530 | 10574703 | 13763210 | 14554187 | 36 |
| 25 | 6872988 | 7263748 | 9462042 | 10568544 | 13766998 | 14549712 | 35 |
| 26 | 6875101 | 7261748 | 9467556 | 10562388 | 13770789 | 14545241 | 34 |
| 27 | 6877213 | 7259748 | 9473074 | 10556235 | 13774583 | 14540774 | 33 |
| 28 | 6879324 | 7257747 | 9478595 | 10550087 | 13778380 | 14536311 | 32 |
| 29 | 6881435 | 7255746 | 9484119 | 10543942 | 13782181 | 14531852 | 31 |
| 30 | 6883545 | 7253744 | 9489646 | 10537801 | 13785985 | 14527397 | 30 |
| 31 | 6885655 | 7251741 | 9495176 | 10531664 | 13789792 | 14522946 | 29 |
| 32 | 6887764 | 7249738 | 9500709 | 10525531 | 13793602 | 14518498 | 28 |
| 33 | 6889873 | 7247734 | 9506245 | 10519401 | 13797416 | 14514055 | 27 |
| 34 | 6891981 | 7245729 | 9511784 | 10513275 | 13801233 | 14509616 | 26 |
| 35 | 6894089 | 7243724 | 9517326 | 10507153 | 13805053 | 14505181 | 25 |
| 36 | 6896196 | 7241718 | 9522871 | 10501034 | 13808877 | 14500749 | 24 |
| 37 | 6898302 | 7239712 | 9528420 | 10494920 | 13812704 | 14496322 | 23 |
| 38 | 6900407 | 7237705 | 9533971 | 10488809 | 13816534 | 14491898 | 22 |
| 39 | 6902512 | 7235698 | 9539526 | 10482702 | 13820367 | 14487478 | 21 |
| 40 | 6904617 | 7233690 | 6545083 | 10476598 | 13824204 | 14483063 | 20 |
| 41 | 6906721 | 7231681 | 9550644 | 10470498 | 13828044 | 14478651 | 19 |
| 42 | 6918824 | 7229671 | 9556208 | 10464402 | 13831887 | 14474243 | 18 |
| 43 | 6910927 | 7227661 | 9561774 | 10458310 | 13835734 | 14469839 | 17 |
| 44 | 6913029 | 7225651 | 9567344 | 10452221 | 13839584 | 14465439 | 16 |
| 45 | 6915131 | 7223640 | 9572917 | 10446136 | 13843437 | 14461043 | 15 |
| 46 | 6917232 | 7221628 | 9578494 | 10440055 | 13847294 | 14456651 | 14 |
| 47 | 6919332 | 7219615 | 9584073 | 10433977 | 13851154 | 14452262 | 13 |
| 48 | 6921432 | 7217602 | 9589655 | 10427904 | 13855017 | 14447878 | 12 |
| 49 | 6923531 | 7215588 | 9595241 | 10421833 | 13858883 | 14443497 | 11 |
| 50 | 6925630 | 7213574 | 9600829 | 10415767 | 13862753 | 14439120 | 10 |
| 51 | 6927728 | 7211559 | 9606421 | 10409704 | 13866626 | 14434748 | 9 |
| 52 | 6929825 | 7209544 | 9612016 | 10403645 | 13870503 | 14430379 | 8 |
| 53 | 6931922 | 7207528 | 9617614 | 10397589 | 13874383 | 14426013 | 7 |
| 54 | 6934018 | 7205511 | 9623215 | 10391537 | 13878266 | 14421652 | 6 |
| 55 | 6936114 | 7203494 | 9628819 | 10385489 | 13882153 | 14417295 | 5 |
| 56 | 6938209 | 7201476 | 9634427 | 10379445 | 13886042 | 14412941 | 4 |
| 57 | 6940304 | 7199457 | 9640037 | 10373404 | 13889936 | 14408591 | 3 |
| 58 | 6942398 | 7197438 | 9645651 | 10367367 | 13893832 | 14404246 | 2 |
| 59 | 6944491 | 7195418 | 9651268 | 10361333 | 13897732 | 14399904 | 1 |
| 60 | 6946584 | 7193398 | 9656888 | 10355303 | 13901636 | 14395565 | 0 |
| M. | N Co-Sine. | N. Sine. | N. Co Tang | N. Tangent. | N. Co-Secant | N. Secant. | M |

46 DEGREES.

43 DEGREES.

| M | L. Sine. | L Co. -Sine | L. Tangent | L. Co. Tang. | L. Secant. | Co L. Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.8337833 | 9.8641275 | 9.9696559 | 10.0303441 | 10.1358725 | 10.1662167 | 60 |
| 1 | 9.8339188 | 9.8640096 | 9.9699091 | 10.0300909 | 10.1359904 | 10.1660812 | 59 |
| 2 | 9.8340541 | 9.8638917 | 9.9701624 | 10.0298376 | 10.1361083 | 10.1659459 | 58 |
| 3 | 9.8341894 | 9.8637737 | 9.9704157 | 10.0295843 | 10.1362263 | 10.1658106 | 57 |
| 4 | 9.8343246 | 9.8636557 | 9.9706689 | 10.0293311 | 10.1363443 | 10.1656754 | 56 |
| 5 | 9.8344597 | 9.8635376 | 9.9709221 | 10.0290779 | 10.1364624 | 10.1655403 | 55 |
| 6 | 9.8345948 | 9.8634194 | 9.9711754 | 10.0288246 | 10.1365806 | 10.1654052 | 54 |
| 7 | 9.8347297 | 9.8633011 | 9.9714286 | 10.0285714 | 10.1366989 | 10.1652703 | 53 |
| 8 | 9.8348646 | 9.8631828 | 9.9716818 | 10.0283182 | 10.1368172 | 10.1651354 | 52 |
| 9 | 9.8349994 | 9.8630644 | 9.9719350 | 10.0280650 | 10.1369356 | 10.1650006 | 51 |
| 10 | 9.8351341 | 9.8629460 | 9.9721882 | 10.0278114 | 10.1370540 | 10.1648659 | 50 |
| 11 | 9.8352688 | 9.8628274 | 9.9724413 | 10.0275587 | 10.1371726 | 10.1647312 | 49 |
| 12 | 9.8354033 | 9.8627088 | 9.9726945 | 10.0273055 | 10.1372912 | 10.1645967 | 48 |
| 13 | 9.8355378 | 9.8625902 | 9.9729477 | 10.0270523 | 10.1374098 | 10.1644622 | 47 |
| 14 | 9.8356722 | 9.8624714 | 9.9732008 | 10.0267992 | 10.1375286 | 10.1643278 | 46 |
| 15 | 9.8358066 | 9.8623526 | 9.9734539 | 10.0265461 | 10.1376474 | 10.1641934 | 45 |
| 16 | 9.8359408 | 9.8622338 | 9.9737071 | 10.0262929 | 10.1377662 | 10.164059 | 44 |
| 17 | 9.8360750 | 9.8621148 | 9.9739602 | 10.0260398 | 10.1378852 | 10.1639250 | 43 |
| 18 | 9.8362091 | 9.8619958 | 9.9742133 | 10.0257867 | 10.1380042 | 10.1637909 | 42 |
| 19 | 9.8363431 | 9.861876 | 9.9744664 | 10.0255336 | 10.1381233 | 10.1636569 | 41 |
| 20 | 9.8364771 | 9.8617576 | 9.9747195 | 10.0252805 | 10.1382424 | 10.1635229 | 40 |
| 21 | 9.8366109 | 9.8616383 | 9.9749726 | 10.0250274 | 10.1383617 | 10.1633891 | 39 |
| 22 | 9.8367447 | 9.8615190 | 9.9752257 | 10.0247743 | 10.1384810 | 10.1632553 | 38 |
| 23 | 9.8368784 | 9.8613997 | 9.9754787 | 10.0245213 | 10.1386003 | 10.1631216 | 37 |
| 24 | 9.8370121 | 9.8612803 | 9.9757318 | 10.0242682 | 10.1387197 | 10.1629879 | 36 |
| 25 | 9.8371456 | 9.8611608 | 9.9759849 | 10.0240151 | 10.1388392 | 10.1628541 | 35 |
| 26 | 9.8372791 | 9.8610412 | 9.9762379 | 10.0237621 | 10.1389588 | 10.1627209 | 34 |
| 27 | 9.8374125 | 9.8609215 | 9.9764909 | 10.0237621 | 10.1390785 | 10.1625875 | 33 |
| 28 | 9.8375458 | 9.8608018 | 9.9767440 | 10.0237560 | 10.1391982 | 10.1624542 | 32 |
| 29 | 9.8376790 | 9.8606821 | 9.9769970 | 10.0230030 | 10.1393179 | 10.1623210 | 31 |
| 30 | 9.8378122 | 9.8605622 | 9.9772500 | 10.0227500 | 10.1394378 | 10.1621878 | 30 |
| 31 | 9.8379453 | 9.8604423 | 9.9775030 | 10.0224970 | 10.1395577 | 10.1620547 | 29 |
| 32 | 9.8380783 | 9.8603223 | 9.9777560 | 10.0222440 | 10.1396777 | 10.1619217 | 28 |
| 33 | 9.8382112 | 9.8602022 | 9.9780090 | 10.0219910 | 10.1397978 | 10.1617888 | 27 |
| 34 | 9.8383441 | 9.8600821 | 9.9782620 | 10.0217380 | 10.1399179 | 10.1616559 | 26 |
| 35 | 9.8384769 | 9.8599619 | 9.9785149 | 10.0214851 | 10.1400381 | 10.1615231 | 25 |
| 36 | 9.8386096 | 9.8598416 | 9.9787679 | 10.0212321 | 10.1401584 | 10.1613904 | 24 |
| 37 | 9.8387422 | 9.8597213 | 9.9790209 | 10.0209791 | 10.1402787 | 10.1612578 | 23 |
| 38 | 9.8388747 | 9.8596009 | 9.9792738 | 10.0207262 | 10.1403991 | 10.1611253 | 22 |
| 39 | 9.8390072 | 9.8594804 | 9.9795268 | 10.0204732 | 10.1405196 | 10.1609928 | 21 |
| 40 | 9.8391399 | 9.8593599 | 9.9797797 | 10.0202203 | 10.1406401 | 10.1608604 | 20 |
| 41 | 9.8392719 | 9.8592393 | 9.9800326 | 10.0199674 | 10.1407607 | 10.1607281 | 19 |
| 42 | 9.8394041 | 9.8591186 | 9.9802856 | 10.0197144 | 10.1408814 | 10.1605959 | 18 |
| 43 | 9.8395363 | 9.8589978 | 9.9805385 | 10.0194615 | 10.1410022 | 10.1604637 | 17 |
| 44 | 9.8396684 | 9.8588770 | 9.9807914 | 10.0192086 | 10.1411230 | 10.1603316 | 16 |
| 45 | 9.8398004 | 9.8587561 | 9.9810443 | 10.0189557 | 10.1412439 | 10.1601995 | 15 |
| 46 | 9.8399323 | 9.8586351 | 9.9812972 | 10.0187028 | 10.1413649 | 10.1600677 | 14 |
| 47 | 9.8400642 | 9.8585141 | 9.9815501 | 10.0184499 | 10.1414859 | 10.1599358 | 13 |
| 48 | 9.8401959 | 9.8583929 | 9.9818030 | 10.0181970 | 10.1416071 | 10.1598041 | 12 |
| 49 | 9.8403276 | 9.8582718 | 9.9820559 | 10.0179441 | 10.1417282 | 10.1596724 | 10 |
| 50 | 9.8404593 | 9.8581505 | 9.9823087 | 10.0176913 | 10.1418495 | 10.1595407 | 11 |
| 51 | 9.8405908 | 9.8580292 | 9.9825616 | 10.0174384 | 10.1419708 | 10.1594092 | 9 |
| 52 | 9.8407223 | 9.8579078 | 9.9828145 | 10.0171855 | 10.1420922 | 10.1592777 | 8 |
| 53 | 9.8408537 | 9.8577863 | 9.9830673 | 10.0169327 | 10.1422137 | 10.1591463 | 7 |
| 54 | 9.8409850 | 9.8576648 | 9.9833202 | 10.0166798 | 10.1423352 | 10.1590150 | 6 |
| 55 | 9.8411162 | 9.8575432 | 9.9835730 | 10.0164270 | 10.1424568 | 10.1588838 | 5 |
| 56 | 9.8412474 | 9.8574215 | 9.9838259 | 10.0161741 | 10.1425785 | 10.1587526 | 4 |
| 57 | 9.8413785 | 9.8572998 | 9.9840787 | 10.0159213 | 10.1427002 | 10.1586215 | 3 |
| 58 | 9.8415095 | 9.8571779 | 9.9843315 | 10.0156685 | 10.1428221 | 10.1584905 | 2 |
| 59 | 9.8416404 | 9.8570561 | 9.9845844 | 10.0154156 | 10.1429439 | 10.1583596 | 1 |
| 60 | 9.8417713 | 9.8569341 | 9.9848372 | 10.0151628 | 10.1430659 | 10.1582287 | 0 |
| | L Co-Sine | L. Sine. | L. Co-Tang. | L. Tangent. | L. Co-Secant | L Secant. | M |

46 DEGREES.

44 DEGREES.

| M | *N. Sine* | *N.Co.Sine.* | *N. Tangent* | *N.Co-Tang.* | *N. Secant.* | *N. Co-Secant.* | |
|---|---|---|---|---|---|---|---|
| 0 | 6946584 | 7193398 | 9656888 | 10355303 | 13901636 | 14395565 | 60 |
| 1 | 6948676 | 7191377 | 9662511 | 10349277 | 13905543 | 14391231 | 59 |
| 2 | 6950767 | 7189355 | 9668137 | 10343254 | 13909453 | 14386900 | 58 |
| 3 | 6952858 | 7187333 | 9673767 | 10337235 | 13913366 | 14382574 | 57 |
| 4 | 6954949 | 7185310 | 9679400 | 10331220 | 13917283 | 14378251 | 56 |
| 5 | 6957039 | 7183287 | 9685035 | 10325208 | 13921203 | 14373932 | 55 |
| 6 | 6959128 | 7181263 | 9690674 | 10319199 | 13925127 | 14369616 | 54 |
| 7 | 6961217 | 7179238 | 9696316 | 10313195 | 13929054 | 14365305 | 53 |
| 8 | 6963305 | 7177213 | 9701962 | 10307194 | 13932985 | 14360997 | 52 |
| 9 | 6965392 | 7175187 | 9707610 | 10301196 | 13936918 | 14356693 | 51 |
| 10 | 6967479 | 7173161 | 9713262 | 10295203 | 13940856 | 14352393 | 50 |
| 11 | 6969565 | 7171134 | 9718917 | 10289212 | 13944796 | 14348097 | 49 |
| 12 | 6971651 | 7169106 | 9724575 | 10283226 | 13948740 | 14343805 | 48 |
| 13 | 6973736 | 7167078 | 9730236 | 10277243 | 13952688 | 14339516 | 47 |
| 14 | 6975821 | 7165049 | 9735901 | 10271263 | 13956639 | 14335231 | 46 |
| 15 | 6977905 | 7163019 | 9741569 | 10265287 | 13960593 | 14330950 | 45 |
| 16 | 6979988 | 7160989 | 9747240 | 10259315 | 13964551 | 14326672 | 44 |
| 17 | 6982071 | 7158958 | 9752914 | 10253346 | 13968512 | 14322399 | 43 |
| 18 | 6984153 | 7156927 | 9758591 | 10247381 | 13972477 | 14318129 | 42 |
| 19 | 6986234 | 7154895 | 9764272 | 10241419 | 13976445 | 14313863 | 41 |
| 20 | 6988315 | 7152863 | 9769956 | 10235461 | 13980416 | 14309600 | 40 |
| 21 | 6990396 | 7150830 | 9775643 | 10229506 | 13984391 | 14305342 | 39 |
| 22 | 6992476 | 7148796 | 9781333 | 10223455 | 13988369 | 14301087 | 38 |
| 23 | 6994555 | 7146763 | 9787027 | 10217608 | 13992351 | 14296836 | 37 |
| 24 | 6996633 | 7144727 | 9792724 | 10211664 | 13996336 | 14292588 | 36 |
| 25 | 6998711 | 7142691 | 9798424 | 10205723 | 14000325 | 14288344 | 35 |
| 26 | 7000789 | 7140655 | 9804127 | 10199786 | 14004317 | 14284104 | 34 |
| 27 | 7002866 | 7138618 | 9809833 | 10193853 | 14008313 | 14279868 | 33 |
| 28 | 7004942 | 7136581 | 9815543 | 10187923 | 14012312 | 14275636 | 32 |
| 29 | 7007018 | 7134543 | 9821256 | 10181997 | 14016315 | 14271407 | 31 |
| 30 | 7009093 | 7132505 | 9826973 | 10176074 | 14020321 | 14267182 | 30 |
| 31 | 7011167 | 7130466 | 9832692 | 10170155 | 14024330 | 14262961 | 29 |
| 32 | 7013241 | 7128426 | 9838415 | 10164239 | 14028343 | 14258743 | 28 |
| 33 | 7015314 | 7126385 | 9844141 | 10158326 | 14032360 | 14254929 | 27 |
| 34 | 7017387 | 7124344 | 9849871 | 10152417 | 14036380 | 14250319 | 26 |
| 35 | 7019459 | 7122302 | 9855603 | 10146512 | 14040403 | 14246112 | 25 |
| 36 | 7021530 | 7120260 | 9861339 | 10140610 | 14044430 | 14241909 | 24 |
| 37 | 7023601 | 7118217 | 9867079 | 10134712 | 14048460 | 14237710 | 23 |
| 38 | 7025671 | 7116174 | 9872821 | 10128817 | 14052494 | 14233514 | 22 |
| 39 | 7027741 | 7114130 | 9878567 | 10122925 | 14056532 | 14229323 | 21 |
| 40 | 7029810 | 7112086 | 9884316 | 10117037 | 14060573 | 14225134 | 20 |
| 41 | 7031879 | 7110041 | 9890069 | 10111153 | 14064617 | 14220950 | 19 |
| 42 | 7033947 | 7107995 | 9895825 | 10105272 | 14068665 | 14216769 | 18 |
| 43 | 7036014 | 7195948 | 9901584 | 10099394 | 14072717 | 14212592 | 17 |
| 44 | 7038081 | 7103901 | 9907346 | 10093520 | 14076772 | 14208418 | 16 |
| 45 | 7040147 | 7101854 | 9913112 | 10087649 | 14080831 | 14204248 | 15 |
| 46 | 7042213 | 7099806 | 9918881 | 10081782 | 14084893 | 14200082 | 14 |
| 47 | 7044278 | 7097757 | 9924654 | 10075918 | 14088958 | 14195919 | 13 |
| 48 | 7046342 | 7095707 | 9930429 | 10070058 | 14093028 | 14191761 | 12 |
| 49 | 7048406 | 7093657 | 9936208 | 10064201 | 14097100 | 14187605 | 11 |
| 50 | 7050469 | 7091607 | 9941991 | 10058347 | 14101177 | 14183454 | 10 |
| 51 | 7052532 | 7089556 | 9947777 | 10052497 | 14105256 | 14179305 | 9 |
| 52 | 7054594 | 7087504 | 9953566 | 10046651 | 14109340 | 14175161 | 8 |
| 53 | 7056655 | 7085451 | 9959358 | 10040807 | 14113427 | 14171020 | 7 |
| 54 | 7058716 | 7083398 | 9965154 | 10034968 | 14117517 | 14166883 | 6 |
| 55 | 7060776 | 7081345 | 9970953 | 10029131 | 14121611 | 14162749 | 5 |
| 56 | 7062835 | 7079291 | 9976756 | 10023298 | 14125709 | 14158619 | 4 |
| 57 | 7064894 | 7077236 | 9982562 | 10017469 | 14129810 | 14154493 | 3 |
| 58 | 7066953 | 7075180 | 9988371 | 10011642 | 14133915 | 14150370 | 2 |
| 59 | 7069011 | 7073124 | 9994184 | 10005819 | 14138024 | 14146251 | 1 |
| 60 | 7071068 | 7071068 | 10000000 | 10000000 | 14142136 | 14142136 | 0 |
| | *N.Co.Sine.* | *N. Sine.* | *L.Co Tang.* | *N.Tangent.* | *N. Co-Secant* | *N.Secant.* | M |

45 DEGREES.

*The* END *of the* TABLE *of*

44 DEGREES.

| M | L. Sine. | L Co.-Sine | L. Tangent | L. Co.Tang. | L. Secant. | L Co-Secant | |
|---|---|---|---|---|---|---|---|
| 0 | 9.8417713 | 9.8569341 | 9.9848327 | 10.0151628 | 10.1430659 | 10.1582287 | 60 |
| 1 | 9.8419021 | 9.8568121 | 9.9850900 | 10.0149100 | 10.1431879 | 10.1580979 | 59 |
| 2 | 9.8420328 | 9.8566900 | 9.9853428 | 10.0146572 | 10.1433100 | 10.1579672 | 58 |
| 3 | 9.8421634 | 9.8565679 | 9.9855956 | 10.0144044 | 10.1434322 | 10.1578366 | 57 |
| 4 | 9.8422939 | 9.8564455 | 9.9858484 | 10.0141516 | 10.1435545 | 10.1577061 | 56 |
| 5 | 9.8424244 | 9.8563232 | 9.9861012 | 10.0138988 | 10.1436768 | 10.1575756 | 55 |
| 6 | 9.8425548 | 9.8562008 | 9.9863540 | 10.0136460 | 10.1437992 | 10.1574452 | 54 |
| 7 | 9.8426851 | 9.8560784 | 9.9866068 | 10.0133932 | 10.1439216 | 10.1573149 | 53 |
| 8 | 9.8428154 | 9.8559558 | 9.9868596 | 10.0131404 | 10.1440442 | 10.1571846 | 52 |
| 9 | 9.8429456 | 9.8558332 | 9.9871123 | 10.0128877 | 10.1441668 | 10.1570544 | 51 |
| 10 | 9.8430757 | 9.8557106 | 9.9873651 | 10.0126349 | 10.1442894 | 10.1569243 | 50 |
| 11 | 9.8432057 | 9.8555878 | 9.9876179 | 10.0123821 | 10.1444122 | 10.1567943 | 49 |
| 12 | 9.8433356 | 9.8554650 | 9.9878706 | 10.0121294 | 10.1445350 | 10.1566644 | 48 |
| 13 | 9.8434655 | 9.8553421 | 9.9881234 | 10.0118766 | 10.1446579 | 10.1565345 | 47 |
| 14 | 9.8435953 | 9.8552192 | 9.9883761 | 10.0116239 | 10.1447808 | 10.1564047 | 46 |
| 15 | 9.8437250 | 9.8550961 | 9.9886289 | 10.0113711 | 10.1449039 | 10.1562750 | 45 |
| 16 | 9.8438547 | 9.8549730 | 9.9888816 | 10.0111184 | 10.1450270 | 10.1561453 | 44 |
| 17 | 9.8439842 | 9.8548499 | 9.9891344 | 10.0108656 | 10.1451501 | 10.1560158 | 43 |
| 18 | 9.8441137 | 9.8547266 | 9.9893871 | 10.0106129 | 10.1452734 | 10.1558863 | 42 |
| 19 | 9.8442432 | 9.8546033 | 9.9896399 | 10.0103601 | 10.1453967 | 10.1557568 | 41 |
| 20 | 9.8443725 | 9.8544799 | 9.9898926 | 10.0100014 | 10.1455201 | 10.1556275 | 40 |
| 21 | 9.8445018 | 9.8543564 | 9.9901453 | 10.0098547 | 10.1456436 | 10.1554982 | 39 |
| 22 | 9.8446310 | 9.8542329 | 9.9903981 | 10.0096019 | 10.1457671 | 10.1553690 | 38 |
| 23 | 9.8447601 | 9.8541093 | 9.9906508 | 10.0093492 | 10.1458907 | 10.1552399 | 37 |
| 24 | 9.8448891 | 9.8539856 | 9.9909035 | 10.0090965 | 10.1460144 | 10.1551109 | 36 |
| 25 | 9.8450181 | 9.8538619 | 9.9911562 | 10.0088438 | 10.1461381 | 10.1549819 | 35 |
| 26 | 9.8451470 | 9.8537381 | 9.9914089 | 10.0085911 | 10.1462619 | 10.1548530 | 34 |
| 27 | 9.8452758 | 9.8536142 | 9.9916616 | 10.0083384 | 10.1463858 | 10.1547242 | 33 |
| 28 | 9.8454045 | 9.8534902 | 9.9919143 | 10.0080857 | 10.1465098 | 10.1545955 | 32 |
| 29 | 9.8455332 | 9.8533662 | 9.9921670 | 10.0078330 | 10.1466338 | 10.1544668 | 31 |
| 30 | 9.8456618 | 9.8532421 | 9.9924197 | 10.0075803 | 10.1467579 | 10.1543382 | 30 |
| 31 | 9.8457903 | 9.8531179 | 9.9926724 | 10.0073276 | 10.1468821 | 10.1542097 | 29 |
| 32 | 9.8459188 | 9.8529936 | 9.9929251 | 10.0070749 | 10.1470064 | 10.1540812 | 28 |
| 33 | 9.8460471 | 9.8528693 | 9.9931778 | 10.0068222 | 10.1471307 | 10.1539519 | 27 |
| 34 | 9.8461754 | 9.8527449 | 9.9934305 | 10.0065695 | 10.1472551 | 10.1538246 | 26 |
| 35 | 9.8463036 | 9.8526204 | 9.9936832 | 10.0063168 | 10.1473796 | 10.1536964 | 25 |
| 36 | 9.8464318 | 9.8524959 | 9.9939359 | 10.0060641 | 10.1475041 | 10.1535682 | 24 |
| 37 | 9.8465599 | 9.8523713 | 9.9941886 | 10.0058114 | 10.1476287 | 10.1534401 | 23 |
| 38 | 9.8466879 | 9.8522466 | 9.9944413 | 10.0055587 | 10.1477534 | 10.1533121 | 22 |
| 39 | 9.8468158 | 9.8521218 | 9.9946940 | 10.0053060 | 10.1478782 | 10.1531842 | 21 |
| 40 | 9.8469436 | 9.8519970 | 9.9949466 | 10.0050534 | 10.1480030 | 10.1530564 | 20 |
| 41 | 9.8470714 | 9.8518721 | 9.9951993 | 10.0048007 | 10.1481279 | 10.1529286 | 19 |
| 42 | 9.8471991 | 9.8517471 | 9.9954520 | 10.0045480 | 10.1482529 | 10.1528009 | 18 |
| 43 | 9.8473267 | 9.8516220 | 9.9957047 | 10.0042953 | 10.1483780 | 10.1526733 | 17 |
| 44 | 9.8474543 | 9.8514969 | 9.9959573 | 10.0040427 | 10.1485031 | 10.1525457 | 16 |
| 45 | 9.8475817 | 9.8513717 | 9.9962100 | 10.0037900 | 10.1486283 | 10.1524183 | 15 |
| 46 | 9.8477091 | 9.8512465 | 9.9964627 | 10.0035373 | 10.1487535 | 10.1522909 | 14 |
| 47 | 9.8478365 | 9.8511211 | 9.9967154 | 10.0032846 | 10.1488789 | 10.1521635 | 13 |
| 48 | 9.8479637 | 9.8509957 | 9.9969680 | 10.0030320 | 10.1490043 | 10.1520363 | 12 |
| 49 | 9.8480909 | 9.8508702 | 9.9972207 | 10.0027793 | 10.1491298 | 10.1519091 | 11 |
| 50 | 9.8482180 | 9.8507446 | 9.9974734 | 10.0025266 | 10.1492554 | 10.1517820 | 10 |
| 51 | 9.8483450 | 9.8506190 | 9.9977260 | 10.0022740 | 10.1493810 | 10.1516550 | 9 |
| 52 | 9.8484720 | 9.8504933 | 9.9979787 | 10.0020213 | 10.1495067 | 10.1515280 | 8 |
| 53 | 9.8485989 | 9.8503675 | 9.9982314 | 10.0017686 | 10.1496325 | 10.1514011 | 7 |
| 54 | 9.8487257 | 9.8502417 | 9.9984840 | 10.0015160 | 10.1497583 | 10.1512743 | 6 |
| 55 | 9.8488524 | 9.8501157 | 9.9987367 | 10.0012633 | 10.1498843 | 10.1511476 | 5 |
| 56 | 9.8489791 | 9.8499897 | 9.9989893 | 10.0010107 | 10.1500103 | 10.1510209 | 4 |
| 57 | 9.8491057 | 9.8498637 | 9.9992420 | 10.0007580 | 10.1501363 | 10.1508943 | 3 |
| 58 | 9.8492322 | 9.8497375 | 9.9994947 | 10.0005053 | 10.1502725 | 10.1507678 | 2 |
| 59 | 9.8493586 | 9.8496113 | 9.9997473 | 10.0002527 | 10.1503887 | 10.1506414 | 1 |
| 60 | 9.8494850 | 9.8494850 | 10.0000000 | 10.0000000 | 10.1505150 | 10.1505150 | 0 |
| | *L Co Sine* | *L. Sine* | *L. Co-Tang.* | *L Tangent* | *L. Co-Secant* | *L. Secant.* | M |

45 DEGREES.

# THE Description and Use OF THE TABLES OF *Natural* and *Artificial Sines*, *Tangents*, and *Secants*.

THESE are continued to every Degree and Minute of the Quadrant.

1. And the first thing to be done is to know how to take out the Sine, Tangent or Secant, whether *Natural* or *Logarithmical*, of any Degrees, or Minutes.

In order to which you will find, that the Natural Numbers are always in the Left-hand Page, and the Artificial or Logarithmical on the Right-hand Pages: So that for every Degree and Minute of the Quadrant, you have before you, one right against the other, the Natural and Logarithmic Sines, Tangents and Secants, with their Complements placed by them.

2. If therefore the Number of the Degrees of any Ark or Angle given be under 45°, you must look for it at the Head of the Table; but if it exceed 45°, you will find it at the Bottom or Foot; and as in the former Case you find the Minutes under M increasing downwards on the Left-hand of the Page; so in the latter, they begin at the Bottom of the Page on the Right-hand of it and increase upward.

Thus, if you look for 23 Degrees 13 Minutes, you will find in Page 48 of the Tables, and its *Natural Sine* will be 3942093, its *Natural Tangent* 4289449, *&c.* and in the Right-hand Page its *Artificial Sine* will be 9.5957268, and its *Logarithmical Tangent* 9.6324015, *&c.*

But if the Degrees given had been more than 45°, as suppose 61°. 25′. then you turn till you come to those Degrees at the Foot of the Table; which you will find in Page 58. 59 and there you will find (reckoning the 23 upwards in the Right-hand Column of Minutes over M) that the *Natural Sine* will be 8781222, and the *Natural Tangent* will be 18353999; the *Logarithmick Sine* will be 9.9435549, and the *Logarithmick Tangent* will be 10.2637307; and so for the *Secants*, &c.

3. If you want the Natural or Artificial Sine, Tangent or Secant of any Ark greater than 90°. as suppose of 123°, 11′ you must first substract it from 180 if it be less than it, or from 360 when 'tis greater than 180; and then seek in the Tables for the Sine, Tangent or Secant of the Remainder. Thus 123°. 11′. substracted from 180° leaves 56°. 49′. whose Sine, or Tangent must be sought in the Tables, as is shewn above.

4. And when this is understood, the *Inverse Practice* of finding the Degrees and Minutes answering to any Sine, Tangent or Secant given, will be easie.

Thus suppose you would have the Degrees and Minutes answering to 7027782, a Natural Sine: you must look amongst the Natural Sines, either downward or upward, till you find the Number given, and then on the Top or Bottom you will have the Degrees; and the Minutes on the Right or Left-hand in the Column marked M accordingly; and so you will find the Degrees and Minutes answering to the Natural Sine 7027782, to be 44° 39′ For tho' it be not to be found there exactly, yet the nearest to it is 7027741; whose Deg. and Min. are 44°. 39′. and so you must always do when you cant find the Numbers exactly; which will most times be the case.

Thus the Arch to the Log. Sine 8.8647376, will be found to be 4°. 12′, *&c.*

How these Tables are useful in all kinds of Trigonometrical Calculations; as in Navigation, Dialling, Astronomy, *&c.* all Treatises on those Subjects do acquaint us.

*N.B.* There hath very great Care been taken in the Correction of these Tables and those of the *Logarithms*, and I believe very few Faults have been committed; but whenever the *Calculator* finds Reason to suspect the Tables, it will be very easie for him, by considering the Course and Proportion of the Encrease or Decrease of the Numbers in the Tables, as they stand near that which he judges faulty, either above or below it, to find out nearly what Figure is wrong, and how much or how little; as Experience will soon teach him.

Deg. 0. 1, 2, 3. A Table of Natural Verſed

| M | N. 0 | N. 1 | N. 2 | N. 3 | L. 0 | L. 1 | L. 2 | L. 3 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000.000 | 0001.523 | 0006.094 | 0013.705 | 0.0000000 | 6.1827137 | 6.7847406 | 7.1368680 | 0 |
| 1 | 0000.001 | 0001.574 | 0006.194 | 0013.857 | 2.6264222 | 6.1970707 | 6.7919482 | 7.1416791 | 1 |
| 2 | .002 | 1.626 | 6.296 | 14.011 | 3.2284822 | 6.2111938 | 6.7990963 | 7.1464636 | 2 |
| 3 | .004 | 1.679 | 6.400 | 14.165 | 3.5806647 | 6.2250913 | 6.8061860 | 7.1512219 | 3 |
| 4 | 007 | 1.733 | 6.505 | 14 320 | 3.8305422 | 6.2387696 | 6.8132185 | 7.1559542 | 4 |
| 5 | .011 | 1.788 | 6.610 | 14.476 | 4.0243620 | 6.2522361 | 6.8201944 | 7.1606609 | 5 |
| 6 | .016 | 1.843 | 6.716 | 14.633 | 4.1827246 | 6.2654968 | 6.8271147 | 7.1653422 | 6 |
| 7 | 0000.022 | 0001.899 | 0006.823 | 0014.791 | 4.3166182 | 6.2785581 | 6.8339812 | 7.1699984 | 7 |
| 8 | .028 | 1.956 | 6.931 | 14.950 | 4.4326020 | 6.2914259 | 6.8407920 | 7.1746297 | 8 |
| 9 | .035 | 2.014 | 7.040 | 15.109 | 4.5349070 | 6.3041058 | 6.8475506 | 7.1792365 | 9 |
| 10 | .043 | 2.073 | 7.150 | 15.269 | 4.6264219 | 6.3166033 | 6.8542572 | 7.1838189 | 10 |
| 11 | .052 | 2.133 | 7.260 | 15.430 | 4.7092072 | 6.3289234 | 6.8609122 | 7.1883773 | 11 |
| 12 | .062 | 2.194 | 7.371 | 15.592 | 4.7847843 | 6.3410714 | 6,8675167 | 7.1929118 | 12 |
| 13 | 0000.073 | 0002.255 | 0007.483 | 0015.755 | 4.8543084 | 6.3530516 | 6.8740712 | 7.1974228 | 13 |
| 14 | .084 | 2.317 | 7.596 | 15.919 | 4.9186777 | 6.3648689 | 6.8805768 | 7.2019104 | 14 |
| 15 | .096 | 2.380 | 7,701 | 16.083 | 4.9786040 | 6.3765275 | 6.8870338 | 7.2063750 | 15 |
| 16 | .109 | 2.444 | 7 825 | 16.248 | 5.0346614 | 6.3880317 | 6.8934434 | 7.2108167 | 16 |
| 17 | .123 | 2.509 | 7.940 | 16.414 | 5.0873192 | 6.3993855 | 6.8998058 | 7.2152358 | 17 |
| 18 | .138 | 2.575 | 8.056 | 16.581 | 5.1369663 | 6.4105928 | 6.9061221 | 7.2196326 | 18 |
| 19 | 0000.154 | 0002.641 | 0008.173 | 0016.749 | 5.1839282 | 6.4216574 | 6.9123926 | 7.2240071 | 19 |
| 20 | .170 | 2.708 | 8.291 | 16.918 | 5.2284810 | 6.4325826 | 6.9186183 | 7.2283597 | 20 |
| 21 | .187 | 2.776 | 8.410 | 17.088 | 5.2708594 | 6.4433603 | 6.9248004 | 7.2326906 | 21 |
| 22 | .205 | 2.845 | 8.530 | 17.258 | 5.3112661 | 6.4540294 | 6.9309372 | 7 2370000 | 22 |
| 23 | .224 | 2.915 | 8.651 | 17.429 | 5.3498762 | 6.4645573 | 6.9370316 | 7.2412881 | 23 |
| 24 | .244 | 2.986 | 8 772 | 17.601 | 5.3868430 | 6.4749592 | 6.9430837 | 7.2455551 | 24 |
| 25 | 0000.265 | 0003.057 | 0008.894 | 0017.774 | 5.4223002 | 6.4852380 | 6.9490938 | 7.2498013 | 25 |
| 26 | .287 | 3.129 | 9.017 | 17 948 | 5.4563669 | 6.4953965 | 6.9550627 | 7.2540267 | 26 |
| 27 | .309 | 3.202 | 9.141 | 18.123 | 5.4891474 | 6.5054376 | 6.9609886 | 7.2582317 | 27 |
| 28 | .332 | 3.276 | 9.266 | 18.299 | 5.5207359 | 6.5153639 | 6.9668786 | 7.2624164 | 28 |
| 29 | .356 | 3.351 | 9.392 | 18.475 | 5.5512156 | 6.5251780 | 6.9727272 | 7.2665810 | 29 |
| 30 | .381 | 3.427 | 9.518 | 18.652 | 5.5806620 | 6.5348825 | 6.9785359 | 7.2707258 | 30 |
| 31 | 0000.407 | 0003.504 | 0009.645 | 0018.830 | 5.6091426 | 6.5444797 | 6.9843062 | 7.2748508 | 31 |
| 32 | .434 | 3.581 | 9.773 | 19.009 | 5.6367191 | 6 5539720 | 6.9900387 | 7.2789563 | 32 |
| 33 | .461 | 3.659 | 9.920 | 19.189 | 5.6634468 | 6.5633617 | 6.9957334 | 7.2830425 | 33 |
| 34 | .489 | 3.738 | 10.032 | 19.369 | 5.6893765 | 6.5726509 | 7.0013911 | 7.2871095 | 34 |
| 35 | .518 | 3.818 | 10.163 | 19.550 | 5.7145546 | 6.5818418 | 7.0069920 | 7.2911576 | 35 |
| 36 | .548 | 3.899 | 10.294 | 19.732 | 5.7390233 | 6.5909365 | 7.0125969 | 7.2951869 | 36 |
| 37 | 0000.579 | 0003.981 | 0010.426 | 0019.925 | 5.7628214 | 6.5999368 | 7.0182460 | 7.2991975 | 37 |
| 38 | .611 | 4.063 | 10.559 | 20.099 | 5.7859850 | 6.6088450 | 7.0236600 | 7.3031897 | 38 |
| 39 | .644 | 4.146 | 10.693 | 20.284 | 5.8085468 | 6.6176626 | 7.0291390 | 7.3071636 | 39 |
| 40 | .677 | 4.230 | 10.828 | 20.470 | 5.8305373 | 6.6263916 | 7.0345838 | 7.3111194 | 40 |
| 41 | .711 | 4.315 | 10.964 | 20.657 | 5.8519848 | 6.6350337 | 7.0399946 | 7.3150572 | 41 |
| 42 | .746 | 4.401 | 10.101 | 20.844 | 5.8729154 | 6.6435907 | 7.0453719 | 7.3189773 | 42 |
| 43 | 0000.782 | 0004.488 | 0011.239 | 0021.032 | 5.8933534 | 6.6520642 | 7.0507160 | 7.3228797 | 43 |
| 44 | .819 | 4.576 | 11.377 | 21.221 | 5.9133217 | 6.6604558 | 7.0560276 | 7.3267646 | 44 |
| 45 | .857 | 4.664 | 11.516 | 21.411 | 5.9328412 | 6.6687671 | 7.0613068 | 7.3306322 | 45 |
| 46 | .896 | 4.753 | 11.656 | 21.602 | 5.9519314 | 6.6769996 | 7.0665540 | 7.3344827 | 46 |
| 47 | .935 | 4.843 | 11.797 | 21.793 | 5.9706112 | 6.6851548 | 7.0717698 | 7.3383161 | 47 |
| 48 | .975 | 4.934 | 11.939 | 21.985 | 5.9888977 | 6.6932340 | 7.0769544 | 7.3421327 | 48 |
| 49 | 0001.016 | 0005.026 | 0012.082 | 0022.178 | 6.0068070 | 6.7012388 | 7.0821082 | 7.3459326 | 49 |
| 50 | 1.058 | 5.119 | 12.225 | 22.372 | 6.0243546 | 6.7091706 | 7.0872316 | 7.3497159 | 50 |
| 51 | 1 101 | 5.213 | 12.369 | 22.567 | 6 0415546 | 6.7170304 | 7.0923238 | 7.3534828 | 51 |
| 52 | 1.145 | 5.307 | 12.514 | 22.763 | 6.0584206 | 6.7248199 | 7.0973885 | 7.3572334 | 52 |
| 53 | 1.189 | 5.402 | 12.660 | 22.960 | 6.0749654 | 6.7325400 | 7.1024228 | 7.3609678 | 53 |
| 54 | 1.234 | 5.498 | 12.807 | 23.157 | 6.0912008 | 6.7401921 | 7.1074280 | 7.3646863 | 54 |
| 55 | 0001.280 | 0005.595 | 0012.955 | 0023.355 | 6.1071384 | 6.7477774 | 7.1124044 | 7.3683888 | 55 |
| 56 | 1.327 | 5.693 | 13.103 | 23 554 | 6.1227887 | 6.7552970 | 7.1173527 | 7.3720757 | 56 |
| 57 | 1.375 | 5.792 | 13.252 | 23.754 | 6.1381620 | 6.7627520 | 7.1222728 | 7.3757469 | 57 |
| 58 | 1.424 | 5.891 | 13.402 | 23 955 | 6.1532679 | 6.7701436 | 7.1271652 | 7.3794027 | 58 |
| 59 | 1.473 | 5.991 | 13.553 | 24.157 | 6.1681156 | 6.7774728 | 7.1320302 | 7.3830431 | 59 |
| 60 | 1.523 | 6.092 | 13.705 | 24.360 | 6.1827137 | 6.7847406 | 7.1368680 | 7.3866683 | 60 |

Sines and their Logarithms. Deg. 89, 88, 87, 86.

| M | L. 89 | L. 88 | L. 87 | L. 86 | N. 89 | N. 88. | N 87 | N. 86 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | [illegible] | 9.9923536 | 9.9845725 | 9.9765544 | 10000000 | 9825.476 | 9651 005 | 9476.640 | 60 |
| 59 | 9.9998736 | 9.9922250 | 9.9844417 | 9.9765212 | 9997.091 | 9822.567 | 9648.098 | 9473.735 | 59 |
| 58 | 9.9997473 | 9.9920964 | 9.9843108 | 9.9763881 | 9994.182 | 9819.659 | 9645.191 | 9470.830 | 58 |
| 57 | 9.9996208 | 9.9919677 | 9.9841799 | 9.9762548 | 9991.273 | 9816,750 | 9642.284 | 9467.925 | 57 |
| 56 | 9.9994944 | 9.9918391 | 9.9840490 | 9.9761216 | 9988.364 | 9813.842 | 9639,337 | 9465.020 | 56 |
| 55 | 9.9993679 | 9.9917103 | 9.9839179 | 9.9759883 | 9985.456 | 9810 934 | 9636.470 | 9462.116 | 55 |
| 54 | 9.9992414 | 9.9915816 | 9.9837869 | 9.9758550 | 9682.547 | 9808.025 | 9633.563 | 9459 211 | 54 |
| 53 | 9.9991148 | 9.9914528 | 9 9835559 | 9.9757216 | 9979.638 | 9805.117 | 9630.656 | 9456.306 | 53 |
| 52 | 9.9989882 | 9.9913240 | 9.9835248 | 9.9755882 | 9976.729 | 9802.208 | 9627.749 | 9453.402 | 52 |
| 51 | 9 9988615 | 9.9911951 | 9.9833936 | 9.9754547 | 9973.820 | 9799.300 | 9624.842 | 9450.497 | 51 |
| 50 | 9.9987348 | 9.9910662 | 9.9832624 | 9 9753212 | 9970.912 | 9796.392 | 9621.936 | 9447.593 | 50 |
| 49 | 9 9986081 | 9.9909372 | 9.9831312 | 9.9751877 | 9968.003 | 9793.483 | 9619.029 | 9444.688 | 49 |
| 48 | 9.9984814 | 9.9908082 | 9.9830000 | 9.9750541 | 9965.094 | 9790.575 | 9616.122 | 9441.784 | 48 |
| 47 | 9.9983546 | 9.9906792 | 9.9828686 | 9.9749205 | 9962.185 | 9787.667 | 9613.215 | 9438.880 | 47 |
| 46 | 9.9982278 | 9.9905501 | 9.9827373 | 9.9747868 | 9959.276 | 9784.759 | 9610.308 | 9435.976 | 46 |
| 45 | 9.9981009 | 9.9904210 | 9.9826059 | 9.9746531 | 9956.368 | 9781.851 | 9607.402 | 9433.072 | 45 |
| 44 | 9.9979740 | 9.9902919 | 9.9824745 | 9.9745194 | 9953.459 | 9778.943 | 9604.495 | 9430.168 | 44 |
| 43 | 9.9978470 | 9.9901627 | 9 9823431 | 9.9743856 | 9950.550 | 9776.035 | 9601.588 | 9427.264 | 43 |
| 42 | 9.9977201 | 9.9900335 | 9.9822116 | 9 9742519 | 9947.641 | 9773,127 | 9598.682 | 9424.360 | 42 |
| 41 | 9.9975930 | 9.9899043 | 9.9820801 | 9.9741180 | 9944.732 | 9770.219 | 9595.775 | 9421.456 | 41 |
| 40 | 9.9974660 | 9.9897750 | 9.9819485 | 9.9739841 | 9941.823 | 9767.311 | 9592.869 | 9418.552 | 40 |
| 39 | 9.9973389 | 9.9896456 | 9.9818169 | 9.9738502 | 9938.914 | 9764.403 | 9589.962 | 9415.648 | 39 |
| 38 | 9.9972118 | 9.9895163 | 9.9816853 | 9.9737162 | 9936.005 | 9761.495 | 9587.056 | 9412.744 | 38 |
| 37 | 9 9970846 | 9.9893869 | 9 9815536 | 9.9735822 | 9933.096 | 9758.587 | 9584.149 | 9409.840 | 37 |
| 36 | 9.9969574 | 9.9892575 | 9.9814219 | 9.9734482 | 9930.187 | 9755.679 | 9581.243 | 9406.936 | 36 |
| 35 | 9.9968302 | 9.9891280 | 9.9812901 | 9.9733141 | 9927.279 | 9752.771 | 9578.337 | 9404.033 | 35 |
| 34 | 9.9967029 | 9.9889985 | 9.9811583 | 9.9731800 | 9924.370 | 9749.863 | 9575.430 | 9401.129 | 34 |
| 33 | 9.9965756 | 9.9888689 | 9.9810265 | 9.9730458 | 9921.461 | 9746.955 | 9572.524 | 9398.225 | 33 |
| 32 | 9.9964483 | 9.9887393 | 9.9808946 | 9.9729117 | 9918.552 | 9744 047 | 9569.618 | 9395.322 | 32 |
| 31 | 9.9963209 | 9.9886097 | 9.9807627 | 9.9727774 | 9915.643 | 9741.139 | 9566.712 | 9392.418 | 31 |
| 30 | 9.9961935 | 9.9884801 | 9.9806308 | 9.9726431 | 9912.735 | 9738.231 | 9563.806 | 9389.515 | 30 |
| 29 | 9.9960660 | 9.9883503 | 9.9804988 | 9 9725088 | 9909.826 | 9735.323 | 9560.900 | 9386.611 | 29 |
| 28 | 9.9959385 | 9.9882206 | 9.9803668 | 9.9723745 | 9906.917 | 9732.415 | 9557.994 | 9383.708 | 28 |
| 27 | 9.9958110 | 9.9880908 | 9.9802347 | 9.9722401 | 9904.008 | 9729.507 | 9555.088 | 9380.804 | 27 |
| 26 | 9 9956834 | 9.9879610 | 9.9801026 | 9.9721056 | 9901.099 | 9726.599 | 9552.182 | 9377.901 | 26 |
| 25 | 9.9955558 | 9.9878311 | 9.9799704 | 9.9719712 | 9898.191 | 9723.692 | 9549.276 | 9374.998 | 25 |
| 24 | 9.9954282 | 9.9877013 | 9.9798383 | 9.9718367 | 9895.282 | 9720.784 | 9546.370 | 9372.095 | 24 |
| 23 | 9.9953005 | 9.9875713 | 9.9797062 | 9.9717021 | 9892.373 | 9717.876 | 9543.464 | 9369.192 | 23 |
| 22 | 9.9951728 | 9.9874414 | 9.9795738 | 9.9715675 | 9889.464 | 9714.968 | 9540.558 | 9366.289 | 22 |
| 21 | 9.9950450 | 9.9873114 | 9.9794415 | 9.9714329 | 9886.555 | 9712.060 | 9537.652 | 9363.386 | 21 |
| 20 | 9.9949172 | 9 9871813 | 9.9793092 | 9.9712982 | 9883.647 | 9709.153 | 9534.747 | 9360.483 | 20 |
| 19 | 9.9947894 | 9.9870512 | 9.9791768 | 9.9711635 | 9880.738 | 9706.245 | 9531.841 | 9357.580 | 19 |
| 18 | 9.9946615 | 9.9869211 | 9.9790444 | 9.9710288 | 9877.829 | 9703.337 | 9528.935 | 9354.677 | 18 |
| 17 | 9.9945336 | 9.9867910 | 9.9789119 | 9.9708940 | 9874.921 | 9700.430 | 9526.030 | 9351.774 | 17 |
| 16 | 9.9944057 | 9.9866608 | 9.9787795 | 9.9707592 | 9872.012 | 9697.522 | 9523.124 | 9348.871 | 16 |
| 15 | 9.9942777 | 9.9865305 | 9.9786469 | 9.9706243 | 9869.104 | 9694.615 | 9520.219 | 9345.969 | 15 |
| 14 | 9.9941497 | 9.9864003 | 9.9785144 | 9 9704894 | 9866.195 | 9691.707 | 9517.313 | 9343.066 | 14 |
| 13 | 9.9940216 | 9.9862700 | 9.9783817 | 9.9703545 | 9863,286 | 9688.800 | 9514.408 | 9340.163 | 13 |
| 12 | 9.9938936 | 9.9861396 | 9.9782491 | 9.9702195 | 9860.378 | 9685.892 | 9511.502 | 9337.261 | 12 |
| 11 | 9.9937654 | 9.9860092 | 9.9781164 | 9.9700845 | 9857.469 | 9682.985 | 9508.595 | 9334.358 | 11 |
| 10 | 9.9936373 | 9.9858788 | 9.9779837 | 9.9699494 | 9854.561 | 9680.079 | 9505.692 | 9331.456 | 10 |
| 9 | 9.9935091 | 9.9857484 | 9.9778509 | 9.9698143 | 9855.652 | 9677.170 | 9502.786 | 9328.553 | 9 |
| 8 | 9.9933808 | 9.9856179 | 9.9777182 | 9.9696792 | 9848.743 | 9674.263 | 9499.881 | 9325.651 | 8 |
| 7 | 9.9932526 | 9.9854873 | 9.9775853 | 9.9695440 | 9845.835 | 9671.355 | 9496.976 | 9322.749 | 7 |
| 6 | 9.9931243 | 9.9853568 | 9.9774525 | 9.9694088 | 9842.926 | 9668.448 | 9494.071 | 9319.847 | 6 |
| 5 | 9.9929959 | 9.9852261 | 9.9773195 | 9.9692735 | 9840.018 | 9665.541 | 9491.166 | 9316.945 | 5 |
| 4 | 9.9928675 | 9.9850955 | 9.9771866 | 9.9691382 | 9837.109 | 9662.633 | 9488.260 | 9314.043 | 4 |
| 3 | 9.9927391 | 9.9849648 | 9.9770536 | 9.9690029 | 9834.201 | 9659.726 | 9485.355 | 9311.141 | 3 |
| 2 | 9 9926106 | 9.9848341 | 9.9769206 | 9.9688675 | 9831.292 | 9656.819 | 9482.450 | 9308.239 | 2 |
| 1 | 9.9924821 | 9.9847033 | 9.9767875 | 9.9687321 | 9828.384 | 9653.912 | 9479.545 | 9305.337 | 1 |
| 0 | 9.9923536 | 9.9845725 | 9.9766544 | 9.9685967 | 9825.476 | 9651.005 | 9476.640 | 9302.435 | 0 |

Deg. 4, 5, 6, 7. A Table of Natural Versed

| M | N. 4 | N. 5 | N. 6 | N. 7 | L. 4 | L. 5 | L. 6 | L. 7 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0024.360 | 0038 053 | 0054.781 | 0074.539 | 7.3866683 | 7·5803891 | 7.7386303 | 7.8723800 | 0 |
| 1 | 0024.563 | 0038.307 | 0055.080 | 0074.894 | 7.3902785 | 7.5832777 | 7.7410375 | 7.8744436 | 1 |
| 2 | 24.767 | 38.562 | 55.391 | 75.250 | 7.3938716 | 7.5861568 | 7.7434380 | 7.8765017 | 2 |
| 3 | 24 972 | 38.817 | 55.697 | 75.607 | 7·3974540 | 7.5890263 | 7.7458319 | 7.8785550 | 3 |
| 4 | 25.178 | 39.074 | 56.004 | 75.964 | 7·4010196 | 7.5918864 | 7·7482192 | 7.8806033 | 4 |
| 5 | 25.385 | 39.331 | 56.212 | 76.322 | 7.4045706 | 7.5947322 | 7·7505999 | 7.8826469 | 5 |
| 6 | 25.592 | 39.589 | 56.621 | 76.681 | 7.4081071 | 7.5975783 | 7.7529742 | 7.8846856 | 6 |
| 7 | 0025.800 | 0039.848 | 0056.931 | 0077.041 | 7.4116293 | 7.6004103 | 7.7553419 | 7.8867196 | 7 |
| 8 | 26.009 | 40.108 | 57.241 | 77.681 | 7.4151372 | 7.6032331 | 7.7577031 | 7.8887487 | 8 |
| 9 | 26.219 | 40.369 | 57.552 | 77.764 | 7.4186311 | 7.6060468 | 7.7600580 | 7.8907784 | 9 |
| 10 | 26.430 | 40.630 | 57.864 | 78.126 | 7.4221109 | 7.6088513 | 7.7624064 | 7.8927928 | 10 |
| 11 | 26.642 | 40.893 | 58.177 | 78.484 | 7.4255767 | 7.6116468 | 7.7647485 | 7.8948078 | 11 |
| 12 | 26.855 | 41.156 | 58.491 | 78.853 | 7.4290288 | 7.6144333 | 7,7670843 | 7.8968181 | 12 |
| 13 | 0027.069 | 0041.420 | 0058.806 | 0079.218 | 7·4324672 | 7.6172109 | 7.7694138 | 7.8988238 | 13 |
| 14 | 27.283 | 41.685 | 59.121 | 79.584 | 7.4358921 | 7.6199796 | 7.7717371 | 7.9008248 | 14 |
| 15 | 27.498 | 41.951 | 59.437 | 79.951 | 7.4393034 | 7.6227395 | 7.7740541 | 7.9028212 | 15 |
| 16 | 27.714 | 42.217 | 59.754 | 80.318 | 7·4417015 | 7.6254906 | 7.7763649 | 7.9048130 | 16 |
| 17 | 27.931 | 42.485 | 60,072 | 80.686 | 7·4460862 | 7.6282330 | 7.7786696 | 7.9068002 | 17 |
| 18 | 28.149 | 42.753 | 60·391 | 81.055 | 7·4494578 | 7.6309668 | 7·7809682 | 7.9087829 | 18 |
| 19 | 0028.367 | 0043.022 | 0060.710 | 0081.425 | 7·4528163 | 7·6336920 | 7.7832607 | 7·9107610 | 19 |
| 20 | 28.586 | 43.292 | 61.030 | 81.796 | 7.4561619 | 7·6364086 | 7·7855472 | 7.9127346 | 20 |
| 21 | 28.806 | 43.563 | 61.351 | 82·168 | 7.4594946 | 7.6391167 | 7.7878276 | 7.9147038 | 21 |
| 22 | 29.027 | 43·835 | 61.673 | 82.541 | 7.4628146 | 7.6418164 | 7·7901020 | 7 9166684 | 22 |
| 23 | 29.249 | 44.107 | 61.996 | 82.914 | 7.4661219 | 7.6445078 | 7·7923705 | 7·9186268 | 23 |
| 24 | 29.472 | 44.380 | 62.320 | 83·288 | 7.4694166 | 7.6471908 | 7·7946331 | 7·9205844 | 24 |
| 25 | 0029.696 | 0044.655 | 0062 645 | 0083·663 | 7 4726989 | 7·6498655 | 7·7968897 | 7·9225358 | 25 |
| 26 | 29.921 | 44.930 | 62.971 | 84.039 | 7·4759688 | 7·6525320 | 7·7991405 | 7·9244827 | 26 |
| 27 | 30.146 | 45.205 | 63.297 | 84.416 | 7·4792265 | 7·6551903 | 7·8013855 | 7·9264253 | 27 |
| 28 | 30.372 | 45·482 | 63.624 | 84.794 | 7·4824719 | 7·6578404 | 7·8036246 | 7·9283636 | 28 |
| 29 | 30.599 | 45·760 | 63.952 | 85·172 | 7·4857052 | 7·6604825 | 7·8058580 | 7·9302975 | 29 |
| 30 | 30.827 | 46.038 | 64.281 | 85.551 | 7.4889265 | 7·6631166 | 7.8080856 | 7·9322271 | 30 |
| 31 | 0031.056 | 0046.317 | 0064.611 | 0085.931 | 7·4921359 | 7.6657427 | 7.8103076 | 7·9341523 | 31 |
| 32 | 31.285 | 46.597 | 64.942 | 86.312 | 7·4953353 | 7 6683608 | 7.8123237 | 7·9360734 | 32 |
| 33 | 31.515 | 46.878 | 65.273 | 86.694 | 7·4985193 | 7.6709711 | 7.8147343 | 7 9379901 | 33 |
| 34 | 31.746 | 47·160 | 65.605 | 87.077 | 7·5016934 | 7.6735735 | 7.8169392 | 7·9399027 | 34 |
| 35 | 31.978 | 47·443 | 65.938 | 87.460 | 7·5048560 | 7·6761682 | 7.8191386 | 7·9418110 | 35 |
| 36 | 32.211 | 47.726 | 66.272 | 87·844 | 7·5080071 | 7·6787550 | 7.8213323 | 7·9437151 | 36 |
| 37 | 0032.445 | 0048.010 | 0066.608 | 0088.229 | 7·5111468 | 7.6813342 | 7.8235205 | 7·9456150 | 37 |
| 38 | 32.680 | 48.295 | 66.943 | 88.615 | 7·5142751 | 7.6839058 | 7.8257032 | 7·9475107 | 38 |
| 39 | 32.915 | 48.581 | 67.279 | 89.002 | 7·5173922 | 7.6864697 | 7.8278804 | 7·9494023 | 39 |
| 40 | 33.151 | 48.868 | 67.616 | 89.391 | 7·5204982 | 7.6890260 | 7.8300522 | 7·9512898 | 40 |
| 41 | 33.388 | 49.156 | 67.954 | 89.779 | 7·5235930 | 7.6915749 | 7.8322185 | 7·9531732 | 41 |
| 42 | 33.626 | 49.444 | 68·293 | 90·168 | 7·5266769 | 7.6941162 | 7.8343794 | 7·9550525 | 42 |
| 43 | 0033.865 | 0049·734 | 0068.633 | 0090.558 | 7·5297498 | 7.6966502 | 7 8365349 | 7·9569276 | 43 |
| 44 | 33.405 | 50·024 | 68.974 | 90.949 | 7·5328119 | 7.6991767 | 7.8386851 | 7·9587988 | 44 |
| 45 | 34.345 | 50.315 | 69.315 | 91.341 | 7·5358632 | 7.7016959 | 7.8408299 | 7·9606663 | 45 |
| 46 | 34.586 | 50.607 | 69.657 | 91.734 | 7·5389038 | 7·7042078 | 7.8429695 | 7·9625290 | 46 |
| 47 | 34.828 | 50.900 | 70·000 | 92.124 | 7·5419338 | 7·7067124 | 7.8451037 | 7·9643880 | 47 |
| 48 | 35.071 | 51 193 | 70.344 | 92.521 | 7·5449532 | 7·7092098 | 7·8472327 | 7 9662431 | 48 |
| 49 | 0035·315 | 0051·487 | 0070.689 | 0092.916 | 7·5479021 | 7·7117001 | 7.8493565 | 7·9680942 | 49 |
| 50 | 35.560 | 51.783 | 71.035 | 93.312 | 7·5509607 | 7·7141832 | 7.8514751 | 7·9699414 | 50 |
| 51 | 35.806 | 52.079 | 71.382 | 93·709 | 7·5539489 | 7·7166592 | 7·8535885 | 7·9717846 | 51 |
| 52 | 36·052 | 52.375 | 71.729 | 94·107 | 7·5569268 | 7·7191281 | 7.8556968 | 7·9736239 | 52 |
| 53 | 36·299 | 52.673 | 72.077 | 94.506 | 7·5598946 | 7·7215900 | 7·8577999 | 7·9754593 | 53 |
| 54 | 36.547 | 52.972 | 72.426 | 94.905 | 7.5628522 | 7.7240450 | 7·8598980 | 7·9772908 | 54 |
| 55 | 0036.796 | 0053.271 | 0072.776 | 0095 305 | 7·5657997 | 7·7264930 | 7·8619910 | 7·9791184 | 55 |
| 56 | 37.046 | 53·572 | 73.127 | 95.706 | 7·5687373 | 7·7289341 | 7·8640789 | 7·9809422 | 56 |
| 57 | 37.297 | 53.873 | 73.479 | 96.108 | 7·5716650 | 7·7313683 | 7·8661618 | 7·9827621 | 57 |
| 58 | 37.548 | 54.175 | 73.831 | 96.511 | 7·5745828 | 7·7337658 | 7·8682397 | 7·9845782 | 58 |
| 59 | 37.800 | 54.477 | 74.184 | 96.915 | 7·5774908 | 7·7362164 | 7·8703126 | 7·9863905 | 59 |
| 60 | 38.053 | 54.781 | 74.539 | 97.319 | 7·5803891 | 7.7386303 | 7.8723806 | 7.9881990 | 60 |

Sines, and their Logarithms — Deg. 85, 84, 83, 82

| M | L. 85 | L. 84 | L. 83 | L. 82 | N. 85 | N. 84 | N. 83 | N. 82 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.9685967 | 9.9603967 | 9.9520518 | 9.9435591 | 9302.435 | 9128.543 | 8954.715 | 8781,307 | 60 |
| 59 | 9.9684611 | 9.9602588 | 9.9519114 | 9.9434163 | 9299.533 | 9125.54[illegible] | 8951.822 | 8778.420 | 59 |
| 58 | 9.9683256 | 9.9601205 | 9.9517711 | 9.9432735 | 9296.631 | 9122.647 | 8948.929 | 8775.533 | 58 |
| 57 | 9.9681900 | 9.9599825 | 9.9516307 | 9.9431306 | 9293.730 | 9119.750 | 8946.036 | 8772.646 | 57 |
| 56 | 9.9680544 | 9.9598445 | 9.9514902 | 9.9429876 | 9290.828 | 9116.852 | 8943.143 | 8769.759 | 56 |
| 55 | 9.9679188 | 9.9597068 | 9.9513497 | 9.9428446 | 9287.927 | 9113.955 | 8940.251 | 8766.872 | 55 |
| 54 | 9.9677831 | 9.9595688 | 9.9512092 | 9.9427016 | 9285.025 | 9111.057 | 8937.358 | 8763.985 | 54 |
| 53 | 9.9676474 | 9.9594306 | 9.9510686 | 9.9425586 | 9282.124 | 9108.160 | 8934.466 | 8761.099 | 53 |
| 52 | 9.9675116 | 9.9592925 | 9.9509280 | 9.9424155 | 9279.223 | 9105.263 | 8931.574 | 8758.212 | 52 |
| 51 | 9.9673758 | 9.9591544 | 9.9507874 | 9.9422723 | 9276.222 | 9102.366 | 8928.682 | 8755.326 | 51 |
| 50 | 9.9672399 | 9.9590160 | 9.9506467 | 9.9421291 | 9273.421 | 9099.469 | 8925.790 | 8752.440 | 50 |
| 49 | 9.9671040 | 9.9588777 | 9.9505059 | 9.9419859 | 9270.520 | 9096.572 | 8922.898 | 8749.554 | 49 |
| 48 | 9.9669681 | 9.9587394 | 9.9503652 | 9.9418426 | 9267.619 | 9093.675 | 8920.006 | 8746.668 | 48 |
| 47 | 9.9668321 | 9.9586010 | 9.9502243 | 9.9416993 | 9264.718 | 9090.778 | 8917.114 | 8743.782 | 47 |
| 46 | 9.9666961 | 9.9584626 | 9.9500835 | 9.9415560 | 9261.817 | 9087.881 | 8914.222 | 8740.856 | 46 |
| 45 | 9.9665601 | 9.9583241 | 9.9499426 | 9.9414125 | 9258.916 | 9084.984 | 8911.331 | 8738.010 | 45 |
| 44 | 9.9664240 | 9.9581857 | 9.9498016 | 9.9412691 | 9256.015 | 9082.087 | 8908.439 | 8735.124 | 44 |
| 43 | 9.9662879 | 9.9580471 | 9.9496606 | 9.9411256 | 9253.114 | 9079.191 | 8905.548 | 8732.239 | 43 |
| 42 | 9.9661517 | 9.9579086 | 9.9495196 | 9.9409822 | 9250.213 | 9076.294 | 8902.656 | 8729.353 | 42 |
| 41 | 9.9660155 | 9.9577699 | 9.9493785 | 9.9408385 | 9247.312 | 9073.398 | 8899.765 | 8726.468 | 41 |
| 40 | 9.9658793 | 9.9576313 | 9.9492375 | 9.9406949 | 9244.412 | 9070.502 | 8896.874 | 8723.583 | 40 |
| 39 | 9.9657430 | 9.9574926 | 9.9490963 | 9.9405513 | 9241.511 | 9067.605 | 8893.983 | 8720.698 | 39 |
| 38 | 9.9656067 | 9.9573539 | 9.9489551 | 9.9404076 | 9238.611 | 9064.709 | 8891.092 | 8717.813 | 38 |
| 37 | 9.9654703 | 9.9572151 | 9.9488139 | 9.9402638 | 9235.710 | 9061.813 | 8888.201 | 8714.928 | 37 |
| 36 | 9.9653339 | 9.9570763 | 9.9486716 | 9.9401201 | 9232.810 | 9058.917 | 8885.310 | 8712.043 | 36 |
| 35 | 9.9651974 | 9.9569374 | 9.9485313 | 9.9399762 | 9229.910 | 9056.021 | 8882.420 | 8709.159 | 35 |
| 34 | 9.9650610 | 9.9567985 | 9.9483899 | 9.9398324 | 9227.009 | 9053.125 | 8879.529 | 8706.274 | 34 |
| 33 | 9.9649244 | 9.9566596 | 9.9482485 | 9.9396885 | 9224.109 | 9050.229 | 8876.639 | 8703.390 | 33 |
| 32 | 9.9647879 | 9.9565206 | 9.9481071 | 9.9395445 | 9221.209 | 9047.333 | 8873.748 | 8700.505 | 32 |
| 31 | 9.9646512 | 9.9563816 | 9.9479656 | 9.9394005 | 9218.309 | 9044.437 | 8870.858 | 8697.622 | 31 |
| 30 | 9.9645146 | 9.9562425 | 9.9478241 | 9.9392565 | 9215.409 | 9041.542 | 8867.968 | 8694.738 | 30 |
| 29 | 9.9643779 | 9.9561034 | 9.9476825 | 9.9391224 | 9212.509 | 9038.646 | 8865.078 | 8691.854 | 29 |
| 28 | 9.9642412 | 9.9559643 | 9.9475409 | 9.9389083 | 9209.609 | 9035.751 | 8862.188 | 8688.970 | 28 |
| 27 | 9.9641044 | 9.9558251 | 9.9473993 | 9.9388241 | 9206.709 | 9032.856 | 8859.298 | 8686.086 | 27 |
| 26 | 9.9639676 | 9.9556859 | 9.9472576 | 9.9386800 | 9203.809 | 9029.061 | 8856.408 | 8683.202 | 26 |
| 25 | 9.9638308 | 9.9555466 | 9.9471159 | 9.9385357 | 9200.910 | 9027.066 | 8853.518 | 8680.319 | 25 |
| 24 | 9.9636939 | 9.9554073 | 9.9469741 | 9.9383914 | 9198.010 | 9024.171 | 8850.628 | 8677.436 | 24 |
| 23 | 9.9635570 | 9.9552680 | 9.9468323 | 9.9382411 | 9195.111 | 9021.276 | 8847.739 | 8674.553 | 23 |
| 22 | 9.9634200 | 9.9551286 | 9.9466904 | 9.9381027 | 9192.211 | 9018.381 | 8844.849 | 8671.670 | 22 |
| 21 | 9.9632830 | 9.9549891 | 9.9465485 | 9.9379583 | 9189.312 | 9015.486 | 8841.960 | 8668.787 | 21 |
| 20 | 9.9631460 | 9.9548497 | 9.9464066 | 9.9378139 | 9186.413 | 9012.592 | 8839.071 | 8665.904 | 20 |
| 19 | 9.9630089 | 9.9547102 | 9.9462646 | 9.9376693 | 9183.514 | 9009.697 | 8836.182 | 8663.921 | 19 |
| 18 | 9.9628718 | 9.9545706 | 9.9461126 | 9.9375248 | 9180.615 | 9006.802 | 8823.293 | 8660.138 | 18 |
| 17 | 9.9627346 | 9.9544310 | 9.9459805 | 9.9373802 | 9177.716 | 9003.908 | 8830.404 | 8657.256 | 17 |
| 16 | 9.9625974 | 9.9542914 | 9.9458385 | 9.9372356 | 9174.817 | 9001.013 | 8827.515 | 8654.373 | 16 |
| 15 | 9.9624601 | 9.9541517 | 9.9456963 | 9.9370909 | 9171.918 | 8998,119 | 8824.626 | 8651.491 | 15 |
| 14 | 9.9623229 | 9.9540120 | 9.9455541 | 9.9369462 | 9169.019 | 8995.225 | 8821.737 | 8648.608 | 14 |
| 13 | 9.9621855 | 9.9538723 | 9.9454119 | 9.9368015 | 9166.120 | 8992.331 | 8818.849 | 8645.726 | 13 |
| 12 | 9.9620482 | 9.9537325 | 9.9452696 | 9.9366567 | 9163.222 | 8989.437 | 8815.960 | 8642.844 | 12 |
| 11 | 9.9619108 | 9.9535926 | 9.9451273 | 9.9365118 | 9160.323 | 8985.543 | 8813.072 | 8639.962 | 11 |
| 10 | 9.9617733 | 9.9534528 | 9.9449850 | 9.9363670 | 9157.424 | 8983.649 | 8810.184 | 8637.080 | 10 |
| 9 | 9.9616358 | 9.9533128 | 6.9448425 | 9.9362220 | 9154.526 | 8980.755 | 8807.296 | 8634.198 | 9 |
| 8 | 9.9614983 | 9.9531729 | 9.9447001 | 9.9360771 | 9151.628 | 8977.861 | 8804.408 | 8631.317 | 8 |
| 7 | 9.9613607 | 9.9530329 | 9.9445576 | 9.9359321 | 9148.729 | 8974.968 | 8801.520 | 8628.436 | 7 |
| 6 | 9.9612232 | 9.9528929 | 9.9444151 | 9.9357870 | 9145.831 | 8972.074 | 8798.632 | 8625.554 | 6 |
| 5 | 9.9610855 | 9.9527528 | 9.9442726 | 9.9356419 | 9142.933 | 8969.181 | 8796.745 | 8622.673 | 5 |
| 4 | 9.9609478 | 9.9526127 | 9.9441300 | 9.9354968 | 9140.035 | 8966.287 | 8792.857 | 8619.792 | 4 |
| 3 | 9.9608101 | 9.9524725 | 9.9439873 | 9.9353156 | 9137.137 | 8963.394 | 8789.969 | 8616.911 | 3 |
| 2 | 9.9606723 | 9.9523323 | 9.9438446 | 9.9352064 | 9134.239 | 8960.501 | 8787.082 | 8614.030 | 2 |
| 1 | 9.9605345 | 9.9521920 | 9.9437019 | 9.9350611 | 9131.341 | 8957.608 | 8784.194 | 8611.194 | 1 |
| 0 | 9.9603967 | 9.9520518 | 9.9435591 | 9.9349158 | 9128.443 | 8954.715 | 8781.307 | 8608.269 | 0 |

Deg. 8, 9, 10, 11. A Table o Natural Verſed

| M | N. 8 | N. 9 | N. 10 | N. 11 | L. 8 | L. 9 | L. 10 | L. 11 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0097·319 | 0123.117 | 0151.923 | 0183.728 | 7·9881990 | 8·0903166 | 8.1816220 | 8.2641757 | 0 |
| 1 | 097·724 | 0123·573 | 0152.428 | 0184.284 | 7.9900038 | 8.0919203 | 8.1830648 | 8.2654867 | 1 |
| 2 | 98.130 | 124.029 | 152.934 | 184.840 | 7·9918047 | 8.0935210 | 8.1845051 | 8·2667957 | 2 |
| 3 | 98.537 | 124.486 | 153.441 | 185·397 | 7.9936020 | 8.0951188 | 8.1859431 | 8.2681028 | 3 |
| 4 | 98.935 | 124.944 | 153.949 | 185.955 | 7·9953955 | 8.0967136 | 8.1873786 | 8.2694078 | 4 |
| 5 | 99.354 | 125·403 | 154.450 | 186.514 | 7·9971853 | 8.0983055 | 8.1888118 | 8.2707169 | 5 |
| 6 | 99.763 | 125·863 | 154.968 | 187.074 | 7·9989713 | 8.0998941 | 8.1902426 | 8.2720119 | 6 |
| 7 | 0100.173 | 0126.323 | 0155.479 | 0187.634 | 8.0007537 | 8.1014804 | 8.1916710 | 8.2733111 | 7 |
| 8 | 100.584 | 126.784 | 155.990 | 188.195 | 8.0025325 | 8.1030635 | 3.1930971 | 8.2746082 | 8 |
| 9 | 100.996 | 127.246 | 156.502 | 188.757 | 8.0043076 | 8.1046437 | 8.1945208 | 8.2759035 | 9 |
| 10 | 101.409 | 127.709 | 157.015 | 189.320 | 8.0060790 | 8·1062211 | 8.1959421 | 8.2771967 | 10 |
| 11 | 101.823 | 128.173 | 157.529 | 189.884 | 8·0078468 | 8.1077955 | 8.1973611 | 8 2784880 | 11 |
| 12 | 102.238 | 128.638 | 158.044 | 190.449 | 8.0096110 | 8.1093671 | 8.1987778 | 8.2797774 | 12 |
| 13 | 0102.653 | 0129.103 | 0158.560 | 0191.014 | 8·0113716 | 8.1109358 | 8.2001921 | 8.2810649 | 13 |
| 14 | 103.069 | 129.569 | 159.076 | 191·580 | 8.0131287 | 8.1125017 | 8.2056042 | 8.2823504 | 14 |
| 15 | 103·486 | 130·036 | 159.593 | 192·147 | 8·0148822 | 8.1140647 | 8.2030139 | 8.2836341 | 15 |
| 16 | 103.904 | 130.544 | 160,111 | 192.715 | 8 0166321 | 8.1156249 | 8.2044213 | 8.2849158 | 16 |
| 17 | 104.323 | 130.973 | 160.630 | 193.284 | 8·0183785 | 8.1171823 | 8.2058264 | 8.2861956 | 17 |
| 18 | 104.743 | 131.443 | 161.150 | 193·853 | 8·0201213 | 8.1187369 | 8.2072293 | 8.2874735 | 18 |
| 19 | 0105.163 | 0131.915 | 0161.671 | 0194.423 | 8·0218607 | 8·1202887 | 8.2086298 | 8.2887495 | 19 |
| 20 | 105.584 | 132.384 | 162.192 | 194.994 | 8.0235965 | 8.1218377 | 8.2100281 | 8.2900236 | 20 |
| 21 | 106.006 | 132.856 | 162.714 | 195.566 | 8.0253289 | 8.1233840 | 8·2114241 | 8·2912958 | 21 |
| 22 | 106.429 | 133·329 | 163.237 | 196.139 | 8.0270578 | 8.1249274 | 8·2128179 | 8·2925661 | 22 |
| 23 | 106.853 | 133·803 | 163·761 | 196.713 | 8.0287833 | 8.1264681 | 8·2142094 | 8·2938346 | 23 |
| 24 | 107.277 | 134.278 | 164.286 | 197.288 | 8.0305053 | 8·1280061 | 8·2155987 | 8·2951012 | 24 |
| 25 | 0107.702 | 0134·754 | 0164.811 | 0197.863 | 8.0322239 | 8.1295413 | 8.2169857 | 8.2963660 | 25 |
| 26 | 108.128 | 135.230 | 165.337 | 198.439 | 8.0339391 | 8.1310738 | 8.2183705 | 8.2976289 | 26 |
| 27 | 108.555 | 135·707 | 165.864 | 199.016 | 8.0356508 | 8·1326036 | 8.2197531 | 8.2988899 | 27 |
| 28 | 108.983 | 136.185 | 166.392 | 199.594 | 8·0373592 | 8.1341307 | 8.2211334 | 8·3001491 | 28 |
| 29 | 109.182 | 136.664 | 166.921 | 200.174 | 8.0390643 | 8.1356551 | 8.2225116 | 8.3014064 | 29 |
| 30 | 109·841 | 137.144 | 167.451 | 200.753 | 8.0407659 | 8.1371768 | 8.2238875 | 8.3026619 | 30 |
| 31 | 0110.271 | 0137.624 | 0167.981 | 0201.333 | 8.0424642 | 8.1386958 | 8.2252613 | 8.3039156 | 31 |
| 32 | 110·702 | 138.105 | 168.512 | 201.914 | 8.0441592 | 8.1402121 | 8.2266329 | 8.3051675 | 32 |
| 33 | 111.134 | 138.587 | 169.044 | 202.496 | 8.0458509 | 8.1417258 | 8.2280023 | 8.3064175 | 33 |
| 34 | 111.567 | 139.070 | 169.577 | 203.079 | 8.0475393 | 8.1432368 | 8·2293695 | 8.3076657 | 34 |
| 35 | 112.001 | 139·554 | 170·111 | 203·663 | 8.0492243 | 8.1447452 | 8·2307345 | 8.3089122 | 35 |
| 36 | 112.436 | 140.039 | 170.646 | 204.247 | 8.0509061 | 8.1462510 | 8.2320974 | 8.3101568 | 36 |
| 37 | 0112.872 | 0140.525 | 0171.182 | 0204.832 | 8.0525847 | 8.1477541 | 8.2334581 | 8.3113996 | 37 |
| 38 | 113.308 | 141.011 | 171.718 | 205.418 | 8.0542599 | 8.1492546 | 8.2348167 | 8.3126406 | 38 |
| 39 | 113.745 | 141.498 | 172.255 | 206.005 | 8.0559319 | 8.1507525 | 8.2361732 | 8.3138798 | 39 |
| 40 | 114.183 | 141.986 | 172.793 | 206·592 | 8.0576007 | 8.1522478 | 8.2375275 | 8.3151172 | 40 |
| 41 | 114.622 | 142.475 | 173.332 | 207.182 | 8.0592663 | 8.1537405 | 8.2388797 | 8.3163529 | 41 |
| 42 | 115.062 | 142.965 | 173.872 | 207.772 | 8.0609286 | 8.1552307 | 8·2452297 | 8.3175868 | 42 |
| 43 | 0115.502 | 0143.456 | 0174.413 | 0208.362 | 8.0625878 | 8.1567182 | 8.2415737 | 8.3188189 | 43 |
| 44 | 115.943 | 143.947 | 174.954 | 208.953 | 8.0641438 | 8.1582032 | 8.2429235 | 8.3200493 | 44 |
| 45 | 116.385 | 144.439 | 175.496 | 209.545 | 8.0658966 | 8.1596857 | 8.2442673 | 8.3212779 | 45 |
| 46 | 116.828 | 144.932 | 176.039 | 210.138 | 8.0675463 | 8.1611656 | 8.2456089 | 8.3225047 | 46 |
| 47 | 117·272 | 145.426 | 176.583 | 210.732 | 8.0691928 | 8.1626430 | 8.2469485 | 8.3237298 | 47 |
| 48 | 117.717 | 145·921 | 177 128 | 211.326 | 8.0708362 | 8·1641178 | 8.2482860 | 8.3249532 | 48 |
| 49 | 0118.162 | 0146.417 | 0177.673 | 0211·921 | 8·0724764 | 8.1655902 | 8.2496214 | 8.3261748 | 49 |
| 50 | 118.608 | 146.913 | 178.219 | 212.517 | 8·0741136 | 8.1670600 | 8.2509547 | 8.3273947 | 50 |
| 51 | 119.055 | 147·410 | 178.766 | 213.114 | 8·0757476 | 8.1685273 | 8.2522860 | 8.3286128 | 51 |
| 52 | 119.503 | 147·908 | 179.314 | 213.712 | 8·0773786 | 8.1699921 | 8·2536152 | 8.3298292 | 52 |
| 53 | 119.952 | 148·407 | 179.863 | 214.311 | 8·0790065 | 8.1714545 | 8·2549424 | 8.3310439 | 53 |
| 54 | 120.402 | 148.907 | 180.413 | 214.910 | 8·0806313 | 8.1729144 | 8.2562675 | 8.3322569 | 54 |
| 55 | 0120·852 | 0149.407 | 0180.963 | 0215.510 | 8.0822531 | 8.1743717 | 8.2575906 | 8·3334682 | 55 |
| 56 | 121.303 | 149.908 | 181.514 | 216·111 | 8.0838718 | 8.1758267 | 8.2589117 | 8.3346778 | 56 |
| 57 | 121.755 | 150.410 | 182·066 | 216.713 | 8.0854976 | 8.1772792 | 8.2602307 | 8.3358857 | 57 |
| 58 | 122.208 | 150.913 | 182.619 | 217·316 | 8·0871002 | 8.1787292 | 8.2615477 | 8.3370918 | 58 |
| 59 | 122·662 | 151.417 | 183·173 | 217·920 | 8·0887099 | 8.1801768 | 8.2628626 | 8.3382963 | 59 |
| 60 | 123·117 | 151.922 | 183·728 | 218·524 | 8.0903166 | 8.1816220 | 8.2641757 | 8.3394991 | 60 |

Sines and their Logarithms. Deg. 81, 80, 79, 78.

| M | L. 81 | L. 80 | L. 79 | L. 78 | N. 81 | N. 80. | N 79 | N. 78 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.9349155 | 9.9261188 | 9.9171650 | 9.9080510 | 8605.260 | 8432.565 | 8263 518 | 8091.916 | 60 |
| 59 | 9.9347705 | 9.9259709 | 9.9170144 | 9.9078977 | 8605.380 | 8432,702 | 8260.653 | 8089.055 | 59 |
| 58 | 9.9346251 | 9.9258229 | 9.9168638 | 9.9077445 | 8602.508 | 8429.909 | 8257.789 | 8086.200 | 58 |
| 57 | 9.6344756 | 9.9256749 | 9.9167131 | 9.9075911 | 8599.627 | 8427.036 | 8254.925 | 8083.345 | 57 |
| 56 | 9.9343342 | 9.9255268 | 9.9165624 | 9.9074377 | 8596.747 | 8424.163 | 8252.061 | 8080.490 | 56 |
| 55 | 9.9341886 | 9.9253787 | 9.9164116 | 9.9072842 | 8593.867 | 8411 291 | 8249,197 | 8077.635 | 55 |
| 54 | 9.9340431 | 9.9252306 | 9.9162609 | 9.9071307 | 8590.987 | 8418.419 | 8246.333 | 8074.780 | 54 |
| 53 | 9.9338975 | 9.9250823 | 9.9161100 | 9.9069771 | 8588.107 | 8415.547 | 8243.469 | 8071.926 | 53 |
| 52 | 9.9337526 | 9.9249341 | 9.9159591 | 9.9068236 | 8585.228 | 8412.675 | 8240.606 | 8069.072 | 52 |
| 51 | 9 9336061 | 9.9247858 | 9.9158082 | 9.9066699 | 8582.348 | 8409.803 | 8237.742 | 8066.218 | 51 |
| 50 | 9.9334604 | 9.9246375 | 9.9156572 | 9.9065163 | 8579.469 | 8406.931 | 8234.879 | 8063.364 | 50 |
| 49 | 9.9333146 | 9.9244891 | 9.9155062 | 9.9063625 | 8576.590 | 8404.059 | 8232.016 | 8060.510 | 49 |
| 48 | 9.9331688 | 9.9243407 | 9.9153551 | 9.9062087 | 8573.711 | 8401.188 | 8229.153 | 8057.656 | 48 |
| 47 | 9.9330229 | 9.9241922 | 9.9152040 | 9.9060549 | 8570.832 | 8398.316 | 8226.290 | 8054.803 | 47 |
| 46 | 9.9328771 | 9.9240437 | 9.9150528 | 9.9059011 | 8567.953 | 8395.445 | 8223.427 | 8051.950 | 46 |
| 45 | 9.9327311 | 9.9238956 | 9.9149016 | 9.9057471 | 8565.074 | 8392.574 | 8220.565 | 8049.097 | 45 |
| 44 | 9.9325851 | 9.9237466 | 9.9147504 | 9.9055932 | 8562.195 | 8389.703 | 8217.702 | 8046.244 | 44 |
| 43 | 9.9324391 | 9.9235979 | 9.9145991 | 9.9054392 | 8559.310 | 8386.832 | 8214.840 | 8043.391 | 43 |
| 42 | 9.9322930 | 9.9234493 | 9.9144478 | 9.9058251 | 8556.438 | 8383.962 | 8211.978 | 8040.538 | 42 |
| 41 | 9.9321469 | 9.9233005 | 9.9142964 | 9.9051310 | 8553.559 | 8381.091 | 8209.116 | 8037.686 | 41 |
| 40 | 9.9320007 | 9.9231518 | 9.9141450 | 9.9049769 | 8550.581 | 8378.221 | 8206.254 | 8034.834 | 40 |
| 39 | 9.9318545 | 9.9230030 | 9.9139935 | 9,9048227 | 8547.803 | 8375.351 | 8203.392 | 8031.982 | 39 |
| 38 | 9.9317083 | 9.9228541 | 9.9138420 | 9.9046685 | 8544.925 | 8372.481 | 8200.531 | 8029.130 | 38 |
| 37 | 9.9315620 | 9.9227052 | 9.9136904 | 9.9045142 | 8542.047 | 8369.611 | 8197.669 | 8026.278 | 37 |
| 36 | 9.9314156 | 9.9225563 | 9.9135388 | 9.9043599 | 8539.169 | 8366.741 | 8194.808 | 8023.426 | 36 |
| 35 | 9.9312692 | 9.9224073 | 9.9133871 | 9.9042055 | 8536.292 | 8363.871 | 8191.946 | 8020.575 | 35 |
| 34 | 9.9311228 | 9.9222583 | 9.9132355 | 9.9040511 | 8533.414 | 8361.001 | 8189.086 | 8017.724 | 34 |
| 33 | 9.9309764 | 9.9221092 | 9.9130837 | 9.9048966 | 8530.537 | 8358.132 | 8186.226 | 8014.873 | 33 |
| 32 | 9.9308299 | 9.9219601 | 9.9129319 | 9.9037421 | 8527.660 | 8355.262 | 8183.366 | 8012.022 | 32 |
| 31 | 9.9306833 | 9.9218109 | 9.9127801 | 9.9035876 | 8524.783 | 8352.393 | 8180.505 | 8009.171 | 31 |
| 30 | 9.9305367 | 9.9216617 | 9.9126282 | 9.9034330 | 8521.906 | 8349.524 | 8177.645 | 8006.321 | 30 |
| 29 | 9.9303901 | 9.9215124 | 9.9124763 | 9.9032783 | 8519.029 | 8346.655 | 8174.785 | 8003.470 | 29 |
| 28 | 9.9302434 | 9.9213632 | 9.9123244 | 9.9031236 | 8516.152 | 8343,786 | 8171.925 | 8000.620 | 28 |
| 27 | 9.9300967 | 9.9212138 | 9.9121723 | 9.9029689 | 8513.276 | 8340.918 | 8169.065 | 7997.770 | 27 |
| 26 | 9.9299499 | 9.9210644 | 9.9120203 | 9.9028141 | 8510.399 | 8338.049 | 8166.205 | 7994.920 | 26 |
| 25 | 9.9298031 | 9.9209150 | 9.9118682 | 9.9026593 | 8507.523 | 8335.181 | 8163.346 | 7992.070 | 25 |
| 24 | 9.9296563 | 9.9207656 | 9.9117161 | 9.9025044 | 8504.647 | 8332.313 | 8160.487 | 7989.220 | 24 |
| 23 | 9.9295094 | 9.9206160 | 9.9115638 | 9.9023495 | 8501.771 | 8329.445 | 8157.628 | 7986.371 | 23 |
| 22 | 9.9293624 | 9.9204665 | 9.9114116 | 9.9021945 | 8498.895 | 8326.577 | 8154.769 | 7983.522 | 22 |
| 21 | 9.9292154 | 9.9203169 | 9.9112593 | 9.9020395 | 8496.019 | 8323.709 | 8151.910 | 7980.673 | 21 |
| 20 | 9.9290684 | 9.9201672 | 9.9111070 | 9.9018845 | 8493.143 | 8320.841 | 8149.051 | 7977.824 | 20 |
| 19 | 9.9289213 | 9.9200175 | 9.9109546 | 9.9017293 | 8490.267 | 8317.973 | 8146.192 | 7974.975 | 19 |
| 18 | 9.9287743 | 9.9198678 | 9.9108022 | 9.9015742 | 8487.392 | 8315.106 | 8143.334 | 7972.126 | 18 |
| 17 | 9,9286271 | 9.9197180 | 9.9106498 | 9.9014190 | 8484.516 | 8312.239 | 8140.476 | 7969.278 | 17 |
| 16 | 9.9284799 | 9.9195682 | 9.9104973 | 9.9012638 | 8481.641 | 8309.372 | 8137.618 | 7965.430 | 16 |
| 15 | 9.9283326 | 9.9194183 | 9.9103447 | 9.9011085 | 8478.766 | 8306.505 | 8134.760 | 7963.582 | 15 |
| 14 | 9.9281854 | 9.9192684 | 9.9101921 | 9.9009531 | 8475.891 | 8303.638 | 8131.902 | 7960.734 | 14 |
| 13 | 9.9280380 | 9.9191184 | 9.9100395 | 9.9007977 | 8473.016 | 8300.771 | 8125.014 | 7957.886 | 13 |
| 12 | 9.9278907 | 9.9189685 | 9.9098868 | 9.9006423 | 8470,141 | 8297.905 | 8126.187 | 7955.038 | 12 |
| 11 | 9.9277432 | 9.9188184 | 9.9097341 | 9.9004868 | 8467.266 | 8295.038 | 8123.330 | 7952.191 | 11 |
| 10 | 9.9275958 | 9.9186683 | 9.9095813 | 9.9003313 | 8464.392 | 8292.172 | 8120.473 | 7949.344 | 10 |
| 9 | 9.9274483 | 9.9185182 | 9.9094285 | 9.9001758 | 8461.518 | 8289.306 | 8117.616 | 7945.497 | 9 |
| 8 | 9.9273008 | 9.9183680 | 9.9092756 | 9 9000202 | 8458.644 | 8286.440 | 8114.759 | 7943.650 | 8 |
| 7 | 9.9271531 | 9.9182278 | 9.9091227 | 9.8998645 | 8455.770 | 8283 574 | 8111.902 | 7940.803 | 7 |
| 6 | 9.9270055 | 9.9180675 | 9.9089697 | 9.8997088 | 8452.896 | 8280.708 | 8109.046 | 7937.957 | 6 |
| 5 | 9.9268578 | 9.9179172 | 9.9088167 | 9.8995530 | 8450.022 | 8277.843 | 8106.190 | 7935.111 | 5 |
| 4 | 9.9267101 | 9.9177669 | 9.9086637 | 9.8993973 | 8447.148 | 8274.978 | 8103.334 | 7932.265 | 4 |
| 3 | 9.9265624 | 9.9176164 | 9.9085106 | 9.8992414 | 8444.275 | 8272.113 | 8100.478 | 7929.419 | 3 |
| 2 | 9.9264146 | 9.9174660 | 9.9083575 | 9.8990855 | 8441.401 | 8269.248 | 8097.622 | 7926.573 | 2 |
| 1 | 9.9262667 | 9.9173155 | 9.9082043 | 9.8989296 | 8438.528 | 8266.383 | 8094.766 | 7923.728 | 1 |
| 0 | 9.9261188 | .9917165o | 9.9080510 | 9.8987736 | 8435.654 | 8263.518 | 8091.910 | 7920.883 | 0 |

Deg. 12, 13, 14, 15. A Table of Natural Versed.

| M | N. 12 | N. 13 | N 14 | N. 15 | L. 12 | L. 13 | L. 14 | L. 15 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0218.524 | 0256.300 | 0297.043 | 0340.742 | 8.3394991 | 8.4087475 | 8.4728189 | 8.5324253 | 0 |
| 1 | 0219.129 | 0256.955 | 0297.747 | 0341.495 | 8.3407002 | 8.4098556 | 8.4738472 | 8.5333844 | 1 |
| 2 | 219.735 | 257.611 | 298.452 | 342.249 | 8.3418997 | 8.4109622 | 8.4748742 | 8.5343423 | 2 |
| 3 | 220.342 | 258.267 | 299,158 | 343.004 | 8.3430975 | 8.4120675 | 8.4759001 | 8.5352992 | 3 |
| 4 | 220.950 | 258.924 | 299.865 | 343.760 | 8.3442936 | 8.4131713 | 8.4769246 | 8.5362551 | 4 |
| 5 | 221.558 | 259.582 | 300.572 | 344.516 | 8.3454880 | 8.4142736 | 8.4779480 | 8.5372098 | 5 |
| 6 | 222.167 | 260,241 | 301.280 | 345.273 | 8.3466808 | 8.4153746 | 8.4789701 | 8.5381635 | 6 |
| 7 | 0222.777 | 0260.901 | 0301.989 | 0346.031 | 8.3478719 | 8.4164741 | 8.4799910 | 8.5391161 | 7 |
| 8 | 223.388 | 261.561 | 302.699 | 346.790 | 8.3490614 | 8.4175723 | 8.4810107 | 8.5400677 | 8 |
| 9 | 224.000 | 262.222 | 303.410 | 347.550 | 8.3502492 | 8.4186690 | 8.4820291 | 8 5410182 | 9 |
| 10 | 224.613 | 262 884 | 304.121 | 348.311 | 8.3514354 | 8.4197644 | 8.4830464 | 8.5419676 | 10 |
| 11 | 225.227 | 263.547 | 304.833 | 349.073 | 8.3526200 | 8.4208583 | 8.4840625 | 8.5429160 | 11 |
| 12 | 225.841 | 264.211 | 305.546 | 349.835 | 8.3538029 | 8.4219508 | 8.4850773 | 8.5438633 | 12 |
| 13 | 0226.456 | 0264.876 | 0306.260 | 0350.598 | 8.3549842 | 8.4230420 | 8.4860910 | 8.5448096 | 13 |
| 14 | 227.072 | 265.541 | 306.975 | 351.362 | 8.3561639 | 8.4241318 | 8.4871034 | 8.5457548 | 14 |
| 15 | 227.689 | 266.207 | 307.691 | 352.127 | 8.3573419 | 8.4252280 | 8.4881146 | 8.5466983 | 15 |
| 16 | 228.307 | 266.874 | 308.407 | 352.892 | 8 3585184 | 8.4263072 | 8.4891247 | 8.5476422 | 16 |
| 17 | 229.925 | 267.542 | 309.124 | 353.658 | 8.3596932 | 8 4273928 | 8.4901336 | 8.5485843 | 17 |
| 18 | 229.544 | 268.211 | 309.842 | 354.425 | 8.3608664 | 8.4284770 | 8.4911412 | 8.5495253 | 18 |
| 19 | 0230.164 | 0268.880 | 0310.561 | 0355.193 | 8.3620380 | 8.4295600 | 8.4921477 | 8.5504654 | 19 |
| 20 | 230.785 | 269.550 | 311.281 | 355.962 | 8.3632081 | 8.4306414 | 8.4931530 | 8.5514044 | 20 |
| 21 | 231.407 | 270.221 | 312.002 | 356.732 | 8,3643765 | 8.4317216 | 8.4941572 | 8.5523423 | 21 |
| 22 | 232.030 | 270.893 | 312.723 | 357.502 | 8.3655434 | 8.4328004 | 8.4951601 | 8.5532793 | 22 |
| 23 | 232.653 | 271.566 | 313.445 | 358.273 | 8.3667086 | 8.4338778 | 8.4961619 | 8.5542152 | 23 |
| 24 | 233.277 | 272.240 | 314.168 | 359.045 | 8.3678723 | 8.4349539 | 8.4971625 | 8.5551500 | 24 |
| 25 | 0233.902 | 0272.915 | 0314.892 | 0359.818 | 8.3690344 | 8.4360286 | 8.4981619 | 8.5560839 | 25 |
| 26 | 234.528 | 273.591 | 315.617 | 360.592 | 8.3701950 | 8.4371020 | 8.4991602 | 8.5570167 | 26 |
| 27 | 235.155 | 274.267 | 316.343 | 361.367 | 8.3713540 | 8.4381740 | 8.5001573 | 8.5579485 | 27 |
| 28 | 235.783 | 274.944 | 317.069 | 362.142 | 8.3725114 | 8.4392447 | 8.5011532 | 8.5588793 | 28 |
| 29 | 236.411 | 275.622 | 317.796 | 362.918 | 8.3736672 | 8.4403141 | 8.5021480 | 8.5598091 | 29 |
| 30 | 237.040 | 276.301 | 318.524 | 363.695 | 8.3748215 | 8.4413821 | 8.5031416 | 8.5607379 | 30 |
| 31 | 0237.670 | 0276.980 | 0319.253 | 0364.473 | 8.3759743 | 8.4424488 | 8.5041341 | 8.5616656 | 31 |
| 32 | 238.301 | 277.660 | 319.983 | 365.252 | 8.3771255 | 8.4435142 | 8.5051254 | 8 5625924 | 32 |
| 33 | 238.933 | 278.341 | 320.713 | 366.031 | 8.3782751 | 8.4445743 | 8.5061136 | 8.5635181 | 33 |
| 34 | 239.565 | 279.023 | 321.444 | 366.811 | 8.3794232 | 8.4456410 | 8.5071046 | 8.5644429 | 34 |
| 35 | 240.198 | 279.706 | 322.176 | 367.592 | 8.3805698 | 8.4467024 | 8.5080925 | 8.5653666 | 35 |
| 36 | 240.832 | 280.390 | 322.909 | 368.374 | 8.3817149 | 8.4477625 | 8.5090792 | 8.5662894 | 36 |
| 37 | 241.467 | 0281.074 | 0323.643 | 0369.157 | 8.3828584 | 8 4488213 | 8.5100648 | 8.5672111 | 37 |
| 38 | 242.103 | 281,759 | 324.377 | 369.941 | 8.3840004 | 8.4498788 | 8.5110493 | 8.5681318 | 38 |
| 39 | 242.740 | 282.445 | 325.112 | 370.725 | 8.3851409 | 8.4509350 | 8.5120326 | 8.5690516 | 39 |
| 40 | 243.377 | 283.132 | 325 848 | 371.510 | 8.3862799 | 8.4519898 | 8.5130148 | 8.5699704 | 40 |
| 41 | 244.015 | 283.820 | 326.585 | 372.296 | 8.3874174 | 8.4530434 | 8.5139959 | 8.5708881 | 41 |
| 42 | 244.654 | 284.509 | 327.323 | 373.083 | 8.3885533 | 8.4540957 | 8.5149758 | 8 5718049 | 42 |
| 43 | 0245.294 | 0285.198 | 0328.002 | 0373.871 | 8.3896878 | 8.4551467 | 8.5159546 | 8.5727207 | 43 |
| 44 | 245.935 | 285.888 | 328.801 | 374.659 | 8.3908207 | 8.4561964 | 8.5169324 | 8.5736355 | 44 |
| 45 | 246.577 | 286.579 | 329.541 | 375.448 | 8.3919522 | 8.4572448 | 8.5179089 | 8.5745494 | 45 |
| 46 | 247.219 | 287.271 | 330.282 | 376.238 | 8 3930822 | 8.4582920 | 8.5188844 | 8.5754622 | 46 |
| 47 | 247.862 | 287.964 | 331.024 | 377.029 | 8.3942107 | 8.4593378 | 8.5198588 | 8.5763741 | 47 |
| 48 | 248.506 | 288.657 | 331.767 | 377.821 | 8.3953377 | 8.4603824 | 8.5208320 | 8.5772850 | 48 |
| 49 | 0249.151 | 0289.351 | 0332.510 | 0378.613 | 8.3964638 | 8.4614257 | 8.5218042 | 8.5781949 | 49 |
| 50 | 249.797 | 290.046 | 333.254 | 379.406 | 8.3975873 | 8.4624677 | 8.5227752 | 8.5791039 | 50 |
| 51 | 250.443 | 290.742 | 333.999 | 380.200 | 8.3987098 | 8.4635085 | 8.5237451 | 8.5800119 | 51 |
| 52 | 251.090 | 291.439 | 334.745 | 380.995 | 8.3998310 | 8.4645480 | 8.5247140 | 8.5809189 | 52 |
| 53 | 251.738 | 292.137 | 335.492 | 381.791 | 8.4009506 | 8.4655863 | 8.5256817 | 8.5818250 | 53 |
| 54 | 252.387 | 292.835 | 336.239 | 382.587 | 8.4020688 | 8.4666233 | 8.5266484 | 8.5827301 | 54 |
| 55 | 0253.037 | 0293.534 | 0336.987 | 0383.384 | 8.4031855 | 8.4676461 | 8.5276139 | 8.5836342 | 55 |
| 56 | 254.688 | 294.234 | 337.736 | 384.182 | 8.4043008 | 8.4686935 | 8.5285784 | 8.5845374 | 56 |
| 57 | 254.340 | 294.935 | 338.486 | 384.981 | 8.4054147 | 8.4697269 | 8.5295417 | 8.5855396 | 57 |
| 58 | 255.992 | 295.637 | 338.237 | 385.781 | 8.4065270 | 8.4707587 | 8.5305040 | 8.5863409 | 58 |
| 59 | 255.645 | 296.340 | 339.989 | 386.582 | 8.4076380 | 8.4717894 | 8.5314652 | 8.5872412 | 59 |
| 60 | 256.300 | 297.043 | 340.742 | 387.383 | 8.4087475 | 8.4728189 | 8.5324253 | 8.5881406 | 60 |

Sines and their Logarithms. Deg. 77, 76, 75, 74.

| M | L. 77 | L. 76 | L. 75 | L. 74 | N. 77 | N. 76 | N. 75 | N. 74 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.898 7736 | 9.8893291 | 9.8797140 | 9.8699243 | 7920.883 | 7750.489 | 7580,781 | 7411.810 | 60 |
| 59 | 9.8986176 | 9.8891703 | 9 8795522 | 9.8697590 | 7918·038 | 7747.655 | 7577.959 | 7409.009 | 59 |
| 58 | 9.8984615 | 9.8890114 | 9.8793905 | 9.8695949 | 7915.193 | 7744.821 | 7575.137 | 7406.191 | 58 |
| 57 | 9.8983054 | 9.8888524 | 9.8792286 | 9.8694301 | 7912.348 | 7741.987 | 7572.315 | 7403.382 | 57 |
| 56 | 9.8981492 | 9·8886935 | 9·8790668 | 9.8692653 | 7909.503 | 7739.153 | 7569.493 | 7400.573 | 56 |
| 55 | 9.8979930 | 9.8885344 | 9.8789048 | 9.8691004 | 7906.658 | 7736.320 | 7566.671 | 7397.764 | 55 |
| 54 | 9·8978367 | 9·8883754 | 9.8787429 | 9.8689355 | 7903.814 | 7733.487 | 7563.850 | 7394.755 | 54 |
| 53 | 9.8976804 | 9.8882162 | 9.8785809 | 9.8687705 | 7900.970 | 7730.654 | 7561.029 | 7392.147 | 53 |
| 52 | 9.8975241 | 9.8880571 | 9.8784188 | 9.8686056 | 7898.126 | 7727.821 | 7558.208 | 7389.339 | 52 |
| 51 | 9.8973676 | 9.8878978 | 9.8782567 | 9.8684405 | 7895.282 | 7724.988 | 7555.387 | 7386.531 | 51 |
| 50 | 9.8972112 | 9.8877386 | 9.8780946 | 9.8682754 | 7892 438 | 7722.156 | 7552.566 | 7383.723 | 50 |
| 49 | 9.8970547 | 9 8875792 | 9.8779323 | 9.8681102 | 7889.595 | 7719.324 | 7549.746 | 7380.916 | 49 |
| 48 | 9.8968982 | 9.8874199 | 9.8777701 | 9.8679450 | 7886·752 | 7716.492 | 7546 926 | 7378.109 | 48 |
| 47 | 9.8967416 | 9.8872604 | 9.8776078 | 9.8677797 | 7883.909 | 7713.660 | 7544.106 | 7375.302 | 47 |
| 46 | 9.8965850 | 9.8871010 | 9.8774454 | 9.8676145 | 7881.066 | 7710.828 | 7541.286 | 7372.495 | 46 |
| 45 | 9.8964283 | 9.8869415 | 9.8772850 | 9.8674491 | 7878.223 | 7707.996 | 7538.467 | 7369.688 | 45 |
| 44 | 9.8962716 | 9.8867819 | 9.8771206 | 9.8672837 | 7875·380 | 7705.165 | 7535.648 | 7366.882 | 44 |
| 43 | 9.8961148 | 9.8866223 | 9.8769581 | 9.8671182 | 7872.538 | 7702·334 | 7532.829 | 7364.076 | 43 |
| 42 | 9.8959580 | 9.8864627 | 9.8767955 | 9.8669527 | 7869.696 | 7699.503 | 7530.010 | 7361.270 | 42 |
| 41 | 9.8958011 | 9.8863029 | 9.8766329 | 9.8667871 | 7866·854 | 7696.672 | 7527.191 | 7358.464 | 41 |
| 40 | 9.8956442 | 9.8861432 | 9.8764703 | 9.8666216 | 7864.012 | 7693.841 | 7524.372 | 7355.658 | 40 |
| 39 | 9.8954872 | 9.8859834 | 9·8763076 | 9.8664559 | 7861.170 | 7691.011 | 7521.554 | 7352.853 | 39 |
| 38 | 9·8953302 | 9.8858236 | 9·8761449 | 9.8662902 | 7858·329 | 7688.181 | 7518·736 | 7350.048 | 38 |
| 37 | 9·8951731 | 9.8856637 | 9.8759821 | 9.8661244 | 7855·488 | 7685.351 | 7515.918 | 7347·243 | 37 |
| 36 | 9.8950161 | 9.8855038 | 9.8758192 | 9.8659586 | 7852.647 | 7682.521 | 7513.100 | 7344.438 | 36 |
| 35 | 9.8948589 | 9.8853437 | 9.8756563 | 9.8657927 | 7849.806 | 7679.691 | 7510.283 | 7341.634 | 35 |
| 34 | 9.8947017 | 9.8851837 | 9.8754934 | 9.8656269 | 7846.965 | 7676.862 | 7507.466 | 7338.830 | 34 |
| 33 | 9.8945445 | 9.8850236 | 9.8753304 | 9.8654609 | 7844.124 | 7674.033 | 7504.649 | 7336.026 | 33 |
| 32 | 9.8943872 | 9.8848635 | 9·8751674 | 9.8652949 | 7841.284 | 7671.204 | 7501.832 | 7333.223 | 32 |
| 31 | 9.8942298 | 9.8847033 | 9.8750043 | 9.8651288 | 7838.444 | 7668.375 | 7499·016 | 7330.420 | 31 |
| 30 | 9 8940725 | 9.8845431 | 9·8748412 | 9.8649627 | 7835.604 | 7665.546 | 7496.200 | 7327.617 | 30 |
| 29 | 9.8939150 | 9.8843828 | 9.8746780 | 9·8647965 | 7832·764 | 7662.718 | 7493·384 | 7324.814 | 29 |
| 28 | 9.8937576 | 9.8842225 | 9.8745147 | 9.8646303 | 7829.924 | 7659.890 | 7490.568 | 7322.011 | 28 |
| 27 | 9.8936000 | 9.8840621 | 9.8743514 | 9.8644641 | 7827.084 | 7657.062 | 7487.752 | 7319.208 | 27 |
| 26 | 9.8934425 | 9.8839017 | 9.8741881 | 9.8642978 | 7824·245 | 7654.234 | 7484·936 | 7316.405 | 26 |
| 25 | 9·8932848 | 9.8837412 | 9.8740247 | 9.8641314 | 7821.406 | 7651.406 | 7482·121 | 7313.603 | 25 |
| 24 | 9.8931272 | 9.8835807 | 9.8738613 | 9.8639650 | 7818.567 | 7648.579 | 7479·306 | 7310.801 | 24 |
| 23 | 9.8929695 | 9.8834202 | 9.8736978 | 9.8637985 | 7815.728 | 7645.752 | 7476.491 | 7307.999 | 23 |
| 22 | 9.8928117 | 9.8832596 | 9.8735343 | 9.8636320 | 7812.889 | 7642 925 | 7473,676 | 7305.196 | 22 |
| 21 | 9.8926539 | 9.8830989 | 9.8733707 | 9.8634655 | 7810.051 | 7640.098 | 7470.862 | 7302.397 | 21 |
| 20 | 9.8924961 | 9.8829382 | 9.8732071 | 9.8632989 | 7807.213 | 7637.271 | 7468.048 | 7299.596 | 20 |
| 19 | 9.8923381 | 9.8827774 | 9 8730434 | 9.8631322 | 7804.375 | 7634.445 | 7465.234 | 7296.795 | 19 |
| 18 | 9.8921802 | 9.8826167 | 9.8728797 | 9.8629655 | 7801.537 | 7631.619 | 7462.420 | 7293.995 | 18 |
| 17 | 9.8920222 | 9.8824558 | 9 8727159 | 9.8627987 | 7798.700 | 7628.793 | 7459.607 | 7291.195 | 17 |
| 16 | 9.8918642 | 9·8822949 | 9.8725521 | 9.8626319 | 7795.863 | 7625.967 | 7456.794 | 7288.395 | 16 |
| 15 | 9.8917061 | 9.8821339 | 9.8723882 | 9.8624650 | 7793.026 | 7623.141 | 7453.981 | 7285.595 | 15 |
| 14 | 9.8915480 | 9.8819730 | 9.8722243 | 9.8622981 | 7790.189 | 7620·316 | 7451:168 | 7282.796 | 14 |
| 13 | 9.8913898 | 9.88:8119 | 9·8720603 | 9.8621314 | 7787·352 | 7617.491 | 7448.355 | 7279 997 | 13 |
| 12 | 9.8912316 | 9.8816508 | 9·8718963 | 9.8619642 | 7784.515 | 7614.666 | 7445.542 | 7277.198 | 12 |
| 11 | 9.8910733 | 9.8814897 | 9·8717322 | 9.8617971 | 7781.678 | 7611.841 | 7442.730 | 7274.399 | 11 |
| 10 | 9.8909150 | 9 8813285 | 9·8715682 | 9.8616300 | 7778.842 | 7609·017 | 7439.918 | 7271,600 | 10 |
| 9 | 9.8907566 | 9.8811672 | 9.8714040 | 9.8614628 | 7776.006 | 7606·192 | 7437.106 | 7268.802 | 9 |
| 8 | 9.8905982 | 9.8810060 | 9.8712398 | 9.8612956 | 7773·170 | 7603·368 | 7434.294 | 7266.004 | 8 |
| 7 | 9.8904397 | 9·8808446 | 9.8710755 | 9.8611283 | 7770·334 | 7600·544 | 7431.483 | 7263.206 | 7 |
| 6 | 9.8902812 | 9·8806833 | 9.8709112 | 9.8609610 | 7767.498 | 7597·720 | 7428.672 | 7260.408 | 6 |
| 5 | 9.8901226 | 9.8805218 | 9·8707468 | 9.8607936 | 7764.963 | 7594.896 | 7425.861 | 7257.611 | 5 |
| 4 | 9.8899640 | 9.8803604 | 9.8705824 | 9.8606262 | 7761.828 | 7592.073 | 7423.050 | 7254.814 | 4 |
| 3 | 9·8898054 | 9.8801988 | 9·8704179 | 9·8604587 | 7758.993 | 7589.250 | 7420.240 | 7252.017 | 3 |
| 2 | 9.8896467 | 9.8800372 | 9.8702534 | 9·8602912 | 7756 158 | 7586.427 | 7417.430 | 7249.220 | 2 |
| 1 | 9·8894879 | 9.8798956 | 9.8700888 | 9.8601236 | 7753.323 | 7583.604 | 7414.620 | 7246.423 | 1 |
| 0 | 9.8893291 | 9.8797140 | 9.8699243 | 9.8599560 | 7750.489 | 7580·781 | 7411.810 | 7243.627 | 0 |

Deg. 16, 17, 18, 19. A Table o Natural Verſed

| M | N. 16 | N. 17 | N. 18 | N. 19 | L. 16 | L. 17 | L. 18 | L. 19 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0387.383 | 0436 952 | 0489.435 | 0544.814 | 8.5881406 | 8.6404342 | 8.6896949 | 8.7362485 | 0 |
| 1 | 0388.185 | 0437.803 | 0490.334 | 0545.762 | 8.5890390 | 8.641279 | 8.6904921 | 8.7370030 | 1 |
| 2 | 388.988 | 438.655 | 491.234 | 546.710 | 8.5899365 | 8.6421231 | 8.6912886 | 8.7377570 | 2 |
| 3 | 389.792 | 439.508 | 492.135 | 547.659 | 8.5908330 | 8.6429663 | 8.6920844 | 8.7385102 | 3 |
| 4 | 390.597 | 440.361 | 493.037 | 548.609 | 8.5917286 | 8.6438037 | 8.6928794 | 8.7392628 | 4 |
| 5 | 391.402 | 441.215 | 493.939 | 549.559 | 8.5926232 | 8.6446502 | 8.6936736 | 8.7400147 | 5 |
| 6 | 392.208 | 442.070 | 494.843 | 550.511 | 8.5935170 | 8.6454909 | 8.6944672 | 8.7407659 | 6 |
| 7 | 0393.015 | 0442.926 | 0495.747 | 0551.463 | 8.5944097 | 8.6463308 | 8.6952599 | 8.7415165 | 7 |
| 8 | 393.823 | 443.782 | 496 652 | 552.416 | 8 5953016 | 8.6471698 | 3.6960520 | 8.7422664 | 8 |
| 9 | 394.632 | 444.639 | 497.557 | 553.370 | 8.5961925 | 8.6479880 | 8.6968432 | 8.7430156 | 9 |
| 10 | 395.441 | 445.498 | 498.464 | 554.325 | 8.5970824 | 8.6488454 | 8.6976338 | 8.7437642 | 10 |
| 11 | 396.251 | 446.357 | 499.371 | 555.280 | 8.5979715 | 8.6496820 | 8.6984236 | 3.7445121 | 11 |
| 12 | 397.062 | 447.216 | 500,279 | 556.236 | 8.5988596 | 8.6505177 | 8.6992127 | 3.7452593 | 12 |
| 13 | 0397.874 | 0448.077 | 0501.188 | 0557.193 | 8.5997468 | 8.6513526 | 8.7000010 | 8.7460059 | 13 |
| 14 | 398.687 | 448.938 | 502.098 | 558.151 | 8.6006330 | 8.6521867 | 8.7007886 | 8.7467518 | 14 |
| 15 | 399.501 | 449.801 | 503.009 | 559.110 | 8.6015184 | 8.6530200 | 8.7015755 | 8.7474971 | 15 |
| 16 | 400.315 | 450.664 | 503.920 | 560.069 | 8.6024028 | 8.6538524 | 8.7023617 | 8.7482417 | 16 |
| 17 | 401.130 | 451.527 | 504.832 | 561.029 | 8.6032763 | 8.6546841 | 8.7031471 | 8.7489857 | 17 |
| 18 | 401.946 | 452.392 | 505.745 | 561.990 | 8.6041689 | 8.6655149 | 8.7039318 | 8.7497290 | 18 |
| 19 | 0402.763 | 0453.257 | 0506.659 | 0562.952 | 8.6050505 | 8.6563449 | 8 7047158 | 8.7504716 | 19 |
| 20 | 403.581 | 454.124 | 507.574 | 563.915 | 8.6059313 | 8.6571741 | 8.7054990 | 8.7512136 | 20 |
| 21 | 404.400 | 454.991 | 508.489 | 564.878 | 8.6068112 | 8.6580025 | 8.7062815 | 8.7519549 | 21 |
| 22 | 405.219 | 455.859 | 509.405 | 565.843 | 8.6076901 | 8.6588301 | 8.7070633 | 8.7526956 | 22 |
| 23 | 406.039 | 456.727 | 510.322 | 566.808 | 8.6085681 | 8.6596569 | 8.7078444 | 8.7534357 | 23 |
| 24 | 406.860 | 457.597 | 511.240 | 567.773 | 8.6094453 | 8.6604829 | 8.7086247 | 8.7541751 | 24 |
| 25 | 0407.682 | 0458.467 | 0512.158 | 0568.740 | 8.6103215 | 8.6613081 | 8.7094044 | 8.7549138 | 25 |
| 26 | 408.505 | 459.338 | 513.078 | 569.707 | 8.6111968 | 8.6621324 | 8.7101833 | 8.7556519 | 26 |
| 27 | 409.328 | 460.210 | 513.998 | 570.676 | 8.6120712 | 8.6629560 | 8.7109615 | 8.7563894 | 27 |
| 28 | 410.152 | 461.083 | 514.919 | 571.645 | 8.6129448 | 8.6637788 | 8.7117390 | 8.7571262 | 28 |
| 29 | 410.977 | 461.956 | 515.841 | 572.614 | 8.6138174 | 8.6646008 | 8.7125157 | 8.7578623 | 29 |
| 30 | 411.803 | 462.830 | 516.763 | 573.585 | 8.6146891 | 8.6654220 | 8.7132918 | 8.7585979 | 30 |
| 31 | 0412.629 | 0463.706 | 0517.687 | 0574.556 | 8.6155600 | 8.6662424 | 8.7140671 | 8.7593327 | 31 |
| 32 | 413.456 | 464.582 | 518.611 | 575.529 | 8.6164299 | 8.6670620 | 8.7148418 | 8.7600670 | 32 |
| 33 | 414.284 | 465.458 | 519.536 | 576.502 | 8.6172990 | 8.6678808 | 8.7156157 | 8.7608006 | 33 |
| 34 | 415.113 | 466.336 | 520.462 | 577.475 | 8.6181672 | 8.6686988 | 8.7163889 | 8.7615336 | 34 |
| 35 | 415.947 | 467.214 | 521.388 | 578.450 | 8.6190345 | 8.6695160 | 8.7171614 | 8.7622659 | 35 |
| 36 | 416.774 | 468.093 | 522.316 | 579.425 | 8.6199009 | 8.6703324 | 8.7179332 | 8.7629976 | 36 |
| 37 | 0417.605 | 0468.973 | 0523.244 | 0580.402 | 8.6207664 | 8.6711481 | 8.7187044 | 8.7637286 | 37 |
| 38 | 418.437 | 469.854 | 524.173 | 581.379 | 8.6216331 | 8.6719630 | 8.7194748 | 8.7644591 | 38 |
| 39 | 419.270 | 470.736 | 525.103 | 582.356 | 8.6224948 | 8.6727771 | 8.7202445 | 8.7651889 | 39 |
| 40 | 420.104 | 471.618 | 526.034 | 583.335 | 8.6233577 | 8.6735904 | 8.7210135 | 8.7659180 | 40 |
| 41 | 420.939 | 472.501 | 526.965 | 584.314 | 8.6242197 | 8.6744029 | 8.7217818 | 8.7666466 | 41 |
| 42 | 421.775 | 473.385 | 527.897 | 585 295 | 8.6250809 | 8.6752147 | 8-7225494 | 8.7673745 | 42 |
| 43 | 0422.611 | 0474.270 | 0528.830 | 0586.276 | 8.6259412 | 8.6760256 | 8.7233163 | 8.7681018 | 43 |
| 44 | 423.448 | 475.156 | 529.764 | 587.257 | 8.6268006 | 8.6768358 | 8.7240825 | 8.7688284 | 44 |
| 45 | 424.286 | 476.042 | 530.699 | 588.240 | 8.6271951 | 8.6776453 | 8.7248480 | 8.7695544 | 45 |
| 46 | 425.125 | 476.929 | 531.634 | 589.223 | 8.6285168 | 8.6784539 | 8.7256129 | 8.7702798 | 46 |
| 47 | 425.964 | 477.817 | 532.570 | 590.207 | 8.6293736 | 8.6792618 | 8.7263770 | 8.7710046 | 47 |
| 48 | 426.804 | 478.706 | 533.507 | 591.192 | 8.6302295 | 8.6800689 | 8.7271404 | 8.7717288 | 48 |
| 49 | 0427.645 | 0479.596 | 0534.445 | 0592.178 | 8.6310846 | 8.6808753 | 8.7279032 | 8.7724523 | 49 |
| 50 | 428.487 | 480.486 | 535.384 | 593.164 | 8.6319388 | 8.6816809 | 8.7286653 | 8.7731752 | 50 |
| 51 | 429.330 | 481.377 | 536.323 | 594.152 | 8.6327922 | 8.6824857 | 8.7294267 | 8.7738975 | 51 |
| 52 | 430.174 | 482.269 | 537.264 | 595.140 | 8.6336447 | 8.6832897 | 8.7301874 | 8.7746192 | 52 |
| 53 | 431.018 | 483.162 | 538.205 | 596.129 | 8.6344964 | 8.6840930 | 8.7309474 | 8.7753402 | 53 |
| 54 | 431.863 | 484.056 | 539.146 | 597.119 | 8 6353472 | 8.6848956 | 8.9317067 | 8.7760607 | 54 |
| 55 | 0432.709 | 0484.950 | 0540.089 | 0598.109 | 8.6361971 | 8.6856973 | 8.7324654 | 8.7767805 | 55 |
| 56 | 433.556 | 485.846 | 541.032 | 599.101 | 8.6370462 | 8.6864984 | 8.7332233 | 8.7774997 | 56 |
| 57 | 434.404 | 486.742 | 541.977 | 600.093 | 8.6378945 | 8.6872986 | 8.7339806 | 8.7782183 | 57 |
| 58 | 435.253 | 487.639 | 542.922 | 601.086 | 8.6387419 | 8.6880981 | 8.7347373 | 8.7789363 | 58 |
| 59 | 436.102 | 488.536 | 543.868 | 602.079 | 8.6395884 | 8.6888969 | 8.7354932 | 8.7796537 | 59 |
| 60 | 436.952 | 489.435 | 544.814 | 603.074 | 8.6404342 | 8.6896949 | 8.7362485 | 8.7803705 | 60 |

Sines, and their Logarithms

Deg. 73, 72, 71, 70

| M | L. 73 | L. 72 | L. 71 | L. 70 | N. 73 | N. 72 | N. 71 | N. 70 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.8599560 | 9.8498052 | 9.8394674 | 9.8289381 | 7243.627 | 7676.283 | 6909.830 | 6744.318 | 60 |
| 59 | 9.8597883 | 9.8496344 | 9.8392934 | 9.8287609 | 7240.831 | 7073.501 | 6907.064 | 6741.568 | 59 |
| 58 | 9.8596206 | 9.8494636 | 9.8391195 | 9.8285837 | 7238.035 | 7070.720 | 6904.298 | 6738.818 | 58 |
| 57 | 9.8594529 | 9.8492928 | 9.8389455 | 9.8284065 | 7235.239 | 7067.939 | 6901.532 | 6736.069 | 57 |
| 56 | 9.8592851 | 9.8491219 | 9.8387714 | 9.8282292 | 7232.444 | 7065.158 | 6898.766 | 6733.319 | 56 |
| 55 | 9.8591171 | 9.8489509 | 9.8385973 | 9.8280518 | 7229.649 | 7062.377 | 6896.001 | 6730.570 | 55 |
| 54 | 9.8589492 | 9.8487799 | 9.8384233 | 9.8278744 | 7226.854 | 7059.597 | 6893.236 | 6727.821 | 54 |
| 53 | 9.8587812 | 9.8486088 | 9.8382489 | 9.8276969 | 7224.059 | 7056.817 | 6890.471 | 6725.073 | 53 |
| 52 | 9.8586132 | 9.8484377 | 9.8380746 | 9.8275194 | 7221.265 | 7054.037 | 6887.706 | 6722.325 | 52 |
| 51 | 9.8584451 | 9.8482665 | 9.8379003 | 9.8273418 | 7218.471 | 7051.257 | 6884.942 | 6719.577 | 51 |
| 50 | 9.8582770 | 9.8480953 | 9.8377259 | 9.8271642 | 7215.677 | 7048.477 | 6882.178 | 6716.829 | 50 |
| 49 | 9.8581088 | 9.8479240 | 9.8375514 | 9.8269865 | 7212.883 | 7045.698 | 6879.414 | 6714.082 | 49 |
| 48 | 9.8579406 | 9.8477527 | 9.8373770 | 9.8268088 | 7210.089 | 7042.919 | 6876.651 | 6711.335 | 48 |
| 47 | 9.8577723 | 9.8475813 | 9.8372024 | 9.8266310 | 7207.296 | 7040.140 | 6873.888 | 6708.588 | 47 |
| 46 | 9.8576040 | 9.8474099 | 9.8370278 | 9.8264532 | 7204.503 | 7037.362 | 6871.125 | 6705.841 | 46 |
| 45 | 9.8574356 | 9.8472384 | 9.8368531 | 9.8262753 | 7201.710 | 7034.584 | 6868.362 | 6703.094 | 45 |
| 44 | 9.8572672 | 9.8470669 | 9.8366785 | 9.8260973 | 7198.918 | 7031.806 | 6865.600 | 6700.348 | 44 |
| 43 | 9.8570987 | 9.8468953 | 9.8365037 | 9.8259193 | 7196.126 | 7029.028 | 6862.838 | 6697.602 | 43 |
| 42 | 9.8569302 | 9.8467237 | 9.8363289 | 9.8257412 | 7193.334 | 7026.250 | 6860.076 | 6694.856 | 42 |
| 41 | 9.8567615 | 9.8465520 | 9.8361540 | 9.8255631 | 7190.542 | 7023.473 | 6857.314 | 6692.111 | 41 |
| 40 | 9.8565929 | 9.8463802 | 9.8359791 | 9.8253849 | 7187.750 | 7020.695 | 6854.552 | 6689.366 | 40 |
| 39 | 9.8564242 | 9.8462084 | 9.8358041 | 9.8252067 | 7184.959 | 7017.919 | 6851.791 | 6686.621 | 39 |
| 38 | 9.8562555 | 9.8460366 | 9.8356291 | 9.8250284 | 7182.168 | 7015.143 | 6849.030 | 6683.877 | 38 |
| 37 | 9.8560867 | 9.8458647 | 9.8354540 | 9.8248501 | 7179.377 | 7012.367 | 6846.269 | 6681.133 | 37 |
| 36 | 9.8559179 | 9.8456927 | 9.8352789 | 9.8246717 | 7176.586 | 7009.591 | 6843.509 | 6678.389 | 36 |
| 35 | 9.8557489 | 9.8455207 | 9.8351037 | 9.8244932 | 7173.796 | 7006.815 | 6840.749 | 6675.645 | 35 |
| 34 | 9.8555800 | 9.8453487 | 9.8349285 | 9.8243147 | 7171.006 | 7004.040 | 6837.989 | 6672.902 | 34 |
| 33 | 9.8554110 | 9.8451765 | 9.8347531 | 9.8241361 | 7168.216 | 7001.265 | 6835.230 | 6670.159 | 33 |
| 32 | 9.8552420 | 9.8450044 | 9.8345778 | 9.8239576 | 7165.426 | 6998.490 | 6832.471 | 6667.415 | 32 |
| 31 | 9.8550728 | 9.8448322 | 9.8344024 | 9.8237785 | 7162.636 | 6995.716 | 6829.712 | 6664.673 | 31 |
| 30 | 9.8549037 | 9.8446599 | 9.8342269 | 9.8236002 | 7159.847 | 6992.942 | 6826.953 | 6661.931 | 30 |
| 29 | 9.8547345 | 9.8444876 | 9.8340514 | 9.8234213 | 7157.058 | 6990.168 | 6824.195 | 6659.189 | 29 |
| 28 | 9.8545653 | 9.8443152 | 9.8338759 | 9.8232425 | 7154.269 | 6987.394 | 6821.437 | 6656.447 | 28 |
| 27 | 9.8543959 | 9.8441428 | 9.8337002 | 9.8230636 | 7151.480 | 6984.620 | 6818.679 | 6653.706 | 27 |
| 26 | 9.8542266 | 9.8439703 | 9.8335246 | 9.8228847 | 7148.692 | 6981.847 | 6815.921 | 6650.965 | 26 |
| 25 | 9.8540572 | 9.8437978 | 9.8333488 | 9.8227057 | 7145.904 | 6979.074 | 6813.103 | 6648.224 | 25 |
| 24 | 9.8538877 | 9.8436252 | 9.8331731 | 9.8225266 | 7143.116 | 6976.301 | 6810.406 | 6645.484 | 24 |
| 23 | 9.8537182 | 9.8434526 | 9.8329972 | 9.8223475 | 7140.328 | 6973.528 | 6807.649 | 6642.744 | 23 |
| 22 | 9.8535486 | 9.8432799 | 9.8328213 | 9.8221684 | 7137.541 | 6970.756 | 6804.892 | 6640.004 | 22 |
| 21 | 9.8533790 | 9.8431071 | 9.8326454 | 9.8219891 | 7134.754 | 6967.984 | 6802.136 | 6637.264 | 21 |
| 20 | 9.8532094 | 9.8429344 | 9.8324694 | 9.8218099 | 7131.967 | 6965.212 | 6799.380 | 6634.525 | 20 |
| 19 | 9.8530396 | 9.8427615 | 9.8322933 | 9.8216305 | 7129.181 | 6962.441 | 6796.625 | 6631.786 | 19 |
| 18 | 9.8528699 | 9.8425886 | 9.8321172 | 9.8214511 | 7126.395 | 6959.670 | 6793.870 | 6629.047 | 18 |
| 17 | 9.8527000 | 9.8424156 | 9.8319411 | 9.8212717 | 7123.609 | 6956.899 | 6791.115 | 6626.309 | 17 |
| 16 | 9.8525302 | 9.8422427 | 9.8317649 | 9.8210922 | 7120.823 | 6954.128 | 6788.360 | 6623.571 | 16 |
| 15 | 9.8523602 | 9.8420696 | 9.8315886 | 9.8209126 | 7118.037 | 6951.357 | 6785.605 | 6620.833 | 15 |
| 14 | 9.8521903 | 9.8418965 | 9.8314123 | 9.8207330 | 7115.252 | 6948.587 | 6782.850 | 6618.095 | 14 |
| 13 | 9.8520202 | 9.8417233 | 9.8312359 | 9.8205533 | 7112.467 | 6945.817 | 6780.096 | 6615.358 | 13 |
| 12 | 9.8518502 | 9.8415501 | 9.8310595 | 9.8203736 | 7109.682 | 6943.047 | 6777.342 | 6612.621 | 12 |
| 11 | 9.8516800 | 9.8413768 | 9.8308830 | 9.8201938 | 7106.897 | 6940.277 | 6774.588 | 6609.884 | 11 |
| 10 | 9.8515099 | 9.8412035 | 9.8307064 | 9.8200140 | 7104.112 | 6937.508 | 6771.835 | 6607.148 | 10 |
| 9 | 9.8513396 | 9.8410301 | 9.8305298 | 9.8198341 | 7101.328 | 6934.739 | 6769.082 | 6604.412 | 9 |
| 8 | 9.8511693 | 9.8408567 | 9.8302532 | 9.8196542 | 7098.544 | 6931.970 | 6766.329 | 6601.676 | 8 |
| 7 | 9.8509990 | 9.8406832 | 9.8301765 | 9.8194741 | 7095.760 | 6929.202 | 6763.577 | 6598.940 | 7 |
| 6 | 9.8508286 | 9.8405097 | 9.8299997 | 9.8192941 | 7092.977 | 6926.434 | 6760.825 | 6596.205 | 6 |
| 5 | 9.8506581 | 9.8403361 | 9.8298229 | 9.8191140 | 7090.194 | 6923.666 | 6758.073 | 6593.470 | 5 |
| 4 | 9.8504877 | 9.8401625 | 9.8296401 | 9.8189338 | 7087.411 | 6920.898 | 6755.221 | 6590.735 | 4 |
| 3 | 9.8503171 | 9.8399887 | 9.8294691 | 9.8187536 | 7084.629 | 6918.131 | 6752.570 | 6588.001 | 3 |
| 2 | 9.8501465 | 9.8398150 | 9.8292922 | 9.8185733 | 7081.847 | 6915.364 | 6749.819 | 6585.267 | 2 |
| 1 | 9.8499759 | 9.8396412 | 9.8291151 | 9.8183930 | 7079.065 | 6912.597 | 6747.068 | 6582.533 | 1 |
| 0 | 9.8498052 | 9.8394674 | 9.8289381 | 9.8182126 | 7076.283 | 6909.830 | 6744.318 | 6579.799 | 0 |

Deg. 8, 9, 10, 11. A Table of Natural Verſed

| M | N. 20 | N. 21 | N. 22 | N. 23 | L. 20 | L. 21 | L. 22 | L. 23 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0603.074 | 0664.196 | 0728.161 | 0794.951 | 8.7803705 | 8.8222961 | 8.8622277 | 8.9003406 | 0 |
| 1 | 0604.069 | 0665.239 | 0729.251 | 0796.008 | 8.7810863 | 8.8229772 | 8.8628771 | 8.9009611 | 1 |
| 2 | 605.065 | 666.282 | 730,342 | 797.226 | 8.7818022 | 8.8236582 | 8.8633265 | 8.9015816 | 2 |
| 3 | 606.062 | 667.327 | 731.434 | 798.365 | 8.7825168 | 8.8243382 | 8.8641749 | 8.9022011 | 3 |
| 4 | 607.060 | 668.372 | 732.526 | 799.504 | 8.7832314 | 8.8250182 | 8.8648233 | 8.9020207 | 4 |
| 5 | 608.058 | 669.418 | 733.619 | 800.644 | 8.7839499 | 8.8256970 | 8.8654707 | 8.9034393 | 5 |
| 6 | 609.057 | 670.465 | 734.713 | 801.785 | 8.7846583 | 8.8263759 | 8.8661181 | 8.9040579 | 6 |
| 7 | 0610.058 | 0671.512 | 0735.808 | 0802.927 | 8.7853705 | 8.8270537 | 8.8667645 | 8.9046757 | 7 |
| 8 | 611.059 | 672.561 | 736 904 | 804.069 | 8.7860827 | 8.8277314 | 8.8674109 | 8.9052934 | 8 |
| 9 | 612.060 | 673.610 | 738.000 | 805.212 | 8.7867937 | 8.8284081 | 8.8680563 | 8.9059102 | 9 |
| 10 | 613.062 | 674.660 | 739.097 | 806.356 | 8.7875047 | 8.8290848 | 8.8687018 | 8 9065270 | 10 |
| 11 | 614.066 | 675.710 | 740.195 | 807.501 | 8.7882146 | 8.8297604 | 8.8693462 | 8.9071429 | 11 |
| 12 | 615.070 | 676.762 | 741.294 | 808.647 | 8.7889244 | 8.8304360 | 8.8699906 | 8.9077588 | 12 |
| 13 | 0616.075 | 0677.814 | 0742.394 | 0809.793 | 8.7896330 | 8.8311105 | 8.8706340 | 8.9083738 | 13 |
| 14 | 617.080 | 678.867 | 743.494 | 810.940 | 8.7903416 | 8.8317850 | 8.8712774 | 8.9089887 | 14 |
| 15 | 618.087 | 679.921 | 744.595 | 812.088 | 8.7910491 | 8.8324584 | 8.8719198 | 8.9096028 | 15 |
| 16 | 619.094 | 680.976 | 745.697 | 813.237 | 8.7917565 | 8.8331318 | 8.8725623 | 8.9102169 | 16 |
| 17 | 620.102 | 682.031 | 746.800 | 814.386 | 8.7924627 | 8.8338041 | 8.8732037 | 8.9108301 | 17 |
| 18 | 621.111 | 683.088 | 747.903 | 815.536 | 8.7931690 | 8.8344765 | 8.8738452 | 8.9114432 | 18 |
| 19 | 0622.120 | 0684.145 | 0749.007 | 0816.687 | 8.7938740 | 8.8351477 | 8 8744856 | 8.9120555 | 19 |
| 20 | 623.131 | 685.203 | 750.112 | 817.839 | 8.7945791 | 8.8358190 | 8.8751261 | 8.9126678 | 20 |
| 21 | 624.142 | 686.261 | 751.218 | 818.991 | 8.7952830 | 8.8364892 | 8.8757656 | 8.9132792 | 21 |
| 22 | 625.154 | 687.321 | 752 324 | 820.145 | 8.7959869 | 8.8371594 | 8.8764051 | 8.9138905 | 22 |
| 23 | 626.167 | 688.381 | 753.431 | 821.299 | 8.7966896 | 8.8378285 | 8.8770436 | 8.9145010 | 23 |
| 24 | 627.180 | 689.442 | 754.539 | 822.454 | 8.7973923 | 8.8384976 | 8.8776821 | 8.9151115 | 24 |
| 25 | 0628.194 | 0690.504 | 0755.648 | 0823.609 | 8.7980938 | 8.8391657 | 8.8783196 | 8.9157211 | 25 |
| 26 | 629.210 | 691.566 | 756.758 | 824.765 | 8.7987953 | 8.8398337 | 8.8789571 | 8.9163306 | 26 |
| 27 | 630.226 | 692.630 | 757.869 | 825.923 | 8.7994957 | 8.8405007 | 8.8795937 | 8.9169393 | 27 |
| 28 | 631.242 | 693.694 | 758.980 | 827.081 | 8.8001961 | 8.8411677 | 8.8808303 | 8.9175480 | 28 |
| 29 | 632.260 | 694.759 | 760.092 | 828.240 | 8.8008953 | 8.8418337 | 8.8808659 | 8.9181558 | 29 |
| 30 | 633.278 | 695.824 | 761.205 | 829.399 | 8.8015945 | 8.8424996 | 8.8815014 | 8.9187636 | 30 |
| 31 | 0634.297 | 0696.891 | 0762.318 | 0830.560 | 8.8022925 | 8.8431645 | 8.8821361 | 8.9193706 | 31 |
| 32 | 635.317 | 697.958 | 763.432 | 831.721 | 8.8029906 | 8.8438294 | 8.8827707 | 8.9199775 | 32 |
| 33 | 636.338 | 699.026 | 764.547 | 832.882 | 8.8036874 | 8.8444932 | 8.8834044 | 8.9205835 | 33 |
| 34 | 637.359 | 700.095 | 765.663 | 834.045 | 8.8043843 | 8.8451570 | 8.8840380 | 8.9211895 | 34 |
| 35 | 638.382 | 701.165 | 766.780 | 835.209 | 8.8050801 | 8.8458198 | 8.8846707 | 8.9217947 | 35 |
| 36 | 639.405 | 702.235 | 767.897 | 836.373 | 8.8057758 | 8.8464826 | 8.8853034 | 8.9223999 | 36 |
| 37 | 0640.429 | 0703.306 | 0769.015 | 0837.538 | 8.8064704 | 8.8471443 | 8.8859352 | 8.9230041 | 37 |
| 38 | 641.453 | 704.378 | 770.134 | 838.703 | 8.8071649 | 8.8478060 | 8.8865669 | 8.9236084 | 38 |
| 39 | 642.479 | 705.451 | 771.254 | 839.870 | 8.8078584 | 8.8484667 | 8.8871977 | 8.9242118 | 39 |
| 40 | 643.505 | 706.525 | 772.375 | 841.037 | 8.8085518 | 8.8491274 | 8.8878285 | 8.9248152 | 40 |
| 41 | 644.532 | 707.599 | 773.496 | 842.205 | 8.8092441 | 8.8497870 | 8.8884584 | 8.9254177 | 41 |
| 42 | 645.560 | 708.674 | 774.618 | 843.374 | 8.8099364 | 8.8504467 | 8.8890882 | 8.9260202 | 42 |
| 43 | 0646.588 | 0709.750 | 0775.741 | 0844.544 | 8.8106276 | 8.8511053 | 8.8897171 | 8.9266219 | 43 |
| 44 | 647.618 | 710.827 | 776.865 | 845.714 | 8.8113187 | 8.8517639 | 8.8903460 | 8.9272235 | 44 |
| 45 | 648.648 | 711.904 | 777.990 | 846.885 | 8.8120087 | 8.8524215 | 8.8909739 | 8.9278243 | 45 |
| 46 | 649.679 | 712.983 | 779.116 | 848.057 | 8.8126988 | 8.8530790 | 8.8916019 | 8.9284251 | 46 |
| 47 | 650.711 | 714.062 | 780.242 | 849.230 | 8.8133876 | 8.8537356 | 8.8922289 | 8.9290250 | 47 |
| 48 | 651.743 | 715.142 | 781.369 | 850.403 | 8.8140765 | 8.8543921 | 8.8928559 | 8.9296249 | 48 |
| 49 | 0652.777 | 0716.222 | 0782.496 | 0851.578 | 8.8147643 | 8.8550476 | 8.8934820 | 8.9302240 | 49 |
| 50 | 653.811 | 717.304 | 783.624 | 852.753 | 8.8154521 | 8.8557032 | 8.8941080 | 8.9308231 | 50 |
| 51 | 654.846 | 718.386 | 784.753 | 853.928 | 8.8161387 | 8.8563576 | 8.8947331 | 8.9314212 | 51 |
| 52 | 655.881 | 719.469 | 785.883 | 855.105 | 8.8168253 | 8.8570121 | 8.8953583 | 8.9320194 | 52 |
| 53 | 656.918 | 720.553 | 787.014 | 856.282 | 8.8175108 | 8.8576656 | 8.8959825 | 8.9326168 | 53 |
| 54 | 657 955 | 721.637 | 788.145 | 857.460 | 8.8181964 | 8.8583191 | 8.8966066 | 8.9332141 | 54 |
| 55 | 0658.993 | 0722.723 | 0789.277 | 0858.639 | 8.8188808 | 8.8589715 | 8.8972299 | 8.9338106 | 55 |
| 56 | 660.032 | 723.809 | 790.410 | 859.819 | 8.8195652 | 8.8596240 | 8.8978532 | 8.9344070 | 56 |
| 57 | 661.072 | 724.896 | 791.544 | 860.999 | 8.8202484 | 8.8602754 | 8.8984755 | 8.9350027 | 57 |
| 58 | 662.112 | 725.984 | 792.679 | 862.181 | 8.8209317 | 8.8609268 | 8.8990978 | 8.9355983 | 58 |
| 59 | 663.154 | 727.072 | 793.815 | 863.363 | 8.8216139 | 8.8615773 | 8.8997192 | 8.9361930 | 59 |
| 60 | 664.196 | 728.161 | 794.951 | 864.545 | 8.8222961 | 8.8622277 | 8.9003406 | 8.9367878 | 60 |

Sines and their Logarithms. Deg. 69, 68, 67, 66.

| M | L. 69 | L. 68 | L. 67 | L. 66 | N. 69 | N. 68 | N. 67 | N. 66 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.8182126 | 9.8072860 | 9.7961533 | 9.7848090 | 6579.799 | 6416.321 | 6253,934 | 6092.689 | 60 |
| 59 | 9.8180321 | 9.8071022 | 9.7959659 | 9.7846181 | 6577.066 | 6413.605 | 6251.237 | 6090.011 | 59 |
| 58 | 9.8178516 | 9.8069183 | 9.7957786 | 9.7844271 | 6574.333 | 6410.890 | 6248.540 | 6087.334 | 58 |
| 57 | 9.8176711 | 9.8067343 | 9.7955911 | 9.7842361 | 6571.600 | 6408.175 | 6245.844 | 6084.657 | 57 |
| 56 | 9.8174905 | 9.8065503 | 9.7954037 | 9.7840450 | 6568.867 | 6405.460 | 6243.148 | 6081.980 | 56 |
| 55 | 9.8173098 | 9.8063652 | 9.7952161 | 9.7838539 | 6566.135 | 6402.746 | 6240.452 | 6079.304 | 55 |
| 54 | 9.8171291 | 9.8061821 | 9.7950285 | 9.7836627 | 6563 403 | 6400.032 | 6237.757 | 6076.628 | 54 |
| 53 | 9.8169483 | 9.8059979 | 9.7948408 | 9.7834714 | 6560.671 | 6397.318 | 6235.062 | 6073.952 | 53 |
| 52 | 9.8167675 | 9.8058137 | 9.7946531 | 9.7832801 | 6557.940 | 6394.605 | 6232.367 | 6071.277 | 52 |
| 51 | 9.8165865 | 9.8056294 | 9.7944652 | 9.7830887 | 6555.209 | 6391.892 | 6229.673 | 6068.602 | 51 |
| 50 | 9.8164056 | 9.8054451 | 9.7942774 | 9.7828973 | 6552.478 | 6389.179 | 6226.979 | 6065.928 | 50 |
| 49 | 9.8162246 | 9.8052606 | 9.7940895 | 9.7827058 | 6549.747 | 6386.467 | 6224.285 | 6063.254 | 49 |
| 48 | 9.8160435 | 9.8050762 | 9.7939015 | 9.7825143 | 6547.017 | 6383.755 | 6221.592 | 6060.580 | 48 |
| 47 | 9.8158624 | 9.8048916 | 9.7937135 | 9.7823226 | 6544.287 | 6381.043 | 6218.899 | 6057.907 | 47 |
| 46 | 9.8156812 | 9.8047070 | 9.7935254 | 9.7821309 | 6541.558 | 6378.331 | 6216 206 | 6055.234 | 46 |
| 45 | 9.8155000 | 9.8045224 | 9.7933372 | 9.7819392 | 6538.829 | 6375.620 | 6213.514 | 6052.561 | 45 |
| 44 | 9.8153187 | 9.8043377 | 9.7931491 | 9.7817474 | 6536.100 | 6372.909 | 6210.822 | 6049.888 | 44 |
| 43 | 9.8151373 | 9.8041529 | 9.7929608 | 9.7815555 | 6533.371 | 6370.198 | 6208.130 | 6047.216 | 43 |
| 42 | 9.8149560 | 9.8039681 | 9.7927725 | 9.7813636 | 6530.643 | 6367.488 | 6205.438 | 6044.544 | 42 |
| 41 | 9.8147745 | 9.8037832 | 9.7925841 | 9.7811716 | 6527.915 | 6364.778 | 6202.747 | 6041.872 | 41 |
| 40 | 9.8145930 | 9.8035983 | 9.7923956 | 9.7809796 | 6525.178 | 6362.068 | 6200.056 | 6039.201 | 40 |
| 39 | 9.8144114 | 9.8034133 | 9.7922071 | 9.7807874 | 6522.460 | 6359 358 | 6197.365 | 6036.530 | 39 |
| 38 | 9.8142298 | 9.8032283 | 9.7920187 | 9.7805953 | 6519 733 | 6356.649 | 6194.675 | 6033.860 | 38 |
| 37 | 9.8140481 | 9.8030431 | 9.7918299 | 9.7804030 | 6517.006 | 6353.940 | 6191.985 | 6031.190 | 37 |
| 36 | 9.8138664 | 9.8028580 | 9.7916413 | 9.7802108 | 6514.279 | 6351.232 | 6189.296 | 6028.520 | 36 |
| 35 | 9.8136846 | 9.8026727 | 9.7914525 | 9.7800184 | 6511.553 | 6348.524 | 6186.607 | 6025.851 | 35 |
| 34 | 9.8135027 | 9.8024875 | 9.7912637 | 9.7798260 | 6509.027 | 6345.816 | 6183.918 | 6023.182 | 34 |
| 33 | 9.8133208 | 9.8023021 | 9.7910748 | 9.7796335 | 6506.101 | 6343.108 | 6181.229 | 6020.513 | 33 |
| 32 | 9.8131389 | 9.8021167 | 9.7908859 | 9.7794410 | 6503-376 | 6340.401 | 6178.541 | 6017.845 | 32 |
| 31 | 9.8129568 | 9.8019313 | 9.7906969 | 9.7792484 | 6500.651 | 6337.698 | 6175.853 | 6015.177 | 31 |
| 30 | 9.8127748 | 9.8017458 | 9.7905079 | 9.7790558 | 6497.925 | 6334.988 | 6173.166 | 6012.509 | 30 |
| 29 | 9.8125926 | 9.8015602 | 9.7903188 | 9.7788630 | 6495.201 | 6332.282 | 6170.479 | 6009.841 | 29 |
| 28 | 9.8124104 | 9.8013746 | 9.7901297 | 9.7786703 | 6492.477 | 6329.576 | 6167.792 | 6007.174 | 28 |
| 27 | 9.8122282 | 9.8011889 | 9.7899404 | 9.7784774 | 6489.753 | 6426.870 | 6165.105 | 6004.507 | 27 |
| 26 | 9.8120459 | 9.8010031 | 9.7897512 | 9.7782845 | 6487.029 | 6324.165 | 6166.419 | 6001.841 | 26 |
| 25 | 9.8118635 | 9.8008173 | 9.7895618 | 9.7780915 | 6484.306 | 6321.459 | 6159.733 | 5999.175 | 25 |
| 24 | 9.8116811 | 9.8006315 | 9.7893725 | 9.7778985 | 6481.583 | 6318.754 | 6157.047 | 5996.509 | 24 |
| 23 | 9.8114986 | 9.8004455 | 9.7891830 | 9.7777054 | 6478.860 | 6316.049 | 6154.362 | 5993.844 | 23 |
| 22 | 9.8113161 | 9.8002596 | 9.7889935 | 9.7775123 | 6476.138 | 6313.345 | 6151.677 | 5991.179 | 22 |
| 21 | 9.8111335 | 9.8000735 | 9.7888039 | 9.7773191 | 6473.416 | 6310.641 | 6148-992 | 5988.514 | 21 |
| 20 | 9.8109509 | 9.7998875 | 9.7886143 | 9.7771258 | 6470.694 | 6307.938 | 6146.308 | 5985.850 | 20 |
| 19 | 9.8107682 | 9.7997013 | 9.7884245 | 9.7769325 | 6467.973 | 6305.235 | 6143.624 | 5983.186 | 19 |
| 18 | 9.8105854 | 9.7995151 | 9.7882348 | 9.7767391 | 6465.252 | 6302.532 | 6140.940 | 5980.522 | 18 |
| 17 | 9.8104026 | 9.7993288 | 9.7880450 | 9.7765456 | 6462.531 | 6299.830 | 6138.257 | 5977.859 | 17 |
| 16 | 9.8102197 | 9.7991425 | 9.7878551 | 9.7763521 | 6559.810 | 6297.128 | 6135.574 | 5975.196 | 16 |
| 15 | 9.8100368 | 9.7989561 | 9.7876652 | 9.7761585 | 6457.090 | 6294.426 | 6132.891 | 5972.533 | 15 |
| 14 | 9.8098538 | 9.7987697 | 9.7874752 | 9.7759649 | 6454.370 | 6291.724 | 6130.209 | 5969.870 | 14 |
| 13 | 9.8096708 | 9.7985831 | 9.7872851 | 9.7757712 | 6451.650 | 6289.023 | 6127.527 | 5967.208 | 13 |
| 12 | 9.8094877 | 9.7983966 | 9.7870950 | 9.7755775 | 6448.930 | 6286.322 | 6124.845 | 5964.546 | 12 |
| 11 | 9.8093045 | 9.7982095 | 9.7869048 | 9.7753836 | 6446.211 | 6283.621 | 6122.163 | 5961.885 | 10 |
| 10 | 9.8091213 | 9.7980233 | 9.7867146 | 9.7751898 | 6443.492 | 6280.920 | 6119.482 | 5959.224 | 11 |
| 9 | 9.8089380 | 9.7978365 | 9.7865243 | 9.7749958 | 6440.773 | 6278.220 | 6116.801 | 5956.563 | 9 |
| 8 | 9.8087547 | 9.7976498 | 9.7863340 | 9.7748018 | 6438.055 | 6275.520 | 6114.120 | 5953.903 | 8 |
| 7 | 9.8085713 | 9.7974629 | 9.7861435 | 9.7746077 | 6435.337 | 6272.820 | 6111.440 | 5951.243 | 7 |
| 6 | 9.8083879 | 9.7972760 | 9.7859531 | 9.7744136 | 6432.620 | 6270.122 | 6108.760 | 5948.584 | 6 |
| 5 | 9.8082044 | 9.7970890 | 9.7857625 | 9.7742194 | 6429.903 | 6267.423 | 6106.081 | 5945.925 | 5 |
| 4 | 9.8080208 | 9.7969020 | 9.7855720 | 9.7740252 | 6427.186 | 6264.725 | 6103,402 | 5943.266 | 4 |
| 3 | 9.8078372 | 9.7967149 | 9.7853813 | 9.7738308 | 6424.469 | 6262.027 | 6100.723 | 5940.608 | 3 |
| 2 | 9.8076536 | 9.7965278 | 9.7851909 | 9.7736365 | 6421.753 | 6259.329 | 6098.045 | 5937.950 | 2 |
| 1 | 9.8074698 | 9.7963405 | 9.7849998 | 9.7734420 | 6419 037 | 6256.631 | 6095.367 | 5935.292 | 1 |
| 0 | 9.8072860 | 9.7961534 | 9.7848090 | 9.7732475 | 6416.321 | 6253.934 | 6092.689 | 5932.634 | 0 |

Sines, and their Logarithms

Deg. 53, 52, 51, 50.

| M | N. 24 | N. 25 | N 26 | N. 27 | L. 24 | L. 25 | L. 26 | L. 27 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0864.545 | 0936.922 | 1012.060 | 1089.935 | 8.9367878 | 8.9717035 | 9.0052061 | 9.0374005 | 0 |
| 1 | 865.729 | 0938.152 | 1013.335 | 1091.256 | 8.9373817 | 8.9722729 | 9.0057529 | 9.0374264 | 1 |
| 2 | 866.913 | 939.382 | 1014.613 | 1092.577 | 8.9379756 | 8.9728424 | 9.0062997 | 9.0384522 | 2 |
| 3 | 868.098 | 940,614 | 1015.888 | 1093.900 | 8.9385687 | 8.9734111 | 9.0068458 | 9.0389774 | 3 |
| 4 | 869.284 | 941.846 | 1017.166 | 1095.223 | 8.9391618 | 8.9739797 | 9.0073920 | 9.0395026 | 4 |
| 5 | 870.471 | 943.078 | 1018.445 | 1096.547 | 8.9397540 | 8.9745476 | 9.0079344 | 9.0400272 | 5 |
| 6 | 871.658 | 944.312 | 1019,724 | 1097.872 | 8.9403462 | 8.9751155 | 9.0084827 | 9.0405517 | 6 |
| 7 | 0872.846 | 0945.546 | 1021.004 | 1099.197 | 8.9409376 | 8.9756826 | 9.0090274 | 9.0410755 | 7 |
| 8 | 874.035 | 946.781 | 1022.285 | 1100.524 | 8.9415290 | 8.9762497 | 9.0095721 | 9.0415944 | 8 |
| 9 | 875.225 | 948.017 | 1023.567 | 1101.851 | 8.9421195 | 8.9768161 | 9.0101160 | 9.0421226 | 9 |
| 10 | 876.416 | 949.254 | 1024.849 | 1103.178 | 8.9427101 | 8.9773824 | 9.0106600 | 9.0426458 | 10 |
| 11 | 877.607 | 950.491 | 1026.132 | 1104.507 | 8.9432998 | 8.9779480 | 9.0112032 | 9.0431683 | 11 |
| 12 | 878.799 | 951.729 | 1027.416 | 1105.836 | 8.9438895 | 8.9785135 | 9.0117465 | 9.0436908 | 12 |
| 13 | 0879.992 | 0952.968 | 1028.701 | 1107.166 | 8.9444783 | 8.9790783 | 9.0122890 | 9.0442127 | 13 |
| 14 | 881.185 | 954.208 | 1029.986 | 1108.497 | 8.9450672 | 8.9796431 | 9.0128315 | 9.0447345 | 14 |
| 15 | 882.380 | 955.449 | 1031.273 | 1109.829 | 8.9456552 | 8.9802071 | 9.0133733 | 9.0452557 | 15 |
| 16 | 883.575 | 956.690 | 1032.560 | 1111.161 | 8.9462433 | 8.9807711 | 9.0139154 | 9.0457769 | 16 |
| 17 | 884.771 | 957.932 | 1033.847 | 1112.494 | 8.9468305 | 8.9813344 | 9.0144562 | 9.0462975 | 17 |
| 18 | 885.967 | 959.175 | 1035.136 | 1113.828 | 8.9474177 | 8.9818976 | 9.0149973 | 9.0468180 | 18 |
| 19 | 0887.165 | 0960.418 | 1036.425 | 1115.162 | 8.9480040 | 8.9824601 | 9.0155377 | 9.0473379 | 19 |
| 20 | 888.363 | 961,662 | 1037.715 | 1116.497 | 8.9485904 | 8.9830226 | 9.0160781 | 9.0478578 | 20 |
| 21 | 889.562 | 962.907 | 1039.006 | 1117.834 | 8.9491759 | 8.9835843 | 9.0166177 | 9.0483770 | 21 |
| 22 | 890.762 | 964.153 | 1040.297 | 1119.170 | 8.9497615 | 8.9841460 | 9.0171574 | 9.0488962 | 22 |
| 23 | 891.962 | 965.400 | 1041.588 | 1120.508 | 8.9503462 | 8.9847070 | 9.0176964 | 9.0494147 | 23 |
| 24 | 893.163 | 966.647 | 1042.882 | 1121.846 | 8.9509309 | 8.9852679 | 9.0182353 | 9.0499333 | 24 |
| 25 | 0894.365 | 0967.895 | 1044.176 | 1123.185 | 8.9515148 | 8.9858281 | 9.0187736 | 9.0504512 | 25 |
| 26 | 895.568 | 969.144 | 1045.471 | 1124.525 | 8.9520982 | 8.9863883 | 9.0193119 | 9.0509691 | 26 |
| 27 | 896.771 | 970.394 | 1046.766 | 1125.866 | 8.9526818 | 8.9869478 | 9.0198494 | 9.0514864 | 27 |
| 28 | 897.976 | 971.644 | 1048.062 | 1127.207 | 8.9532648 | 8.9875072 | 9.0203870 | 9.0520036 | 28 |
| 29 | 899.181 | 972.895 | 1049.359 | 1128.549 | 8.9538471 | 8.9880659 | 9.0209238 | 9.0525202 | 29 |
| 30 | 900.387 | 974.147 | 1050.656 | 1129.892 | 8.9544294 | 8.9886246 | 9.0214607 | 9.0530368 | 30 |
| 31 | 0901.594 | 0975.400 | 1051.955 | 1131.235 | 8.9550108 | 8.9891825 | 9.0219969 | 9.0535528 | 31 |
| 32 | 902.801 | 976.653 | 1053.254 | 1132.580 | 8.9555922 | 8.9897404 | 9.0225330 | 9.0540687 | 32 |
| 33 | 904.010 | 977.908 | 1054.554 | 1133.925 | 8.9561729 | 8.9902976 | 9.0230685 | 9.0545840 | 33 |
| 34 | 905.219 | 979.162 | 1055.854 | 1135.270 | 8.9567535 | 8.9908548 | 9.0236039 | 9.0550993 | 34 |
| 35 | 906.428 | 980.418 | 1057.156 | 1135.617 | 8.9573333 | 8.9914112 | 9.0241387 | 9.0555140 | 35 |
| 36 | 907.639 | 981.675 | 1058.458 | 1137.964 | 8.9579131 | 8.9919675 | 9.0246735 | 9.0561286 | 36 |
| 37 | 0908.850 | 0982.932 | 1059.760 | 1139.312 | 8.9584921 | 8.9925233 | 9.0258076 | 6.0566426 | 37 |
| 38 | 910.062 | 984.190 | 1061.064 | 1140.661 | 8.9590711 | 8.9930790 | 9.0257416 | 6.0571566 | 38 |
| 39 | 911.275 | 985.449 | 1062.368 | 1142.011 | 8.9596493 | 8.9936339 | 9.0262750 | 6.0576700 | 39 |
| 40 | 912.489 | 986.708 | 1063.674 | 1143.361 | 8.9602275 | 8.9941888 | 9.0268084 | 6.0581833 | 40 |
| 41 | 913.703 | 987.969 | 1064.979 | 1144.712 | 8.9608049 | 8.9947430 | 9.0273411 | 6.0586961 | 41 |
| 42 | 914.918 | 989.230 | 1066.286 | 1146.064 | 8.9613823 | 8.9952972 | 9.0278738 | 6.0592088 | 42 |
| 43 | 0916.134 | 0990.492 | 1067.594 | 1147.416 | 8.9619589 | 8.9958506 | 9.0284058 | 6.0597209 | 43 |
| 44 | 917.351 | 991.754 | 1068.902 | 1148.770 | 8.9625355 | 8.9964041 | 9.0289378 | 6.0602329 | 44 |
| 45 | 918.568 | 993.018 | 1070.211 | 1150.124 | 8.9631112 | 8.9969568 | 9.0294691 | 6.0607444 | 45 |
| 46 | 919.786 | 994.282 | 1071.520 | 1151.478 | 8.9636870 | 8.9975095 | 9.0300004 | 6.0612558 | 46 |
| 47 | 921.005 | 995.547 | 1072.831 | 1152.834 | 8.9642620 | 8.9980614 | 9.0305310 | 6.0617666 | 47 |
| 48 | 922.225 | 996.812 | 1074.142 | 1154.191 | 8.9648370 | 8.9986134 | 9.0310616 | 6.0622774 | 48 |
| 49 | 0923.446 | 0998.079 | 1075.454 | 1155.547 | 8.9654122 | 8.9991646 | 9.0315916 | 9.0627876 | 49 |
| 50 | 924,667 | 999.346 | 1076.766 | 1156.905 | 8.9659854 | 8.9997158 | 9.0321215 | 9.0632977 | 50 |
| 51 | 925.889 | 1000.614 | 1078.080 | 1158.264 | 8.9665588 | 9.0002663 | 9.0326508 | 9.0638073 | 51 |
| 52 | 927.112 | 1001.883 | 1079.394 | 1159.623 | 8.9671322 | 9.0008168 | 9.0331800 | 9.0643168 | 52 |
| 53 | 928.335 | 1003.152 | 1080.709 | 1160 983 | 8,9677048 | 9.0013666 | 9 0337086 | 9.0648257 | 53 |
| 54 | 929.560 | 1004.422 | 1082.025 | 1162.344 | 8.9682774 | 9.0019163 | 9.0342372 | 9.0653346 | 54 |
| 55 | 0930.785 | 1005.694 | 1083.341 | 1163.705 | 8.9688492 | 9.0024653 | 9.0347651 | 9.0658428 | 55 |
| 56 | 932.011 | 1006.965 | 1084.658 | 1165.068 | 8.9694210 | 9.0030144 | 9.0352930 | 9.0663511 | 56 |
| 57 | 933.238 | 1008.237 | 1085.976 | 1166.431 | 8.9699900 | 9.0035626 | 9.0358202 | 9.0668587 | 57 |
| 58 | 934.465 | 1009.511 | 1087.295 | 1167.794 | 8.9705630 | 9.0041109 | 9.0363474 | 9.0673663 | 58 |
| 59 | 935.693 | 1010.785 | 1088.615 | 1169.159 | 8.9711333 | 9.0046585 | 9.0368740 | 9.0678733 | 59 |
| 60 | 936.922 | 1012.060 | 1089.935 | 1170.524 | 8.9717035 | 9.0052061 | 9.0374005 | 9.0683803 | 60 |

A Table of Natural Versed — Deg. 65, 64, 63, 62.

| M | L. 65 | L. 64 | L. 63 | L. 62 | N. 65 | N. 64 | N. 63 | N. 62 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.7732475 | 9.7614630 | 9.7494494 | 9.7372002 | 5932.954 | 5773.817 | 5610,288 | 5460.095 | 60 |
| 59 | 9.7730529 | 9.7612647 | 9.7492472 | 9.7369940 | 5929.977 | 5771.181 | 5613.674 | 5455.703 | 59 |
| 58 | 9.7728583 | 9.7610663 | 9.7490449 | 9.7367878 | 5927.320 | 5768.545 | 5611.060 | 5454.912 | 58 |
| 57 | 9.7726636 | 9.7608678 | 9.7488426 | 9.7365814 | 5924.663 | 5765.910 | 5608.446 | 5452.321 | 57 |
| 56 | 9.7724689 | 9.7606693 | 9.7486402 | 9.7363750 | 5922.007 | 5763.275 | 5605.833 | 5449.730 | 56 |
| 55 | 9.7722741 | 9.7604707 | 9.7484377 | 9.7361686 | 5919.351 | 5760.640 | 5603.220 | 5447.140 | 55 |
| 54 | 9.7720792 | 9.7602721 | 9.7482352 | 9.7359621 | 5916.695 | 5758.006 | 5600.608 | 5444.550 | 54 |
| 53 | 9.7718842 | 9.7600733 | 9.7480326 | 9.7357554 | 5914.040 | 5755.372 | 5597.996 | 5441.961 | 53 |
| 52 | 9.7716893 | 9.7598746 | 9.7478299 | 9.7355488 | 5911.385 | 5752.738 | 5595.364 | 5439.372 | 52 |
| 51 | 9.7714942 | 9.7596757 | 9.7476272 | 9.7353421 | 5908.731 | 5750.105 | 5592.773 | 5436.784 | 51 |
| 50 | 9.7712991 | 9.7594769 | 9.7474244 | 9.7351353 | 5906.077 | 5747.472 | 5590.162 | 5434.196 | 50 |
| 49 | 9.7711039 | 9.7592779 | 9.7472215 | 9.7349284 | 5903.423 | 5744.839 | 5587.551 | 5431.608 | 49 |
| 48 | 9.7709087 | 9.7590789 | 9.7470186 | 9.7347215 | 5900.769 | 5742.207 | 5584.941 | 5429.021 | 48 |
| 47 | 9.7707133 | 9.7588797 | 9.7468156 | 9.7345145 | 5898.116 | 5739.575 | 5582.331 | 5426.434 | 47 |
| 46 | 9.7705180 | 9.7586806 | 9.7466126 | 9.7343074 | 5895.463 | 5736.944 | 5579.722 | 5423.847 | 46 |
| 45 | 9.7703225 | 9.7584813 | 9.7464094 | 9.7341003 | 5892.811 | 5734.313 | 5577.113 | 5421.261 | 45 |
| 44 | 9.7701271 | 9.7582821 | 9.7462063 | 9.7338931 | 5890.159 | 5731.682 | 5574.504 | 5418.675 | 44 |
| 43 | 9.7699315 | 9.7580827 | 9.7460030 | 9.7336858 | 5887.507 | 5729.051 | 5571.896 | 5416.089 | 43 |
| 42 | 9.7697359 | 9.7578833 | 9.7457997 | 9.7334785 | 5884.856 | 5726.421 | 5569.288 | 5413.504 | 42 |
| 41 | 9.7695402 | 9.7576838 | 9.7455963 | 9.7332711 | 5882.205 | 5723.794 | 5566.680 | 5410.919 | 41 |
| 40 | 9.7693444 | 9.7574843 | 9.7453928 | 9.7330636 | 5879.554 | 5721.162 | 5564.073 | 5408.335 | 40 |
| 39 | 9.7691486 | 9.7572846 | 9.7451893 | 9.7328560 | 5876.904 | 5718.533 | 5561.466 | 5405.751 | 39 |
| 38 | 9.7689528 | 9.7570850 | 9.7449857 | 9.7326485 | 5874.254 | 5715.904 | 5558.860 | 5403.167 | 38 |
| 37 | 9.7687568 | 9.7568852 | 9.7447821 | 9.7324408 | 5871.605 | 5713.276 | 5556.254 | 5400.584 | 37 |
| 36 | 9.7685608 | 9.7566854 | 9.7445784 | 9.7322331 | 5868.956 | 5710.648 | 5553.648 | 5398.001 | 36 |
| 35 | 9.7683647 | 9.7564855 | 9.7443745 | 9.7320252 | 5866.307 | 5708.021 | 5551.043 | 5395.419 | 35 |
| 34 | 9.7681687 | 9.7562856 | 9.7441707 | 9.7318174 | 5863.656 | 5705.394 | 5548.438 | 5392.837 | 34 |
| 33 | 9.7679724 | 9.7560856 | 9.7439668 | 9.7316094 | 5861.011 | 5702.767 | 5545.833 | 5390.256 | 33 |
| 32 | 9.7677762 | 9.7558856 | 9.7437628 | 9.7314014 | 5858.363 | 5700.141 | 5543.229 | 5387.675 | 32 |
| 31 | 9.7675799 | 9.7556854 | 9.7435587 | 9.7311933 | 5855.715 | 5697.515 | 5540.625 | 5385.094 | 31 |
| 30 | 9.7673835 | 9.7554853 | 9.7433547 | 9.7309852 | 5853.068 | 5694.889 | 5538.022 | 5382.514 | 30 |
| 29 | 9.7671871 | 9.7552850 | 9.7431505 | 9.7307769 | 5850.421 | 5692.264 | 5535.419 | 5379.933 | 29 |
| 28 | 9.7669906 | 9.7550847 | 9.7429462 | 9.7305686 | 5847.774 | 5689.639 | 5532.816 | 5377.354 | 28 |
| 27 | 9.7667940 | 9.7548843 | 9.7427419 | 9.7303603 | 5845.128 | 5687.014 | 5530.214 | 5374.775 | 27 |
| 26 | 9.7665974 | 9.7546839 | 9.7425375 | 9.7301519 | 5842.482 | 5684.390 | 5527.612 | 5372.196 | 26 |
| 25 | 9.7664007 | 9.7544838 | 9.7423331 | 9.7299433 | 5839.837 | 5681.766 | 5525.010 | 5369.618 | 25 |
| 24 | 9.7662040 | 9.7542828 | 9.7421286 | 9.7297348 | 5837.192 | 5679.142 | 5522.409 | 5367.040 | 24 |
| 23 | 9.7660071 | 9.7540821 | 9.7419241 | 9.7295261 | 5834.547 | 5676.519 | 5519.808 | 5364.462 | 23 |
| 22 | 9.7658103 | 9.7538814 | 9.7417195 | 9.7293175 | 5831.903 | 5673.896 | 5517.208 | 5361.885 | 22 |
| 21 | 9.7656133 | 9.7536806 | 9.7415148 | 9.7291087 | 5829.259 | 5671.274 | 5514.608 | 5359.308 | 21 |
| 20 | 9.7654164 | 9.7534798 | 9.7413099 | 9.7288999 | 5826.615 | 5668.652 | 5512.008 | 5356.732 | 20 |
| 19 | 9.7652193 | 9.7532789 | 9.7411050 | 9.7286909 | 5823.972 | 5666.030 | 5509.409 | 5354.156 | 19 |
| 18 | 9.7650222 | 9.7530779 | 9.7409001 | 9.7284820 | 5821.329 | 5663.409 | 5506.810 | 5351.580 | 18 |
| 17 | 9.7648249 | 9.7528769 | 9.7406951 | 9.7282729 | 5818.687 | 5660.788 | 5504.212 | 5349.005 | 17 |
| 16 | 9.7646277 | 9.7526758 | 9.7404900 | 9.7280638 | 5816.045 | 5658.167 | 5501.614 | 5346.410 | 16 |
| 15 | 9.7644304 | 9.7524746 | 9.7402849 | 9.7278546 | 5813.403 | 5655.547 | 5499.016 | 5343.855 | 15 |
| 14 | 9.7642330 | 9.7522734 | 9.7400797 | 9.7276454 | 5810.761 | 5652.927 | 5496.418 | 5341.281 | 14 |
| 13 | 9.7640355 | 9.7520721 | 9.7398745 | 9.7274360 | 5808.120 | 5650.307 | 5493.821 | 5338.707 | 13 |
| 12 | 9.7638381 | 9.7518708 | 9.7396692 | 9.7272267 | 5805.479 | 5647.688 | 5491.224 | 5336.134 | 12 |
| 11 | 9.7636405 | 9.7516693 | 9.7394638 | 9.7270172 | 5802.838 | 5645.029 | 5488.628 | 5333.561 | 11 |
| 10 | 9.7634429 | 9.7514679 | 9.7392584 | 9.7268077 | 5800.198 | 5642.451 | 5486.032 | 5330.988 | 10 |
| 9 | 9.7632451 | 9.7512662 | 9.7390528 | 9.7265981 | 5797.558 | 5639.833 | 5483.437 | 5328.416 | 9 |
| 8 | 9.7630474 | 9.7510647 | 9.7388473 | 9.7262885 | 5794.919 | 5637.215 | 5480.842 | 5325.844 | 8 |
| 7 | 9.7628496 | 9.7508630 | 9.7386416 | 9.7261787 | 5792.280 | 5634.598 | 5478.242 | 5323.273 | 7 |
| 6 | 9.7626517 | 9.7506613 | 9.7384359 | 9.7259689 | 5789.641 | 5631.981 | 5475.653 | 5320.702 | 6 |
| 5 | 9.7624537 | 9.7504594 | 9.7382301 | 9.7257590 | 5787.003 | 5629.365 | 5473.059 | 5318.131 | 5 |
| 4 | 9.7622557 | 9.7502576 | 9.7380243 | 9.7255491 | 5784.365 | 5626.749 | 5470.465 | 5315.561 | 4 |
| 3 | 9.7620576 | 9.7500556 | 9.7378183 | 9.7253391 | 5781.727 | 5624.133 | 5467.872 | 5312.991 | 3 |
| 2 | 9.7618595 | 9.7498536 | 9.7376124 | 9.7251290 | 5779.090 | 5621.518 | 5465.279 | 5310.422 | 2 |
| 1 | 9.7616613 | 9.7496515 | 9.7374063 | 9.7249188 | 5776.453 | 5618.903 | 5462.687 | 5307.853 | 1 |
| 0 | 9.7614620 | 9.7494494 | 9.7372002 | 9.7247087 | 5773.817 | 5616.288 | 5460.095 | 5305.284 | 0 |

Sines, and their Logarithms Deg. 28, 29, 30, 31

| M | N. 28 | N. 29 | N 30 | N. 31 | L. 28 | L. 29 | L. 30 | 31 L. | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 170.521 | 1253.803 | 1339 746 | 1428 327 | 9.0683803 | 9.0982293 | 9.1270225 | 9.1548276 | 0 |
| 1 | 1171.890 | 1255.214 | 1341.201 | 1429.820 | 9.0688867 | 9.0987175 | 9.1274937 | 9.1552829 | 1 |
| 2 | 1173.257 | 1256.625 | 1342.656 | 1431.325 | 9.0693931 | 9.0992057 | 9.1279649 | 9.1557382 | 2 |
| 3 | 1174.624 | 1258.037 | 1344.113 | 1432.825 | 9.0698988 | 9.0996933 | 9.1284355 | 9.1561930 | 3 |
| 4 | 1175.993 | 1259.450 | 1345.570 | 1434.326 | 9.0704046 | 9.1001809 | 9.1289062 | 9.1566477 | 4 |
| 5 | 1177.362 | 1260,863 | 1347.027 | 1435.827 | 9.0709097 | 9.1006679 | 9.1293763 | 9.157 1020 | 5 |
| 6 | 1178.721 | 1262.278 | 1348.486 | 1437.329 | 9.0714148 | 9.1011549 | 9.1298464 | 9.1575562 | 6 |
| 7 | 1180.102 | 1263.693 | 1349,945 | 1438.832 | 9.0719193 | 9.1016414 | 9.1303159 | 9.1580100 | 7 |
| 8 | 1181.473 | 1265.109 | 1351.405 | 1440.336 | 9.0724238 | 9.1021278 | 9.1307855 | 9.1584637 | 8 |
| 9 | 1182.845 | 1266.525 | 1352.866 | 1441 840 | 9.0729227 | 9.1026130 | 9.1312545 | 9.1589169 | 9 |
| 10 | 1184.218 | 1267.942 | 1354.327 | 1443.345 | 9.0734316 | 9.1030995 | 9.1317235 | 9.1593702 | 10 |
| 11 | 1185.591 | 1269.360 | 1355.789 | 1444.851 | 9.0739348 | 9.1035848 | 9.1321920 | 9.1598229 | 11 |
| 12 | 1186.965 | 1270.779 | 1357.252 | 1446.357 | 9.0744381 | 9.1040701 | 9.1326605 | 9.1602756 | 12 |
| 13 | 1188.340 | 1272.199 | 1358.716 | 1447.865 | 6,0749407 | 9.1045548 | 9.1331284 | 9.1607278 | 13 |
| 14 | 1189.716 | 1273.619 | 1360.180 | 14:9.373 | 6.0754434 | 9.1050395 | 9.1335964 | 9.1611800 | 14 |
| 15 | 1191.093 | 1275.040 | 1361.645 | 1450.881 | 6.0759454 | 9.1055236 | 9.1340637 | 9.1616318 | 15 |
| 16 | 1192.470 | 1276.462 | 1363.111 | 1452.391 | 6.0764474 | 9.1060078 | 9.1345311 | 9.1620835 | 16 |
| 17 | 1193.848 | 1277.884 | 1364.577 | 1453.901 | 6.0769488 | 9.1064913 | 9.1349980 | 9.1625347 | 17 |
| 18 | 1195.220 | 1279.307 | 1366.044 | 1455.412 | 6.0774502 | 9.1069749 | 9.1354648 | 9.1629859 | 18 |
| 19 | 1196.606 | 1280.731 | 1367.512 | 1456.923 | 9.0779510 | 9 1074578 | 9 1359312 | 9.1634366 | 19 |
| 20 | 1197.986 | 1282.156 | 1368.981 | 1458.436 | 9.0784518 | 9.1079408 | 9.1363975 | 9.1638873 | 20 |
| 21 | 1199.367 | 1283.581 | 1370.451 | 1459.949 | 9.0789519 | 9.1084232 | 9.1368633 | 9.1643374 | 21 |
| 22 | 1200.749 | 1285.007 | 1371.921 | 1461.462 | 9.0794521 | 9.1089056 | 9.1373290 | 9.1647876 | 22 |
| 23 | 1202.131 | 1286.434 | 1373.392 | 1462.977 | 9.0799517 | 9.1093875 | 9.1377943 | 9.1652373 | 23 |
| 24 | 1203.514 | 1287.862 | 1374.863 | 1464.492 | 9.0804512 | 9.1098693 | 9.1382595 | 9.1656870 | 24 |
| 25 | 1204.898 | 12°9.290 | 1376.336 | 1466.008 | 9.0809502 | 9.1103506 | 9.1387242 | 9.1661362 | 25 |
| 26 | 1206.283 | 1290.719 | 1377.809 | 1467.525 | 9.0814491 | 9.1108318 | 9.1391889 | 9.1665854 | 26 |
| 27 | 1207.668 | 1292.149 | 1379.283 | 1469.042 | 9.0819475 | 9.1113125 | 9.1396531 | 9.1670341 | 27 |
| 28 | 1209.054 | 1293.580 | 1380.757 | 1470.560 | 9.0824458 | 9.1117932 | 9.1401173 | 9.1674828 | 28 |
| 29 | 1210.441 | 1295.011 | 1382.232 | 1472.079 | 9.0829436 | 9.1122733 | 9.1405809 | 9.1679309 | 29 |
| 30 | 1211.829 | 1296.443 | 1383.708 | 1473.598 | 9.0834413 | 9.1127534 | 9.1410446 | 9.1683791 | 30 |
| 31 | 1213.217 | 1297.876 | 1385.185 | 1475.119 | 9.0839384 | 9.1132330 | 9.1415077 | 9.1688268 | 31 |
| 32 | 1214,606 | 1299.309 | 1386.663 | 1476.640 | 9.0844356 | 9.1137126 | 9.1419708 | 9.1692745 | 32 |
| 33 | 1215.996 | 1300.744 | 1388.141 | 1478.161 | 9.0849321 | 9.1141915 | 9.1424334 | 9.1697217 | 33 |
| 34 | 1217 387 | 1302.179 | 1389.620 | 1479.684 | 9 0854286 | 9.1146705 | 9.1428960 | 9.1701689 | 34 |
| 35 | 1218.778 | 1303.614 | 1391.099 | 1481.207 | 9.0859245 | 9.1151490 | 9.1433580 | 9.1706156 | 35 |
| 36 | 1220.170 | 1305.051 | 1392.580 | 1482.731 | 9.0864204 | 9.1156274 | 9.1438201 | 9.1710623 | 36 |
| 37 | 1221.563 | 1306.488 | 1394.061 | 1484.255 | 9.0869157 | 9.1161052 | 9.1442816 | 6.1715085 | 37 |
| 38 | 1222.957 | 1307.926 | 1395.543 | 1485.781 | 9.0874111 | 9.1165831 | 9.1447431 | 6.1719547 | 38 |
| 39 | 1224.351 | 1309.364 | 1397.025 | 1487.307 | 9.0879058 | 9.1170604 | 9.1452041 | 6.1724004 | 39 |
| 40 | 1225.746 | 1310.804 | 1398.509 | 1488.833 | 9.0884005 | 9.1175377 | 9.1456651 | 6.1728461 | 40 |
| 41 | 1227.142 | 1312.244 | 1399.993 | 1490.361 | 9.0888946 | 9.1180145 | 9.1461256 | 6.1732913 | 41 |
| 42 | 1228.538 | 1313.685 | 1401.477 | 1491.889 | 9.0893887 | 9.1184912 | 9.1465861 | 6.1737365 | 42 |
| 43 | 1229.936 | 1315.126 | 1402.963 | 1493.418 | 6.0898822 | 9.1189674 | 9.1470460 | 6.1741812 | 43 |
| 44 | 1231.334 | 1316.569 | 1404.449 | 1494.947 | 6.0903758 | 9.1194436 | 9.1475060 | 6.1746259 | 44 |
| 45 | 1232.732 | 1318.012 | 1405.936 | 1496.478 | 6.0908687 | 9.1199192 | 9.1479654 | 6.1750701 | 45 |
| 46 | 1234.132 | 1319.456 | 1407.424 | 1498.009 | 6.0913616 | 9.1203948 | 9.1484248 | 6.1755144 | 46 |
| 47 | 1235.532 | 1320.900 | 1408.912 | 1499.541 | 6.0918539 | 9.1208699 | 9.1488837 | 6.1759581 | 47 |
| 48 | 1236.933 | 1322.345 | 1410.401 | 1501.073 | 6.0923462 | 9.1213449 | 9.1493426 | 6.1764018 | 48 |
| 49 | 1238.335 | 1323.791 | 1411.891 | 1502.506 | 6.0928380 | 9.1218194 | 9.1498010 | 9.1768451 | 49 |
| 50 | 1239.737 | 1325.238 | 1413.381 | 1504.140 | 6.0933297 | 9.1222939 | 9.1502594 | 9.1772883 | 50 |
| 51 | 1241.141 | 1326.686 | 1414.373 | 1505.675 | 6.0938208 | 9.1227679 | 9.1507172 | 9.1777311 | 51 |
| 52 | 1242.545 | 1328.134 | 1416.365 | 1507.210 | 6.0943120 | 9.1232419 | 9.1511751 | 9.1781738 | 52 |
| 53 | 1243.949 | 1329.583 | 1417.857 | 1508.746 | 6.0948025 | 9.1237153 | 9.1516324 | 9.1786161 | 53 |
| 54 | 1345.355 | 1331.033 | 1419.351 | 1510.283 | 6.0952931 | 9.1241887 | 9.1520898 | 9.1790584 | 54 |
| 55 | 1246.761 | 1332.483 | 1420.845 | 1511.821 | 6.0957830 | 9.1246615 | 9.1525466 | 9.1795002 | 55 |
| 56 | 1248.168 | 1333.934 | 1422.340 | 1513.358 | 6.0962730 | 9.1251344 | 9.1530034 | 9.1799419 | 56 |
| 57 | 1249.575 | 1335.386 | 1423.836 | 1514.898 | 6.0967625 | 9.1256057 | 9.1534597 | 9.1803832 | 57 |
| 58 | 1250.984 | 1336.839 | 1425.332 | 1516.438 | 6.0972517 | 9.1260790 | 9.1539161 | 9.1808245 | 58 |
| 59 | 1252.393 | 1338.292 | 1426.829 | 1517.978 | 6 0977405 | 9.1265507 | 9.1543719 | 9.1812653 | 59 |
| 60 | 1253 803 | 1339.746 | 1428.327 | 1519.519 | 6.0982293 | 9.1270225 | 9.1548276 | 9.1817061 | 60 |

Deg. 61, 60, 59, 58. A Table of Natural Versed

| M | L. 61 | L. 60 | L. 59 | L. 58 | N. 61 | N. 00 | N. 59 | N 58 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.7247087 | 9.7119677 | 9 6989700 | 9.6857076 | 5305.28 | 5151.904 | 5000,000 | 4849.619 | 60 |
| 59 | 9.7244983 | 9.711753? | 9.6987511 | 9.6854843 | 5302.716 | 5159.300 | 49?7.481 | 4847.126 | 59 |
| 58 | 9.7242880 | 9.7115387 | 9.6985322 | 9.6852609 | 5300.148 | 5146.816 | 4994.962 | 4844.633 | 58 |
| 57 | 9.7240776 | 9.711324( | 9 6983132 | 9.6850374 | 5297.581 | 5144.273 | 4992.444 | 4842.141 | 57 |
| 56 | 9.7238671 | 9.7111093 | 9 6980942 | 9.6848139 | 5295.014 | 5141.730 | 4989.926 | 4839.649 | 56 |
| 55 | 9.7236565 | 9.710894 | 9.6978750 | 9.6845902 | 5292.447 | 5139.188 | 4987.409 | 4837.157 | 55 |
| 54 | 9.7234459 | 9.7106797 | 9.6976558 | 9.6843665 | 5289.881 | 5136.646 | 4984.892 | 4834.666 | 54 |
| 53 | 9.7232352 | 9.7104647 | 9.6974365 | 9.6841427 | 5287.315 | 5134.105 | 4982.376 | 4832.175 | 53 |
| 52 | 9.7230244 | 9.710?497 | 9.6972172 | 9.6839189 | 5284.750 | 5131.564 | 4979.860 | 4829 685 | 52 |
| 51 | 9.7228136 | 9.7100346 | 9.6969977 | 9.6836949 | 5282 185 | 5129.023 | 4977.344 | 4827.195 | 51 |
| 50 | 9.7226037 | 9.7098195 | 9.6967782 | 9.6834710 | 5279.620 | 5126.483 | 4974.829 | 4824.706 | 50 |
| 49 | 9.7223917 | 9 7096042 | 9.6965586 | 9.6832468 | 5277.056 | 5123.943 | 4972.314 | 4822.217 | 49 |
| 48 | 9.7221807 | 9.7093890 | 9.6963390 | 9.6830227 | 5274.49? | 5121.404 | 4969.800 | 4819.729 | 48 |
| 47 | 9.7219695 | 9.7091736 | 9 6961192 | 9.6827984 | 5271.929 | 5118.865 | 4967.286 | 4817.241 | 47 |
| 46 | 9.7217584 | 9.7089582 | 9.6958994 | 9.6825741 | 5269.360 | 5116.326 | 4964.773 | 4814.754 | 46 |
| 45 | 9.7215471 | 9.7087426 | 9.6956795 | 9.6823497 | 5266.803 | 5113.788 | 4962.260 | 4812.267 | 45 |
| 44 | 9.7213358 | 9.7085271 | 9.6954596 | 9.6821253 | 5264.241 | 5111.250 | 4959.747 | 4809.780 | 44 |
| 43 | 9.7211243 | 9.7083114 | 9.6952395 | 9.6819007 | 5261.679 | 5108.713 | 4957.235 | 4807.294 | 43 |
| 42 | 9.7209129 | 9.7080957 | 9.6950194 | 9.6816761 | 5259.118 | 5106.176 | 4954.723 | 4804.808 | 42 |
| 41 | 9.7207013 | 9.7078799 | 9.6947992 | 9.6814514 | 5256.557 | 5103.639 | 4952.212 | 4802.323 | 41 |
| 40 | 9.7204898 | 9.7076641 | 9.6945790 | 9.6812266 | 5253.996 | 5101.103 | 4949.701 | 4799.838 | 40 |
| 39 | 9.7202781 | 9.7074481 | 9.6943587 | 9.6810018 | 5251.436 | 5098.567 | 4947.191 | 4797.354 | 39 |
| 38 | 9.7200663 | 9.7072321 | 9.6941383 | 9.6307769 | 5248.876 | 5096.032 | 4944.681 | 4794.870 | 38 |
| 37 | 9.7198545 | 9.707016 | 9.6939178 | 9.6805518 | 5246.317 | 5093.497 | 4942.171 | 4792.386 | 37 |
| 36 | 9.7196426 | 9.7067999 | 9.6936973 | 9.6803268 | 5243.758 | 5090.963 | 4939.662 | 4789.903 | 36 |
| 35 | 9.7194306 | 9.7065836 | 9.6934766 | 9.6801015 | 5241.199 | 5088.429 | 4937.153 | 4787.420 | 35 |
| 34 | 9.7192186 | 9.7063674 | 9.6932559 | 9.6798764 | 5238.641 | 5085.895 | 4934.645 | 4784.938 | 34 |
| 33 | 9.7190065 | 9.7061510 | 9.6930351 | 9.6796510 | 5236.083 | 5083.362 | 4932.137 | 4782.456 | 33 |
| 32 | 9.7187944 | 9.7059346 | 9.6928143 | 9.6794257 | 5233.526 | 5080.829 | 4929.630 | 4779.975 | 32 |
| 31 | 9.7185821 | 9.7057180 | 9.6925934 | 9.6792002 | 5230.969 | 5078.297 | 4927.123 | 4777.494 | 31 |
| 30 | 9.7183698 | 9.7055015 | 9.6923724 | 9.6789747 | 5228.412 | 5075.765 | 4924.616 | 4775.014 | 30 |
| 29 | 9.7181574 | 9.7052848 | 9.6921513 | 9.6787490 | 5225.856 | 5073.233 | 4922.110 | 4772.534 | 29 |
| 28 | 9.7179450 | 9.7050681 | 9.6919302 | 9.6785234 | 5223.300 | 5070.702 | 4919.604 | 4770.054 | 28 |
| 27 | 9.7177325 | 9.7048512 | 9.6917089 | 9.6782976 | 5220.745 | 5068.171 | 4917.099 | 4767.575 | 27 |
| 26 | 9.7175199 | 9.7046344 | 9.6914877 | 9.6780717 | 5218 190 | 5065.641 | 4914.594 | 4765.096 | 26 |
| 25 | 9.7173072 | 9.7044174 | 9.6912663 | 9.6778458 | 5215.635 | 5063.111 | 4912.089 | 4762.618 | 25 |
| 24 | 9.7170945 | 9.7042004 | 9.6910449 | 9.6776198 | 5213.081 | 5060.582 | 4909.585 | 4760.140 | 24 |
| 23 | 9.7168817 | 9.7039833 | 9.6908233 | 9.6773937 | 5210.527 | 5058.053 | 4907.081 | 4757.663 | 23 |
| 22 | 9.7166688 | 9.7037661 | 9.6906017 | 9.6771676 | 5207.974 | 5055.524 | 4904.578 | 4755.186 | 22 |
| 21 | 9.7164559 | 9.7035489 | 9.6903800 | 9.0769413 | 5205.421 | 5052.996 | 4902.075 | 4752.710 | 21 |
| 20 | 9.7162429 | 9.7033316 | 9.6901583 | 9.6767150 | 5202.868 | 5050.468 | 4899.573 | 4750.234 | 20 |
| 19 | 9.7160298 | 9.7031742 | 9.6899365 | 9.6764886 | 5200.316 | 5047.941 | 4897.071 | 4747.759 | 19 |
| 18 | 9.7158186 | 9.7028967 | 9 6897146 | 9.6762622 | 5197.764 | 5045.414 | 4894.570 | 4745.284 | 18 |
| 17 | 9.7156034 | 9.7026792 | 9.6894926 | 9.6760356 | 5195.213 | 5042.887 | 4892.069 | 4742.809 | 17 |
| 16 | 9.7153901 | 9.7024616 | 9.6892706 | 9.6758090 | 5192.662 | 5040.361 | 4889.569 | 4740.335 | 16 |
| 15 | 9.7151767 | 9.7022439 | 9.6890484 | 9.6755823 | 5190.112 | 5037.835 | 4887.069 | 4737.861 | 15 |
| 14 | 9.7149633 | 9.7020262 | 9.6888263 | 9.6753555 | 5187.562 | 5035.310 | 4884.569 | 4735.388 | 14 |
| 13 | 9.7147498 | 9.7018083 | 9 6886040 | 9.6751286 | 5185.012 | 5032.785 | 4882.070 | 4732.915 | 13 |
| 12 | 9.7145362 | 9.7015905 | 9.6883817 | 9.6749017 | 5182.463 | 5030.260 | 4879.571 | 4730.443 | 12 |
| 11 | 9.7143225 | 9.7013725 | 9.6881592 | 9.6746747 | 5179.914 | 5027.736 | 4877.073 | 4727.971 | 11 |
| 10 | 9.7141089 | 9.7011545 | 9.6879368 | 9.6744476 | 5177.365 | 5025.212 | 4874.575 | 4725.499 | 10 |
| 9 | 9.7138950 | 9.7009363 | 9.6877141 | 9.6742204 | 5174.817 | 5022.689 | 4872.078 | 4723.028 | 9 |
| 8 | 9.7136812 | 9.7007182 | 9.6874915 | 9.6739932 | 5172.269 | 5020.166 | 4869.581 | 4720.557 | 8 |
| 7 | 9.7134672 | 9.7004999 | 9.6872688 | 9.6737659 | 5169.722 | 5017.644 | 4867.084 | 4718.087 | 7 |
| 6 | 9.7132533 | 9.7002816 | 9.6870460 | 9.6735385 | 5167.175 | 5015.122 | 4864.588 | 4715.617 | 6 |
| 5 | 9.7130392 | 9.7000631 | 9.6868231 | 9.6733110 | 5164.629 | 5012.601 | 4862.092 | 4713.148 | 5 |
| 4 | 9.7128250 | 9.6998447 | 9.6866002 | 9.6730835 | 5162 083 | 5010.080 | 4859.597 | 4710.679 | 4 |
| 3 | 9.7126108 | 9.6996271 | 9.6863771 | 9.6728558 | 5159.538 | 5007.559 | 4857.102 | 4708.211 | 3 |
| 2 | 9.7123965 | 9.6994075 | 9.6861541 | 9.6726281 | 5156 993 | 5005.039 | 4854.607 | 4705.742 | 2 |
| 1 | 9.7121821 | 9.6991887 | 9.6859309 | 9.6724003 | 5154.448 | 5002.519 | 4852.113 | 4703.275 | 1 |
| 0 | 9.7119677 | 9.6989700 | 9.6857076 | 9.6721725 | 5151.904 | 5000.000 | 4849.619 | 4700.808 | 0 |

Deg. 32, 33, 34, 35. Sines and their Logarithms.

| M | N. 32 | N. 33 | N. 34 | N. 35 | L. 32 | L. 33 | L. 34 | L. 35 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1519.519 | 1613 294 | 1709 624 | 1808.480 | 9.1817001 | 9.2077136 | 9.2329007 | 9.2573136 | 0 |
| 1 | 1521.061 | 1614.879 | 1711.251 | 1810.148 | 9.1821465 | 9.2081299 | 9.2333137 | 9.2577141 | 1 |
| 2 | 1522.603 | 1616.464 | 1712.879 | 1811.818 | 9.1825868 | 9.2085661 | 9.2337267 | 9.2581145 | 2 |
| 3 | 1524.147 | 1618.050 | 1714.507 | 1813.488 | 9.1830265 | 9.2089919 | 9.2341392 | 9.2585146 | 3 |
| 4 | 1525.691 | 1619.637 | 1716 136 | 1815.159 | 9 1834665 | 9.2094177 | 9.2345518 | 9.2589147 | 4 |
| 5 | 1527.235 | 1621.225 | 1717.766 | 1816.831 | 9.1839059 | 9.2098431 | 9.2349639 | 9.2593143 | 5 |
| 6 | 1528.781 | 1622.813 | 1719.397 | 1818.502 | 9.1843452 | 9.2102684 | 9.2353761 | 9.2597140 | 6 |
| 7 | 1530.327 | 1624.402 | 1721.028 | 1820.178 | 9.1847841 | 9.2106933 | 9.2357878 | 9.2601132 | 7 |
| 8 | 1531.874 | 1625.991 | 1722 660 | 1821.849 | 9.1852230 | 9.2111182 | 9.2361995 | 9.2605125 | 8 |
| 9 | 1533.421 | 1627.582 | 1724.292 | 1823.524 | 9.1856614 | 9.2115427 | 9.2366108 | 9.2609113 | 9 |
| 10 | 1534.970 | 1629.173 | 1725.926 | 1825.199 | 9.1860998 | 9.2119671 | 9.2370221 | 9.2613102 | 10 |
| 11 | 1536.519 | 1630.764 | 1727 560 | 1826.875 | 9.1865377 | 9.2123911 | 9.2374329 | 9 2617086 | 11 |
| 12 | 1538.068 | 1632.357 | 1729.194 | 1828.551 | 9.1869756 | 9.2128151 | 9.2378438 | 9.2621071 | 12 |
| 13 | 1539.619 | 1633.950 | 1730.830 | 1830.228 | 9.1874131 | 9.2132387 | 9.2382542 | 9.2625051 | 13 |
| 14 | 1541.170 | 1635.544 | 1732.460 | 1831.906 | 9.1878505 | 9.2136622 | 9.2386647 | 9.2629032 | 14 |
| 15 | 1542.722 | 1637.138 | 1734.103 | 1833.584 | 9.1882875 | 9.2140853 | 9.2390747 | 9.2633008 | 15 |
| 16 | 1544.274 | 1638.734 | 1735.740 | 1835.264 | 9.1887245 | 9.2545084 | 9.2394847 | 9.2636985 | 16 |
| 17 | 1545.828 | 1640.330 | 1737.378 | 1836.944 | 9.1891610 | 9.2149310 | 9.2398943 | 9.2640957 | 17 |
| 18 | 1547.382 | 1641.926 | 1739.017 | 1838.624 | 9.1895974 | 9.2153537 | 9.2403038 | 9.2644929 | 18 |
| 19 | 1548.936 | 1643.524 | 1740.657 | 1840.305 | 9.1900335 | 9.2157759 | 9.2407130 | 9.2648898 | 19 |
| 20 | 1550.492 | 1645.122 | 1742.297 | 1841.987 | 9 1904695 | 9.2161981 | 9.2411222 | 9.2658266 | 20 |
| 21 | 1552.048 | 1646.721 | 1743.938 | 1843.670 | 9.1909050 | 9.2166198 | 9.2415309 | 9.2656831 | 21 |
| 22 | 1553.605 | 1648.320 | 1745.580 | 1845.353 | 9.1913406 | 9.2170416 | 9.2419396 | 9.2660795 | 22 |
| 23 | 1555.162 | 1649.920 | 1747.222 | 1847.037 | 9.1917756 | 9.2174629 | 9.2423480 | 9.2664756 | 23 |
| 24 | 1556.721 | 1651.521 | 1748.865 | 1848.722 | 9.1922107 | 9.2178842 | 9.2427563 | 9.2668716 | 24 |
| 25 | 1558.280 | 1653.123 | 1750.509 | 1850.407 | 9.1926453 | 9.2183051 | 9.2431642 | 9.2672673 | 25 |
| 26 | 1559.839 | 1654.725 | 1752.153 | 1852.094 | 9.1930799 | 9.2187259 | 9.2435721 | 9.2676729 | 26 |
| 27 | 1561.400 | 1656.328 | 1753.795 | 1853.780 | 9.1935140 | 9.2191463 | 9.2439796 | 9.2680582 | 27 |
| 28 | 1562.961 | 1657 932 | 1755.444 | 1855.468 | 9.1939482 | 9.2195668 | 9.2443871 | 9.2684534 | 28 |
| 29 | 1564.523 | 1659.537 | 1757.091 | 1857.156 | 9.1943818 | 9.2199867 | 9.2441941 | 9.2688483 | 29 |
| 30 | 1566.086 | 1661.142 | 1758.738 | 1858.845 | 9.1948155 | 9.2204067 | 9.2452012 | 9.2692431 | 30 |
| 31 | 1567.649 | 1662.748 | 1760.386 | 1860.534 | 9.1952487 | 9.2208262 | 9.2456078 | 9.2696376 | 31 |
| 32 | 1569.213 | 1664.354 | 1762.035 | 1862.225 | 9.1956819 | 9.2212458 | 9.2460145 | 9.2700321 | 32 |
| 33 | 1570.778 | 1665.962 | 1763.684 | 1863.916 | 9 1961146 | 9.2216649 | 9.2464207 | 9.2704251 | 33 |
| 34 | 1572.343 | 1667.570 | 1765.334 | 1865.607 | 9.1965473 | 9.2220839 | 9.2468269 | 9.2708202 | 34 |
| 35 | 1573.909 | 1669.178 | 1766.985 | 1867.299 | 9.1969795 | 9.2225026 | 9.2472327 | 9.2712139 | 35 |
| 36 | 1575.476 | 1670.788 | 1768.636 | 1868.992 | 9.1974118 | 9.2229212 | 9 2476385 | 9.2716075 | 36 |
| 37 | 1577.044 | 1672.398 | 1770.288 | 1870.686 | 9.1978436 | 9.2233395 | 9.2480439 | 9.2720008 | 37 |
| 38 | 1578.612 | 1674.009 | 1771.941 | 1872.380 | 9.1982754 | 9.2237577 | 9.2484493 | 9.2723941 | 38 |
| 39 | 1580.181 | 1675.620 | 1773.595 | 1874.075 | 9.1987067 | 9.2241754 | 9.2488543 | 9.2727870 | 39 |
| 40 | 1581.751 | 1677.232 | 1775.249 | 1875.771 | 9.1991380 | 9.2245932 | 9.2492593 | 9.2731799 | 40 |
| 41 | 1583.321 | 1678.845 | 1776.904 | 1877.468 | 9.1995689 | 9.2250105 | 9.2496619 | 9.2735724 | 41 |
| 42 | 1584.892 | 1680.459 | 1778.560 | 1879.165 | 9.1999997 | 9.2254279 | 9.2500584 | 9.2739649 | 42 |
| 43 | 1586.464 | 1682.073 | 1780.216 | 1880.863 | 9.2004301 | 9.2258448 | 9.2504726 | 9.2743570 | 43 |
| 44 | 1588.037 | 1683.688 | 1781.873 | 1882.561 | 9.2008605 | 9.2262617 | 9.2508767 | 9.2747491 | 44 |
| 45 | 1589.610 | 1685.304 | 1783.531 | 1884.260 | 9 2012904 | 9.2266781 | 9.2512805 | 9.2751408 | 45 |
| 46 | 1591.184 | 1686.920 | 1785.189 | 1885.960 | 9.2017204 | 9 2270946 | 9.2516842 | 9 2755325 | 46 |
| 47 | 1592.759 | 1688.537 | 1786.848 | 1887.661 | 9.2021498 | 9.2275106 | 9.2520875 | 9.2759238 | 47 |
| 48 | 1534.334 | 1690.155 | 1788.508 | 1889.362 | 9.2025793 | 9.2279266 | 9.2524909 | 9.2763151 | 48 |
| 49 | 1595.910 | 1691.774 | 1790.168 | 1891.064 | 9 2030083 | 9.2283422 | 9.2528938 | 9.2767061 | 49 |
| 50 | 1597.487 | 1693.393 | 1791 830 | 1892.765 | 9.2034373 | 9.2287578 | 9.2532967 | 9.2770970 | 50 |
| 51 | 1599.064 | 1695 013 | 1793.491 | 1894.470 | 9.2038659 | 9.2291729 | 9.2536992 | 9.2774875 | 51 |
| 52 | 1600.643 | 1696.634 | 1795.154 | 1896.174 | 9.2042944 | 9.2295881 | 9.2541017 | 9.2778787 | 52 |
| 53 | 1602.222 | 1698.255 | 1796.817 | 1897.878 | 9.2047225 | 9.2300028 | 9.2545038 | 9.2782683 | 53 |
| 54 | 1603.801 | 1699.877 | 1798.481 | 1899.584 | 9.2051506 | 9.2304175 | 9.2549059 | 9.2786584 | 54 |
| 55 | 1605.382 | 1701.500 | 1800.146 | 1901.290 | 9.2055782 | 9.2308318 | 9.2553076 | 9.2790482 | 55 |
| 56 | 1606.963 | 1703.123 | 1801.811 | 1902.996 | 9.2060058 | 9.2312461 | 9.2557093 | 9.2794380 | 56 |
| 57 | 1608.545 | 1704.748 | 1803.477 | 1904.704 | 9.2064330 | 9.2316600 | 9.2561106 | 9.2798273 | 57 |
| 58 | 1610.127 | 1706.372 | 1805.144 | 1906.412 | 9.2068602 | 9.2320738 | 9.2565119 | 9.2802167 | 58 |
| 59 | 1611.710 | 1707.998 | 1806.811 | 1908.121 | 9.2072869 | 9.2324872 | 9.2569127 | 9.2806657 | 59 |
| 60 | 1613.294 | 1709.624 | 1808.480 | 1909.830 | 9.2077136 | 9.2329007 | 9,2573136 | 9.2809947 | 60 |

Deg. 57, 56, 55, 54. A Table of Natural Verſed.

| M | L. 57 | L. 56 | L. 55 | L. 54 | N. 57 | N. 56 | N. 55 | N. 54 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.6721725 | 9.6583558 | 9.6442486 | 9.6298412 | 4700.808 | 4553.610 | 4408.071 | 4264.236 | 60 |
| 59 | 9.6719445 | 9.6581230 | 9.6440109 | 9.6295984 | 4698.341 | 4551.171 | 4405.666 | 4261.853 | 59 |
| 58 | 9.6717165 | 9.6578903 | 9.6437732 | 9.6293557 | 4695.875 | 4548.732 | 4403.249 | 4259.471 | 58 |
| 57 | 9.6714883 | 9.6576574 | 9.6435354 | 9.6291127 | 4693.409 | 4546.293 | 4400.839 | 4257.089 | 57 |
| 56 | 9.6712602 | 9.6574245 | 9.6432975 | 9.6288698 | 4690.944 | 4543.855 | 4398.429 | 4254.708 | 56 |
| 55 | 9.6710319 | 9.6571914 | 9.6430595 | 9.6286267 | 4688.479 | 4541.417 | 4396.019 | 4252.328 | 55 |
| 54 | 9.6708036 | 9.6569583 | 9.6428215 | 9.6283836 | 4686.015 | 4538.980 | 4393.610 | 4249.948 | 54 |
| 53 | 9.6705751 | 9.6567251 | 9.6425833 | 9.6281403 | 4683.551 | 4536.543 | 4391.202 | 4247.563 | 53 |
| 52 | 9.6703467 | 9.6564918 | 9.6423452 | 9.6278970 | 4681.087 | 4534.108 | 4388.794 | 4245.189 | 52 |
| 51 | 9.6701181 | 9.6562584 | 9.6421068 | 9.6276535 | 4678.624 | 4531.672 | 4386.386 | 4242.810 | 51 |
| 50 | 9.6698895 | 9.6560250 | 9.6418685 | 9.6274101 | 4676.161 | 4529.237 | 4383.979 | 4240.432 | 50 |
| 49 | 9.6696607 | 9.6557915 | 9.6416299 | 9.6271664 | 4673.699 | 4526.802 | 4381.573 | 4238.054 | 49 |
| 48 | 9.6694319 | 9.6555579 | 9.6413914 | 9.6269228 | 4671.237 | 4524.368 | 4379.167 | 4235.677 | 48 |
| 47 | 9.6692030 | 9.6553242 | 9.6411527 | 9.6266790 | 4668.776 | 4521.934 | 4376.761 | 4233.309 | 47 |
| 46 | 9.6689741 | 9.6550904 | 9.6409141 | 9.6264352 | 4666.315 | 4519.501 | 4374.356 | 4230.924 | 46 |
| 45 | 9.6687450 | 9.6548566 | 9.6406752 | 9.6261912 | 4663.855 | 4517.068 | 4371.951 | 4228.548 | 45 |
| 44 | 9.6685159 | 9.6546227 | 9.6404364 | 9.6259473 | 4661.395 | 4514.636 | 4369.547 | 4226.173 | 44 |
| 43 | 9.6682867 | 9.6543886 | 9.6401973 | 9.6257031 | 4658.935 | 4512.204 | 4367.143 | 4223.798 | 43 |
| 42 | 9.6680574 | 9.6541546 | 9.6399583 | 9.6254589 | 4656.476 | 4509.772 | 4364.740 | 4221.424 | 42 |
| 41 | 9.6678280 | 9.6539204 | 9.6397191 | 9.6252146 | 4654.017 | 4507.341 | 4362.337 | 4219.050 | 41 |
| 40 | 9.6675986 | 9.6536861 | 9.6394800 | 9.6249703 | 4651.559 | 4504.910 | 4359.934 | 4216.676 | 40 |
| 39 | 9.6673691 | 9.6534518 | 9.6392406 | 9.6247258 | 4649.102 | 4502.480 | 4357.532 | 4214.303 | 39 |
| 38 | 9.6671395 | 9.6532174 | 9.6390012 | 9.6244813 | 4646.645 | 4500.050 | 4355.131 | 4211.931 | 38 |
| 37 | 9.6669098 | 9.6529828 | 9.6387617 | 9.6242366 | 4644.188 | 4497.621 | 4352.730 | 4209.559 | 37 |
| 36 | 9.6666801 | 9.6527483 | 9.6385222 | 9.6239919 | 4641.732 | 4495.192 | 4350.330 | 4207.188 | 36 |
| 35 | 9.6664502 | 9.6525136 | 9.6382825 | 9.6237471 | 4639.276 | 4492.764 | 4347.930 | 4204.817 | 35 |
| 34 | 9.6662203 | 9.6522789 | 9.6380428 | 9.6235022 | 4636.821 | 4490.336 | 4345.531 | 4202.447 | 34 |
| 33 | 9.6659903 | 9.6520440 | 9.6378030 | 9.6232572 | 4634.366 | 4487.909 | 4343.132 | 4200.077 | 33 |
| 32 | 9.6657603 | 9.6518092 | 9.6375633 | 9.6230122 | 4631.912 | 4485.482 | 4340.734 | 4197.708 | 32 |
| 31 | 9.6655301 | 9.6515741 | 9.6373231 | 9.6227670 | 4626.458 | 4483.056 | 4338.336 | 4195.339 | 31 |
| 30 | 9.6652989 | 9.6513391 | 9.6370830 | 9.6225218 | 4627.004 | 4480.630 | 4335.938 | 4192.970 | 30 |
| 29 | 9.6650695 | 9.6511039 | 9.6368428 | 9.6222764 | 4624.551 | 4478.205 | 4333.541 | 4190.602 | 29 |
| 28 | 9.6648392 | 9.6508687 | 9.6366016 | 9.6220311 | 4622.098 | 4475.780 | 4331.144 | 4188.234 | 28 |
| 27 | 9.6646087 | 9.6506333 | 9.6363623 | 9.6217855 | 4619.646 | 4473.355 | 4328.748 | 4185.867 | 27 |
| 26 | 9.6643781 | 9.6503980 | 9.6361219 | 9.6215400 | 4617.194 | 4470.931 | 4326.352 | 4183.501 | 26 |
| 25 | 9.6641475 | 9.6501625 | 9.6358813 | 9.6212942 | 4614.742 | 4468.507 | 4323.957 | 4181.135 | 25 |
| 24 | 9.6639168 | 9.6499269 | 9.6356408 | 9.6210485 | 4612.291 | 4466.084 | 4321.562 | 4178.770 | 24 |
| 23 | 9.6636860 | 9.6496912 | 9.6354001 | 9.6208026 | 4609.841 | 4463.662 | 4319.168 | 4176.405 | 23 |
| 22 | 9.6634552 | 9.6494556 | 9.6351594 | 9.6205567 | 4607.391 | 4461.240 | 4316.774 | 4174.041 | 22 |
| 21 | 9.6632242 | 9.6492197 | 9.6349185 | 9.6203106 | 4604.942 | 4458.818 | 4314.381 | 4171.677 | 21 |
| 20 | 9.6629932 | 9.6489839 | 9.6346776 | 9.6200645 | 4602.493 | 4456.397 | 4311.988 | 4169.313 | 20 |
| 19 | 9.6627620 | 9.6487478 | 9.6344366 | 9.6198183 | 4600.045 | 4453.976 | 4309.596 | 4166.950 | 19 |
| 18 | 9.6625309 | 9.6485118 | 9.6341955 | 9.6195720 | 4597.597 | 4451.556 | 4307.204 | 4164.588 | 18 |
| 17 | 9.6622996 | 9.6482756 | 9.6339543 | 9.6193256 | 4595.148 | 4449.136 | 4304.813 | 4162.226 | 17 |
| 16 | 9.6620683 | 9.6480394 | 9.6337131 | 9.6190792 | 4592.702 | 4446.717 | 4302.422 | 4159.864 | 16 |
| 15 | 9.6618368 | 9.6478031 | 9.6334717 | 9.6188326 | 4590.255 | 4444.298 | 4300.032 | 4157.503 | 15 |
| 14 | 9.6616053 | 9.6475667 | 9.6332303 | 9.6185860 | 4587.809 | 4441.880 | 4297.642 | 4155.141 | 14 |
| 13 | 9.6613737 | 9.6473302 | 9.6329887 | 9.6183392 | 4585.363 | 4439.462 | 4295.253 | 4152.782 | 13 |
| 12 | 9.6611421 | 9.6470937 | 9.6327472 | 9.6180924 | 4582.918 | 4437.044 | 4292.864 | 4150.422 | 12 |
| 11 | 9.6609103 | 9.6468570 | 9.6325054 | 9.6178454 | 4580.473 | 4434.627 | 4290.476 | 4148.063 | 11 |
| 10 | 9.6606785 | 9.6466204 | 9.6322637 | 9.6175985 | 4578.028 | 4432.210 | 4288.088 | 4145.705 | 10 |
| 9 | 9.6604466 | 9.6463835 | 9.6320218 | 9.6173513 | 4575.584 | 4429.793 | 4285.701 | 4143.347 | 9 |
| 8 | 9.6602146 | 9.6461467 | 9.6317799 | 9.6171042 | 4573.141 | 4427.378 | 4283.314 | 4141.990 | 8 |
| 7 | 9.6599825 | 9.6459097 | 9.6315378 | 9.6168569 | 4570.698 | 4424.96 | 4280.928 | 4138.633 | 7 |
| 6 | 9.6597504 | 9.6456726 | 9.6312957 | 9.6166096 | 4568.255 | 4422.548 | 4278.542 | 4136.276 | 6 |
| 5 | 9.6595181 | 9.6454355 | 9.6310535 | 9.6163621 | 4565.813 | 4420.134 | 4276.156 | 4133.920 | 5 |
| 4 | 9.6592858 | 9.6451983 | 9.6308112 | 9.6161146 | 4563.371 | 4417.72 | 4273.771 | 4131.564 | 4 |
| 3 | 9.6590534 | 9.6449609 | 9.6305688 | 9.6158669 | 4560.930 | 4415.307 | 4271.387 | 4129.200 | 3 |
| 2 | 9.6588210 | 9.6447236 | 9.6303264 | 9.6156192 | 4558.490 | 4412.894 | 4269.003 | 4126.855 | 2 |
| 1 | 9.6585884 | 9.6444861 | 9.6300838 | 9.6153714 | 4556.050 | 4410.482 | 4266.619 | 4124.501 | 1 |
| 0 | 9.6583558 | 9.6442486 | 9.6298412 | 9.6151235 | 4553.610 | 4408.071 | 4264.236 | 4122.148 | 0 |

eg. 35, 37, 38, 39. Sines and their Logarithms.

| M | N. 36 | N. 37 | N. 38 | N. 39 | L. 36 | L. 37 | L. 38 | L. 39 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1909.830 | 2013 645 | 2119.08. | 2228.54[illegible] | 9.2809947 | 9.3039829 | 9.3263138 | 9.348 205 | 0 |
| 1 | 1911.540 | 2015.396 | 2121.884 | 2230.371 | 9.2813833 | 9.3042603 | 9.3265805 | 9.3483771 | 1 |
| 2 | 1913.251 | 2017.147 | 2123.476 | 2232.203 | 9.2817720 | 9.3047376 | 9.3270473 | 9.3487337 | 2 |
| 3 | 1914.963 | 2018.900 | 2125.268 | 2234.035 | 9.2821602 | 9.3051147 | 9.3274136 | 9.3490899 | 3 |
| 4 | 1916.675 | 2020.653 | 2127.061 | 2235.868 | 9 2825484 | 9.3054917 | 9.327780 | 9.3494462 | 4 |
| 5 | 1918.388 | 2022.406 | 2128.855 | 2237.702 | 9.2829363 | 9.3058633 | 9.3281450 | 9.3498021 | 5 |
| 6 | 1920.101 | 2024.161 | 2130.650 | 2239.536 | 9.2833241 | 9.3062450 | 9.3285121 | 9.3501580 | 6 |
| 7 | 1921.815 | 2025.916 | 2132.445 | 2241.37[illegible] | 9.2837116 | 9.3066213 | 9.3288778 | 9.3505136 | 7 |
| 8 | 1923.530 | 2027.671 | 2134.241 | .243.20[illegible] | 9.2840990 | 9.3069972 | 9.3292434 | 9.3508692 | 8 |
| 9 | 1925.246 | 2029.428 | 2136 037 | 2245.043 | 9.2844861 | 9.3073735 | 9.3296088 | 9.3512245 | 9 |
| 10 | 1926 962 | 2031.185 | 2137.835 | 2246.87[illegible] | 9.2848732 | 9.3077494 | 9.3299741 | 9.3515798 | 10 |
| 11 | 1928.679 | 2032.942 | 2139.633 | 2248.717 | 9.2852599 | 9.3081250 | 9.3303391 | 9.3519347 | 11 |
| 12 | 1930.397 | 2034.701 | 2141.431 | 2250.55[illegible] | 9.2856466 | 9.3085006 | 9.3307042 | 9.3522897 | 12 |
| 13 | 1932.115 | 2036.460 | 2143.230 | 2252.394 | 9.2860329 | 9.3088758 | 9.3310688 | 9.3526443 | 13 |
| 14 | 1933.834 | 2038.220 | 2145.030 | 2254.23[illegible] | 9.2864192 | 9.3092510 | 9.3314334 | 9.3529989 | 14 |
| 15 | 1935.554 | 2039.980 | 2146.831 | 2256.074 | 9.2868052 | 9.3096258 | 9.3317977 | 9.3533532 | 15 |
| 16 | 1937.274 | 2041.741 | 2148.632 | 2257.914 | 9.2871911 | 9.3100007 | 9.3321620 | 9.3537075 | 16 |
| 17 | 1938.995 | 2043.503 | 2150.434 | 2259.756 | 9.2875767 | 9.3103572 | 9.3325260 | 9.3540614 | 17 |
| 18 | 1940.717 | 2045.265 | 2152 236 | 2261.598 | 9.2879622 | 9.3107495 | 9.332890[illegible] | 9.3544454 | 18 |
| 19 | 1942.440 | 2047.028 | 2154.039 | 2263.441 | 9.2883474 | 9.3111238 | 9.3332536 | 9.3547690 | 19 |
| 20 | 1944.163 | 2048.792 | 2155.843 | 2265.284 | 9 2887326 | 9.3114979 | 9.3336172 | 9.3551227 | 20 |
| 21 | 1945.887 | 2050.556 | 2157 648 | 2267.128 | 9.2891174 | 9.3118716 | 9.3339805 | 9.3554760 | 21 |
| 22 | 1947.611 | 2052.322 | 2159.453 | 2268.973 | 9.2895022 | 9.3122454 | 9.3343438 | 9.3558293 | 22 |
| 23 | 1949.336 | .054.087 | 2161.259 | 2270.818 | 9 2898856 | 9.3126188 | 9.3347067 | 9.3561823 | 23 |
| 24 | 1951.062 | 2055.854 | 2163.065 | 2272.654 | 9.2902711 | 9.3129922 | 9.3350697 | 9.3565353 | 24 |
| 25 | 1952.789 | 2057.621 | 2164.873 | 2274.511 | 9.2906551 | 9.3133653 | 9.3354323 | 9.3568880 | 25 |
| 26 | 1954.516 | 2059.389 | 2166 680 | 2276.358 | 9.2910392 | 9.3137383 | 9.3357949 | 9.3572406 | 26 |
| 27 | 1956.244 | 2061.157 | 2168.489 | 2278.206 | 9.2914229 | 9.3141110 | 9.3361571 | 9.3575930 | 27 |
| 28 | 1957.972 | 2062.926 | 2170.298 | 2280.055 | 9.2918065 | 9.3144837 | 9.3368194 | 9.3579453 | 28 |
| 29 | 1959.701 | 2064.696 | 2172.108 | 2181.904 | 9.2921898 | 9.3148561 | 9.3368813 | 9.3582973 | 29 |
| 30 | 1961.431 | 2066.467 | 2173.918 | 2283.754 | 9.2925731 | 9.3152284 | 9.3372432 | 9.3586494 | 30 |
| 31 | 1963.162 | 2068.238 | 2175.370 | 2285.605 | 9.2929560 | 9.3156004 | 9.3376048 | 9.3590011 | 31 |
| 32 | 1964.893 | 2070.010 | 2177.451 | 2287.456 | 9.2933390 | 9.3159724 | 9.3379664 | 9.3593528 | 32 |
| 33 | 1966.625 | 2071.782 | 2179.534 | 2289.308 | 9.2937215 | 9.3163440 | 9.3383277 | 9.3597041 | 33 |
| 34 | 1968.358 | 2073.555 | 2181.167 | 2291.160 | 9.2941041 | 9.3167156 | 9.3386889 | 9.3600555 | 34 |
| 35 | 1970.091 | 2075.329 | 2182.981 | 2293.014 | 9.2944862 | 9.3170869 | 9.3390498 | 9.3604066 | 35 |
| 36 | 1971.825 | 2077.104 | 2184.795 | 2294.868 | 9.2948684 | 9.3174582 | 9.3394107 | 9.3607576 | 36 |
| 37 | 1973.560 | 2078.879 | 2186.610 | 2296.722 | 9.2952502 | 9.3178291 | 9.3397713 | 9.3611084 | 37 |
| 38 | 1975.295 | 2080.655 | 2188.426 | 2298.577 | 9.2956320 | 9.3182000 | 9.3401319 | 9.3614591 | 38 |
| 39 | 1977.031 | 2082 431 | 2190.243 | 2300.433 | 9.2900135 | 9.3185706 | 9.3404921 | 9.3618095 | 39 |
| 40 | 1978.768 | 2084.208 | 2192.060 | 2302 290 | 9.2963949 | 9.3189413 | 9.3408524 | 9.3621599 | 40 |
| 41 | 1980.505 | 2085.986 | 2193.877 | 2304 147 | 9.2967760 | 9.3193113 | 9.3412123 | 9.3625100 | 41 |
| 42 | 1982.244 | 2087.765 | 2195.696 | 2306.004 | 9.2971570 | 9.3196815 | 9.3415722 | 9.3628601 | 42 |
| 43 | 1983.982 | 2089.544 | 2197.515 | 2307.863 | 9.2975377 | 9.3200514 | 9.3419318 | 9.3632099 | 43 |
| 44 | 1985.722 | 2091.324 | 2199.335 | 2309.722 | 9.2979184 | 9.3204213 | 9.3422913 | 9 3635597 | 44 |
| 45 | 1987.462 | 2093.101 | 2201.155 | 2311.582 | 9.2982987 | 9.3207908 | 9.3426506 | 9.3639092 | 45 |
| 46 | 1989.203 | 2094.885 | 2202.976 | 2313.442 | 9.2986790 | 9.3211603 | 9.3430098 | 9.3642586 | 46 |
| 47 | 1990.944 | 2096.667 | 2204.798 | 2315.303 | 9.2990590 | 9.3215294 | 9.3433687 | 9.3646078 | 47 |
| 48 | 1992.686 | 2098.450 | 2206.620 | 2317.165 | 9.2994389 | 9.3218986 | 9.3437276 | 9.3649569 | 48 |
| 49 | 1994.429 | 2100.233 | 2208.443 | 2319.027 | 9.2998185 | 9.3222674 | 9.3440862 | 9.3653057 | 49 |
| 50 | 1996.173 | 2102.017 | 2210.267 | 2320.89[illegible] | 9.3001981 | 9.3226362 | 9.3444448 | 9.3656546 | 50 |
| 51 | 1997.917 | 2103.802 | 2212.090 | 2322.754 | 9.3005773 | 9.3230047 | 9.3448030 | 9.3660031 | 51 |
| 52 | 1999.662 | 2105.587 | 2213.916 | 2324.618 | 9.3009565 | 9.3233771 | 9.3451612 | 9.3663516 | 52 |
| 53 | 2001.407 | 2107.373 | 2215.742 | 2326.483 | 9.3013354 | 9.3237412 | 9.3455191 | 9.3666998 | 53 |
| 54 | 2003.154 | 2109.159 | 2217.569 | 2328.348 | 9.3017142 | 9.3241094 | 9.3458770 | 9.3670480 | 54 |
| 55 | 2004.900 | 2110 946 | 2219.396 | 2330.215 | 9.3020927 | 9.3244771 | 9.3462346 | 9.3673959 | 55 |
| 56 | 2006.648 | 2112.734 | 2221.223 | 2332.082 | 9.3024712 | 9.3248449 | 9.3465921 | 9.3677437 | 56 |
| 57 | 2008.396 | 2114.523 | 2223.051 | 2333.949 | 9 3028493 | 9.3252123 | 9.3469494 | 9.3680913 | 57 |
| 58 | 2010.145 | 2116.312 | 2224.880 | 2335.817 | 9.3032274 | 9.3255797 | 9.3473067 | 9.3684389 | 58 |
| 59 | 2011.895 | 2118.102 | 2226.710 | 2337.686 | 9.3036051 | 9.3259468 | 9.3476636 | 9.3687861 | 59 |
| 60 | 2013.645 | 2119.892 | 2228.540 | 2339.556 | 9.3039829 | 9.3263138 | 9,3480205 | 9.3691334 | 60 |

Deg. 24, 25, 26, 27. A Table of Natural Verſed.

| M | L. 53 | L. 52 | L. 51 | L. 50 | N. 53 | N. 52 | N. 51 | N. 50 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.6151235 | 9.6000849 | 9.5847129 | 9.5689987 | 4122.148 | 3981.850 | 3843.285 | 3706,796 | 60 |
| 59 | 9.6148755 | 9.5998314 | 9.5844548 | 9.5687337 | 4119.795 | 3979.527 | 3841.093 | 3704.536 | 59 |
| 58 | 9.6146275 | 9.5995779 | 9.5841957 | 9.5684688 | 4117.442 | 3977.204 | 3838.802 | 3702.276 | 58 |
| 57 | 9.6143793 | 9.5993243 | 9.5839364 | 9.5682036 | 4115.090 | 3974.882 | 3836.511 | 3700.017 | 57 |
| 56 | 9.6141311 | 9.5990706 | 9.5836771 | 9.5679385 | 4112.738 | 3972.561 | 3834.220 | 3697.758 | 56 |
| 55 | 9.0138827 | 9.5988168 | 9.5834176 | 9.5676731 | 4110.387 | 3970.240 | 3831.930 | 3695.499 | 55 |
| 54 | 9.6136343 | 9.5985629 | 9.5831581 | 9.5674078 | 4108.036 | 3967.920 | 3829.641 | 3693.241 | 54 |
| 53 | 9.6133857 | 9.5983089 | 9.5828984 | 9.5671422 | 4105.686 | 3965.600 | 3827.352 | 3690.984 | 53 |
| 52 | 9.6131372 | 9.5980545 | 9.5826387 | 9.5668766 | 4103.336 | 3963.281 | 3825.054 | 3688.727 | 52 |
| 51 | 9.6128884 | 9.5978007 | 9.5823788 | 9.5666109 | 4100.987 | 3960.962 | 3822.776 | 3686.471 | 51 |
| 50 | 9.6126397 | 9.5975464 | 9.5821190 | 9.5663451 | 4098.639 | 3958.643 | 3820.488 | 3684.216 | 50 |
| 49 | 9.6123907 | 9.5972920 | 9.5818589 | 9.5660792 | 4096.291 | 3956.325 | 3818.201 | 3681.961 | 49 |
| 48 | 9.6121418 | 9.5970376 | 9.5815988 | 9.5658132 | 4093.944 | 3954.008 | 3815.915 | 3679.707 | 48 |
| 47 | 9,6118927 | 9.5967831 | 9.5813385 | 9.5655471 | 4091.597 | 3951.691 | 3813.629 | 3677.453 | 47 |
| 46 | 9.6116436 | 9.5965285 | 9.5810783 | 9.5652804 | 4089.250 | 3949.375 | 3811.344 | 3675.200 | 46 |
| 45 | 9.6113943 | 9.5962737 | 9.5808178 | 9.5659564 | 4086.904 | 3947.060 | 3809.060 | 3672.947 | 45 |
| 44 | 9.6111451 | 9.5960189 | 9.5805574 | 9.5647482 | 4084.558 | 3944.745 | 3806.776 | 3670.695 | 44 |
| 43 | 9.6108956 | 9.5957640 | 9.5802967 | 9.5644817 | 4082.213 | 3942.430 | 3804.492 | 3668.443 | 43 |
| 42 | 9.6106461 | 9.5955090 | 9.5800361 | 9.5642151 | 4079.868 | 3940.116 | 3802.209 | 3666.192 | 42 |
| 41 | 9.6103965 | 9.5952539 | 9.5797752 | 9.5639484 | 4077.524 | 3937.802 | 3799.926 | 3663.941 | 41 |
| 40 | 9.6101469 | 9.5949987 | 9.5795144 | 9.5636816 | 4075.180 | 3935.489 | 3797.644 | 3661.690 | 40 |
| 39 | 9.6098970 | 9.5947434 | 9.5792533 | 9.5634147 | 4072.837 | 3933.176 | 3795.362 | 3659.440 | 39 |
| 38 | 9.6096472 | 9.5944881 | 9.5789923 | 9.5631477 | 4070.495 | 3930.864 | 3793.081 | 3657.191 | 38 |
| 37 | 9.6093972 | 9.5942325 | 9.5787311 | 9.5628805 | 4068.153 | 3928.552 | 3790.801 | 3654.942 | 37 |
| 36 | 9.6091472 | 9.5939770 | 9.5784698 | 9.5626134 | 4065.811 | 3926.241 | 3788.521 | 3652.694 | 36 |
| 35 | 9.6088970 | 9.5937213 | 9.5782084 | 9.5623460 | 4063.470 | 3923.931 | 3786.242 | 3650.447 | 35 |
| 34 | 9.6086468 | 9.5934656 | 9.5779470 | 9.5620787 | 4061.129 | 3921.621 | 3783.963 | 3648.200 | 34 |
| 33 | 9.6083965 | 9.5932097 | 9.5776854 | 9.5618111 | 4058.789 | 3919.312 | 3781.685 | 3645.954 | 33 |
| 32 | 9.6081461 | 9.5929538 | 9.5774237 | 9.5615436 | 4056.449 | 3917.003 | 3779.407 | 3643.708 | 32 |
| 31 | 9.6078956 | 9.5926977 | 9.5771619 | 9.5612758 | 4054.110 | 3914.694 | 3777.130 | 3641.463 | 31 |
| 30 | 9.6076450 | 9.5924417 | 9.5769001 | 9.5610080 | 4051.772 | 3912.386 | 3774.854 | 3639.218 | 30 |
| 29 | 9.6073943 | 9.5921854 | 9.5766381 | 9.5607401 | 4049.434 | 3910.078 | 3772.578 | 3636.974 | 29 |
| 28 | 9.6071346 | 9.5919291 | 9.5763761 | 9.5604721 | 4047.096 | 3907.771 | 3770.302 | 3634.730 | 28 |
| 27 | 9.6068927 | 9.5916727 | 9.5761139 | 9.5602040 | 4044 759 | 3905.464 | 3768.027 | 3632.487 | 27 |
| 26 | 9.6066417 | 9.5914162 | 9.5758517 | 9.5599358 | 4042.422 | 3903.158 | 3765.752 | 3630.244 | 26 |
| 25 | 9.6063907 | 9.5911599 | 9.5755893 | 9.5596674 | 4040.086 | 3900.853 | 3763.478 | 3628.001 | 25 |
| 24 | 9.6061396 | 9.5909029 | 9.5753269 | 9.5593991 | 4037.750 | 3898.548 | 3761.204 | 3625.759 | 24 |
| 23 | 9.6058883 | 9.5906461 | 9.5750643 | 9.5591305 | 4035.415 | 3896.244 | 3758.931 | 3623.518 | 23 |
| 22 | 9.6056370 | 9.5903893 | 9.5748417 | 9.5588619 | 4033.081 | 3893.940 | 3756.058 | 3621,278 | 22 |
| 21 | 9.6053856 | 9.5901322 | 9.5745389 | 9.5585932 | 4030.747 | 3891.636 | 3754.386 | 3619.038 | 21 |
| 20 | 9.6051341 | 9.5898752 | 9.5742761 | 9.5583244 | 4028.414 | 3889.333 | 3752.115 | 3616.799 | 20 |
| 19 | 9.6048825 | 9.5896180 | 9.5740131 | 9.5580554 | 4026.081 | 3887.030 | 3749.844 | 3614.560 | 19 |
| 18 | 9.6046308 | 9.5893608 | 9.5737502 | 9.5577864 | 4023.749 | 3884.728 | 8747.574 | 3612.322 | 18 |
| 17 | 9.6043790 | 9.5891034 | 9.5734870 | 9.5575173 | 4021.417 | 3882.427 | 3745.304 | 3610.084 | 17 |
| 16 | 9.6041272 | 9.5888460 | 9.5732218 | 9.5572481 | 4019.083 | 3880.127 | 3743.034 | 3607.847 | 16 |
| 15 | 9.6038752 | 9.5885884 | 9.5729604 | 9.5569787 | 4016.754 | 3877.827 | 3740.765 | 3605.610 | 15 |
| 14 | 9.6036232 | 9.5883308 | 9.5726970 | 9.5567093 | 4014.423 | 3875.527 | 3738.497 | 3603.374 | 14 |
| 13 | 9.6033710 | 9.5880730 | 9.5724335 | 9.5564397 | 4012.093 | 3873.228 | 3736.229 | 3601.138 | 13 |
| 12 | 9.6031188 | 9.5878153 | 9.5721699 | 9.5561701 | 4009.763 | 3870.929 | 3733.962 | 3598.903 | 12 |
| 11 | 9.6028664 | 9.5875573 | 9.5719061 | 9.5559004 | 4007.434 | 3868.631 | 3731.695 | 3596.668 | 11 |
| 10 | 9.6026143 | 9.5872993 | 9.5716423 | 9.5556306 | 4005.106 | 3866.333 | 3729.428 | 3594.434 | 10 |
| 9 | 9.6023615 | 9.5870412 | 9.5713784 | 9.5553606 | 4002.778 | 3864.035 | 3727.162 | 3592.201 | 9 |
| 8 | 9.6021090 | 9.5867830 | 9.5711144 | 9.5550906 | 4000.451 | 3861.739 | 3724.897 | 3589.968 | 8 |
| 7 | 9.6018562 | 9.5865247 | 9 5708502 | 9.5548204 | 3998.124 | 3859,443 | 3722.532 | 3587.736 | 7 |
| 6 | 9.6016035 | 9.5862663 | 9.5705861 | 9.5545502 | 3995.798 | 3857.147 | 3720.368 | 3585.504 | 6 |
| 5 | 9.6013506 | 9.5860078 | 9.5703217 | 9.5542798 | 3993.472 | 3854.852 | 3718.105 | 3583.272 | 5 |
| 4 | 9.6010976 | 9.5857492 | 9.5700573 | 9.5540094 | 3991.147 | 3852.558 | 3715.842 | 3581.041 | 4 |
| 3 | 9.6008446 | 9.5854905 | 9.5697928 | 9.5537388 | 3988.822 | 3850.264 | 3713.580 | 3578.811 | 3 |
| 2 | 9.6005914 | 9.5852318 | 9.5695282 | 9.5534681 | 3986.498 | 3847.970 | 3711.318 | 3576.581 | 2 |
| 1 | 9.6003382 | 9.5849728 | 9.5692635 | 9.5531973 | 3984.174 | 3845.677 | 3709.057 | 3574.352 | 1 |
| 0 | 9.6000849 | 9.5847139 | 9.5689987 | 9.5529265 | 3981.850 | 3843.385 | 3706.796 | 3572.124 | 0 |

Sines and their Logarithms.

| Deg. 40, 41, 42, 43. M | N. 40 | N. 41 | N. 42 | N. 43 | L. 40 | L. 41 | L. 42 | L. 43 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 2339.556 | 2452.904 | 2508.55[illegible] | 2686.463 | 9.3691334 | 9.38060[illegible] | 9.4096883 | 9.4291808 | 0 |
| 1 | 2341.426 | 2454.813 | 2570.498 | 2688.447 | 9.3694803 | 9.39 0183 | 9.4100173 | 9.4295015 | 1 |
| 2 | 2343.296 | 2456.722 | 2572.44[illegible] | 2690.43[illegible] | 9.3698272 | 9.3903561 | 9.4103462 | 9.4298220 | 2 |
| 3 | 2345.168 | 2458.632 | 2574.394 | 2692 417 | 9.3701739 | 9.3906935 | 9.4106749 | 9.4301424 | 3 |
| 4 | 2347.040 | 2460.543 | 2576 342 | 2694.403 | 9 3705205 | 9.3910309 | 9.4110036 | 9.4304646 | 4 |
| 5 | 2348.913 | 2462.454 | 2578.292 | 2696.390 | 9.3708668 | 9.3913681 | 9 4113220 | 9.4307827 | 5 |
| 6 | 2350.786 | 2464.366 | 258[illegible].242 | 2698.377 | 9.3712111 | 9.3917052 | 9.4116603 | 9.4311026 | 6 |
| 7 | 2352.660 | 2466.279 | 2582.193 | 2700.36[illegible] | 9.3715591 | 9.3920421 | 9.4119885 | 9.4314224 | 7 |
| 8 | 2354.535 | 2468.192 | 2584.143 | 2702.354 | 9.3719051 | 9.3923789 | 9.4123166 | 9.4317423 | 8 |
| 9 | 2356.410 | 2470 106 | 258[illegible].095 | 2704.343 | 9.3722508 | 9.3927155 | 9.4126444 | 9.4320617 | 9 |
| 10 | 2358.286 | 2472.020 | 2588.047 | 2706.332 | 9.3725964 | 9.3930520 | 9.4129722 | 9.4323811 | 10 |
| 11 | 2360.162 | 2473.935 | 2590.000 | 2708.323 | 9.3729418 | 9.3933882 | 9.4122998 | 9.4327004 | 11 |
| 12 | 2362.040 | 2475.851 | 259[illegible].954 | 2710.314 | 9.3732872 | 9.3937245 | 9.4136273 | 9.4330195 | 12 |
| 13 | 2363.918 | 2477.767 | 2593.908 | 2712.305 | 9.3736323 | 9.3940604 | 9.4139546 | 9.4333385 | 13 |
| 14 | 2365.296 | 2479.684 | 2[illegible]95.863 | 2714.297 | 9.3739773 | 9.3943964 | 9.4142818 | 9.4336574 | 14 |
| 15 | 2367.675 | 2481.602 | 2597.819 | 2716.29[illegible] | 9.3743221 | 9.3947310 | 9.4146088 | 9.4339761 | 15 |
| 16 | 2369.555 | 2483.520 | 2599.775 | 2718.284 | 9.3746668 | 9.3950677 | 9.4149357 | 9.4342948 | 16 |
| 17 | 2371.436 | 2485.439 | 2901.732 | 2720.278 | 9.3750113 | 9.3954081 | 9.4152625 | 9.4346132 | 17 |
| 18 | 2373.317 | 2487.359 | 2903.689 | 2722.272 | 9.3753557 | 9.3957384 | 9.4155891 | 9.43493 6 | 18 |
| 19 | 2375.198 | 2489.279 | 2605.647 | 2724.26[illegible] | 9.3756998 | 9.3960735 | 9.4159155 | 9.4352497 | 19 |
| 20 | 2377.081 | 2491.200 | 2607.606 | 2726.264 | 9 3760440 | 9.3964085 | 9.4162419 | 9.4355678 | 20 |
| 21 | 2378.964 | 2433.121 | 2609.565 | 2728.260 | 9.3763878 | 9.3967433 | 9.4165681 | 9.4358857 | 21 |
| 22 | 2380.848 | 2495.043 | 2611.525 | 2730.257 | 9.3767316 | 9.3970781 | 9.4168941 | 9.4362035 | 22 |
| 23 | 2382.732 | 2496.966 | 2613.485 | 2732.255 | 9 3770751 | 9.3974125 | 9.4172199 | 9.4365212 | 23 |
| 24 | 2384.617 | 2498.889 | 2615.447 | 2734.253 | 9.3774186 | 9.3977470 | 9.4175458 | 9.4368387 | 24 |
| 25 | 2386.503 | 2500.813 | 2617.408 | 2736.252 | 9.3777618 | 9.3980812 | 9.4178715 | 9.4371561 | 25 |
| 26 | 2388.389 | 2502.738 | 2619.371 | 2738.252 | 9.3781050 | 9.3984154 | 9.4181970 | 9.4374734 | 26 |
| 27 | 2390.276 | 2504.663 | 2621.334 | 2748.252 | 9.3784479 | 9.3987493 | 9.4185223 | 9.4377994 | 27 |
| 28 | 2392.163 | 2506.589 | 2623.297 | 2742.253 | 9.3787908 | 9.3990831 | 9.4188475 | 9.4381075 | 28 |
| 29 | 2394.051 | 2508.516 | 2625.262 | 2744.254 | 9.3791334 | 9.3994167 | 9.4191726 | 9.4384243 | 29 |
| 30 | 2395.940 | 2510.443 | 2627.227 | 2746.256 | 9.3794760 | 9.3997503 | 9.4194975 | 9.4387410 | 30 |
| 31 | 2397.830 | 2512.371 | 2629.192 | 2748.259 | 9.3798183 | 9.4000836 | 9.4198223 | 9.4390576 | 31 |
| 32 | 2399.720 | 2514.299 | 2631.158 | 2750 262 | 9.3801606 | 9 4004169 | 9.4201470 | 9.4393741 | 32 |
| 33 | 2401.611 | 2516.228 | 2633.125 | 2752.266 | 9 3805025 | 9.4007499 | 9.4204714 | 9.4396904 | 33 |
| 34 | 2403.502 | 2518.158 | 2635.092 | 2754.271 | 9.3808445 | 9.4010829 | 9.4207958 | 9.4400066 | 34 |
| 35 | 2405.394 | 2520.088 | 2637 060 | 2756 276 | 9.3811862 | 9.4014157 | 9.4211201 | 9.4403226 | 35 |
| 36 | 2407.287 | 2522.019 | 2639.029 | 2758.281 | 9.3815279 | 9.4018484 | 9.4214442 | 9.4406385 | 36 |
| 37 | 2409.180 | 2523.951 | 2640.998 | 2760.288 | 9.3818692 | 9.4020808 | 9.4217681 | 9.4409543 | 37 |
| 38 | 2411.074 | 2525.883 | 2642.968 | 2762.295 | 9.3822106 | 9.4024132 | 9.4220919 | 9.4412700 | 38 |
| 39 | 2412.969 | 2527.816 | 2644.939 | 2764.302 | 9.3825510 | 9.4027453 | 9.4224156 | 9.4415855 | 39 |
| 40 | 2414.864 | 2529.749 | 2646.910 | 2766.310 | 9.3828927 | 9.4030775 | 9 4227391 | 9.4419009 | 40 |
| 41 | 2416.760 | 2531.683 | 2648.882 | 2768.319 | 9.3832335 | 9.4034093 | 9.4230625 | 9.4422161 | 41 |
| 42 | 2418.657 | 2533.618 | 2650.854 | 2770.329 | 9.3835742 | 9.4037412 | 9.4233858 | 9.4425313 | 42 |
| 43 | 2420.554 | 2535.554 | 2652.827 | 2772.339 | 9.3839147 | 9.4040727 | 9.4237089 | 9.4428462 | 43 |
| 44 | 2422.452 | 2537.49[illegible] | 2654.801 | 2774.349 | 9.3842551 | 9.4044043 | 9.4240319 | 9 4431611 | 44 |
| 45 | 2424.350 | 2539.426 | 2656.775 | 2776.360 | 9 3845953 | 9.4047355 | 9.4243547 | 9.4434758 | 45 |
| 46 | 2426.249 | 2541.364 | 2658.750 | 2778.372 | 9.3849354 | 9.4050668 | 9.4246774 | 9.4437904 | 46 |
| 47 | 2428.149 | 2543.301 | 2660.725 | 2780.385 | 9.3852753 | 9.4053978 | 9.4250000 | 9.4441048 | 47 |
| 48 | 2430.049 | 2545.240 | 2662 701 | 2782.398 | 9.3856151 | 9.4057287 | 9.4253224 | 9.4444192 | 48 |
| 49 | 2431.950 | 2547.179 | 2664.678 | 2784.411 | 9.3859547 | 9.4060594 | 9.4256447 | 9.4447334 | 49 |
| 50 | 2433.852 | 2549.119 | 2666.655 | 2786.425 | 9.3862942 | 9.4063901 | 9.4259669 | 9.4450474 | 50 |
| 51 | 2435.754 | 2551.059 | 2668.633 | 2788.441 | 9.3866334 | 9.4067205 | 9.4262889 | 9.4453614 | 51 |
| 52 | 2437.657 | 2553.000 | 2670.612 | 2790.456 | 9 3869727 | 9 4070509 | 9.4266108 | 9.4456752 | 52 |
| 53 | 2439.561 | 2554.942 | 2672.591 | 2792.472 | 9.3873116 | 9.4073810 | 9.4269325 | 9.4459888 | 53 |
| 54 | 2441.465 | 2556.885 | 2674.571 | 2794.488 | 9.3876506 | 9.4077111 | 9.4272541 | 9.4463024 | 54 |
| 55 | 2443.370 | 2558.827 | 2676.551 | 2796.506 | 9.3879892 | 9.4080409 | 9.4275755 | 9.4466157 | 55 |
| 56 | 2445.276 | 2560.771 | 2678.533 | 2798.524 | 9.3883278 | 9.4083708 | 9.4278969 | 9.4469290 | 56 |
| 57 | 2447.182 | 2562.715 | 2680.514 | 2800.543 | 9.3886562 | 9.4087003 | 9.4282181 | 9.4472422 | 57 |
| 58 | 2449.089 | 2564.660 | 2682.497 | 2802.562 | 9.3890045 | 9.4090298 | 9.4285391 | 9.4475552 | 58 |
| 59 | 2450.996 | 2564.606 | 2684.479 | 2804.582 | 9.3893425 | 9.4093591 | 9.4288600 | 9.4478680 | 59 |
| 60 | 2452.904 | 2568.552 | 2686.463 | 2806.602 | 9.3896806 | 9.4096883 | 9.4291808 | 9.4481808 | 60 |

Deg. 49, 48, 47, 46. A Table of Natural Verſed.

| M | L. 49 | L. 48 | L. 47 | L. 46 | N. 49 | N. 48 | N. 47 | N. 46 | M |
|---|---|---|---|---|---|---|---|---|---|
| 60 | 9.5529265 | 9.5364839 | 9.5196566 | 9.5024293 | 3572.124 | 3439.410 | 3308.694 | 3180,016 | 60 |
| 59 | 9.5526555 | 9.5362066 | 9.5193727 | 9.5021388 | 3569.896 | 3437.215 | 3306.532 | 3177.889 | 59 |
| 58 | 9.5523845 | 9.5359293 | 9.5190889 | 9.5018480 | 3567.669 | 3435.021 | 3304.371 | 3175.763 | 58 |
| 57 | 9.5521132 | 9.5356518 | 9.5188048 | 9.5015572 | 3565.442 | 3432.827 | 3302.211 | 3173.637 | 57 |
| 56 | 9.5518420 | 9.5353742 | 9.5185207 | 9.5012662 | 3563.215 | 3430.633 | 3300.051 | 3171.511 | 56 |
| 55 | 9.5515706 | 9.5350965 | 9.5182364 | 9.5009751 | 3560.989 | 3428.440 | 3297.892 | 3169.387 | 55 |
| 54 | 9.5512992 | 9.5348187 | 9.5179521 | 9.5006840 | 3558.764 | 3426.247 | 3295.733 | 3167.262 | 54 |
| 53 | 9.5510275 | 9.5345408 | 9.5176676 | 9.5003927 | 3556.539 | 3424.055 | 3293.573 | 3165.139 | 53 |
| 52 | 9.5507559 | 9.5342628 | 9.5173830 | 9.5001013 | 3554.315 | 3421.864 | 3291.418 | 3163.016 | 52 |
| 51 | 9.5504840 | 9.5339846 | 9.5170984 | 9.4998097 | 3552.091 | 3419,674 | 3289.261 | 3160.873 | 51 |
| 50 | 9.5502122 | 9.5337065 | 9.5168136 | 9.4995181 | 3549.868 | 3417.484 | 3287.105 | 3158.791 | 50 |
| 49 | 9.5499401 | 9.5334281 | 9.516528 | 9.4992263 | 3547.645 | 3415.295 | 3284.949 | 3156.650 | 49 |
| 48 | 9.5496681 | 9.5331497 | 9.5162436 | 9 4989345 | 3545.423 | 3413.106 | 3282.794 | 3154.529 | 48 |
| 47 | 9.5493958 | 9.5328711 | 9.5159585 | 9.4986425 | 3543.201 | 3410.918 | 3280.639 | 3152.409 | 47 |
| 46 | 9,5491236 | 9.5325925 | 9.5156732 | 9.4983504 | 3540.980 | 3408.730 | 3278.485 | 3150.289 | 46 |
| 45 | 9.5488511 | 9.5323137 | 9.5153879 | 9.4980581 | 3538.760 | 3406.542 | 3276.332 | 3148.170 | 45 |
| 44 | 9.5485786 | 9.5320349 | 9.5151024 | 9.4977658 | 3536.540 | 3404.355 | 3274.179 | 3146.052 | 44 |
| 43 | 9.5483059 | 9.5317558 | 9.5148168 | 9.4974733 | 3534.321 | 3402.169 | 3272.027 | 3143.934 | 43 |
| 42 | 9.5480333 | 9.5314768 | 9.5145311 | 9.4971808 | 3532.102 | 3399.984 | 3269.875 | 3141.816 | 42 |
| 41 | 9.5477604 | 9.5311975 | 9.5142453 | 9.4968881 | 3529.884 | 3397.799 | 3267.724 | 3139.700 | 41 |
| 40 | 9.5474875 | 9.5309183 | 9.5139594 | 9.4965953 | 3527.667 | 3395.614 | 3265.573 | 3137.584 | 40 |
| 39 | 9.5472144 | 9.5306388 | 9.5136733 | 9.4963023 | 3525.450 | 3393.430 | 3263.423 | 3135.468 | 39 |
| 38 | 9.5469413 | 9.5303593 | 9.5133872 | 9.4960093 | 3523.234 | 3391.247 | 3261.274 | 3133.353 | 38 |
| 37 | 9.5466680 | 9.5300797 | 9.5131009 | 9.4957161 | 3521.018 | 3389.064 | 3259.125 | 3131.239 | 37 |
| 36 | 9.5463947 | 9.5298000 | 9.5128146 | 9.4954229 | 3518.802 | 3386.882 | 3256.976 | 3129.124 | 36 |
| 35 | 9.5461212 | 9.5295201 | 9.5125280 | 9.4951295 | 3516.587 | 3384.700 | 3254.828 | 3127.012 | 35 |
| 34 | 9.5458477 | 9.5292402 | 9.5122415 | 9.4948360 | 3514.372 | 3382.519 | 3252.681 | 3124.899 | 34 |
| 33 | 9.5455740 | 9.5289601 | 9.5119547 | 9.4945424 | 3512.158 | 3380.339 | 3250.535 | 3122.787 | 33 |
| 32 | 9.5453002 | 9.5286799 | 9.5116679 | 9.4942486 | 3509.945 | 3378.159 | 3248.389 | 3120.675 | 32 |
| 31 | 9.5450263 | 9.5283996 | 9.5113810 | 9.4939547 | 3507.732 | 3375.979 | 3246.243 | 3118.565 | 31 |
| 30 | 9.5447524 | 9.5281195 | 9.5110939 | 9.4936607 | 3505.520 | 3373.800 | 3244.098 | 3116.454 | 30 |
| 29 | 9.5444783 | 9.5278387 | 9.5108068 | 9.4933666 | 3503.308 | 3371.621 | 3241.954 | 3114.345 | 29 |
| 28 | 9.5442041 | 9.5275581 | 9.5105195 | 9.4930724 | 3501.097 | 3369.443 | 3239.810 | 3112.236 | 28 |
| 27 | 9.5439298 | 9.5272774 | 9.5102321 | 9.4927780 | 3498.886 | 3367.266 | 3237.667 | 3110.127 | 27 |
| 26 | 9.5536554 | 9.5269966 | 9.5099446 | 9.4924836 | 3496.676 | 3365.089 | 3235.524 | 3108.019 | 26 |
| 25 | 9.5433809 | 9.5267156 | 9.5096569 | 9.4921890 | 3494.467 | 3362.913 | 3233.382 | 3105.911 | 25 |
| 24 | 9.5431063 | 9.5264346 | 9.5093692 | 9.4918944 | 3492.258 | 3360.737 | 3231.240 | 3103.805 | 24 |
| 23 | 9.5428315 | 9.5261534 | 9.5090813 | 9.4915995 | 3490.050 | 3358.562 | 3229.099 | 3101.698 | 23 |
| 22 | 9.5425568 | 9.5258722 | 9.5087934 | 9.4913046 | 3487.842 | 3356.388 | 3226.959 | 3099.593 | 22 |
| 21 | 9.5422818 | 9.5255908 | 9.5085053 | 9.4910095 | 3485.635 | 3354.214 | 3224.819 | 3097.488 | 21 |
| 20 | 9.5420068 | 9.5253094 | 9.5082172 | 9.4907144 | 3483.428 | 3352.041 | 3222.680 | 3095.383 | 20 |
| 19 | 9.5417316 | 9.5250277 | 9.5079288 | 9.4904191 | 3481.222 | 3349.868 | 3220.541 | 3093.279 | 19 |
| 18 | 9.5414564 | 9.5247461 | 9.5076404 | 9.4901237 | 3479.016 | 3347.696 | 3218.403 | 3091.176 | 18 |
| 17 | 9.5411810 | 9.5244642 | 9.5073519 | 9.4898281 | 3476.811 | 3345.524 | 3216.266 | 3089.073 | 17 |
| 16 | 9.5409056 | 9.5241823 | 9.5070633 | 9.4895325 | 3474.606 | 3343.353 | 3214.129 | 3086.971 | 16 |
| 15 | 9.5406300 | 9.5239002 | 9.5067745 | 9.4892361 | 3472.402 | 3341.183 | 3211.993 | 3084.869 | 15 |
| 14 | 9.5403544 | 9.5236182 | 9.5064856 | 9.4889409 | 3470.199 | 3339.013 | 3209.857 | 3082.768 | 14 |
| 13 | 9.5400786 | 9.5233358 | 9.5061966 | 9.4886448 | 3467.996 | 3336.844 | 3207.722 | 3080.608 | 13 |
| 12 | 9.5398027 | 9.5230535 | 9.5059075 | 9.4883488 | 3465.794 | 3334.675 | 3205.587 | 3078.568 | 12 |
| 11 | 9.5395267 | 9.5227710 | 9.5056183 | 9.4880525 | 3463.592 | 3332.507 | 3203.453 | 3076.469 | 11 |
| 10 | 9.5392507 | 9.5224885 | 9.5053290 | 9.4877562 | 3461.391 | 3330.339 | 3201.319 | 3074.370 | 10 |
| 9 | 9.5389744 | 9.5222057 | 9.5050395 | 9.4874597 | 3459.191 | 3328.172 | 3199.187 | 3072.272 | 9 |
| 8 | 9.5386982 | 9.5219230 | 9.5047500 | 9.4871631 | 3456 991 | 3326.006 | 3197.054 | 3070.175 | 8 |
| 7 | 9.5384217 | 9.5216400 | 9.5044603 | 9.4868663 | 3454.792 | 3323.840 | 3194.922 | 3068.078 | 7 |
| 6 | 9.5381452 | 9.5213570 | 9.5041705 | 9.4865696 | 3452.593 | 3321.674 | 3192.791 | 3065.982 | 6 |
| 5 | 9.5378686 | 9.5210739 | 9.5038806 | 9.4862726 | 3450.394 | 3319.509 | 3190.661 | 3063.886 | 5 |
| 4 | 9.5375919 | 9.5207907 | 9.5035906 | 9.4859755 | 3448.196 | 3317.845 | 3188.531 | 3061.791 | 4 |
| 3 | 9.5373150 | 9.5205073 | 9.5033005 | 9.4856783 | 3445.999 | 3315.182 | 3186.401 | 3059.696 | 3 |
| 2 | 9.5370381 | 9.5202239 | 9.5030102 | 9.4853810 | 3443.802 | 3313.019 | 3184.272 | 3057.602 | 2 |
| 1 | 9.5367610 | 9.5199402 | 9 5027198 | 9.4850835 | 3441.606 | 3310.856 | 3182.144 | 3055.509 | 1 |
| 0 | 9.5364839 | 9.5196566 | 9.5024293 | 9.4847860 | 3439.410 | 3308.694 | 3180,016 | 3053.416 | 0 |

Deg. 44, 45, 44, 45. Sines and their Logarithms.

| M | N. 44 | 45 N | 44 N. | L. 45 | L. 45 | L. 44 | L. 45 | N. 44 | M |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 2806.602 | 2928.932 | 9.4480808 | 9.4667093 | 9.4847860 | 9.4067093 | 3053,416 | 2928.932 | 0 |
| 1 | 2808.623 | 2930.989 | 9.4484934 | 9.4670142 | 9.4844853 | 9.4064042 | 3051.324 | 2926 876 | 1 |
| 2 | 2810.645 | 2933.047 | 9.4488059 | 9.4673190 | 9.4841905 | 9.4660991 | 3049.233 | 2924.820 | 2 |
| 3 | 2812.667 | 2935.106 | 9.4491182 | 9.4676237 | 9.4838926 | 9.4557937 | 3047.142 | 2922.764 | 3 |
| 4 | 2814.690 | 2937.165 | 9.4494305 | 9.4679283 | 9.4835949 | 9.4654883 | 3045.051 | 2920.709 | 4 |
| 5 | 2816.713 | 2939.224 | 9 4497426 | 9.4682326 | 9.4832964 | 9.4651828 | 3042.961 | 2918.655 | 5 |
| 6 | 2818.737 | 2941.284 | 9.4500546 | 9.4685370 | 9.4829981 | 9.4648771 | 3040.872 | 2916.602 | 6 |
| 7 | 2820.762 | 2943.345 | 9.4503664 | 9.4688411 | 9.4826997 | 9.4645713 | 3038.783 | 2914.549 | 7 |
| 8 | 2822.787 | 2945.406 | 9.4506781 | 9.4691452 | 9.4824012 | 9.4642654 | 3036.695 | 2912.496 | 8 |
| 9 | 2824.813 | 2947.468 | 9.4509896 | 9.4694491 | 9.4821025 | 9.4639593 | 3034.608 | 2910.444 | 9 |
| 10 | 2826.839 | 2949.531 | 9.4513011 | 9.4697536 | 9.4818038 | 9.4636531 | 3032.521 | 2908.393 | 10 |
| 11 | 2828.866 | 2951.594 | 9.4516123 | 9.4700566 | 9.4815049 | 9.4633468 | 3030.435 | 2906.343 | 11 |
| 12 | 2830.894 | 2953.658 | 9.4519236 | 9.4703602 | 9.4812059 | 9.4630404 | 3028.349 | 2904.293 | 12 |
| 13 | 2832.922 | 2955.722 | 9.4522346 | 9.4706636 | 9.4809067 | 9.4627338 | 3026.264 | 2902.243 | 13 |
| 14 | 2834.951 | 2957.787 | 9.4525456 | 9.4709669 | 9.4806075 | 9.4624271 | 3024.179 | 2900.194 | 14 |
| 15 | 2836.981 | 2959.853 | 9.4528563 | 9.4712700 | 9.4803081 | 9.4621202 | 3022.095 | 2898.146 | 15 |
| 16 | 2839.011 | 2961.919 | 9.4531670 | 9.4715732 | 9.4800087 | 9.4618133 | 3020.012 | 2896.099 | 16 |
| 17 | 2841.041 | 2963.986 | 9.4534775 | 9.4718760 | 9.4797090 | 9.4615062 | 3017.929 | 2894.052 | 17 |
| 18 | 2843.073 | 2966.053 | 9.4537879 | 9.4721789 | 9.4794093 | 9.4611991 | 3015.847 | 2892.005 | 18 |
| 19 | 2845.105 | 2968.121 | 9.4540982 | 9.4724815 | 9.4791094 | 9.4608917 | 3013.766 | 2889.959 | 19 |
| 20 | 2847.137 | 2970.189 | 9.4544084 | 9.4727841 | 9.4788095 | 9.4605843 | 3011.685 | 2887.914 | 20 |
| 21 | 2849.170 | 2972.259 | 9.4547184 | 9.4730865 | 9.4785093 | 9.4602767 | 3009 604 | 2885.870 | 21 |
| 22 | 2851.204 | 2974.328 | 9.4550283 | 9.4733889 | 9.4782091 | 9.4599611 | 3007.524 | 2883.826 | 22 |
| 23 | 2853.238 | 2976.399 | 9.4553380 | 9.4736910 | 9.4779088 | 9.4593532 | 3005.445 | 2881.782 | 23 |
| 24 | 2855.272 | 2978.469 | 9.4556476 | 9.4739931 | 9.4776083 | 9.4593532 | 3003.367 | 2879.740 | 24 |
| 25 | 2857.309 | 2980.541 | 9.2559571 | 9.4742951 | 9.4773077 | 9.4590451 | 3001.289 | 2877.697 | 25 |
| 26 | 2859.345 | 2982.613 | 9.4562665 | 9.4745969 | 9 4770070 | 9.4587369 | 2999.211 | 2875.656 | 26 |
| 27 | 2861.382 | 2984.686 | 9.4565758 | 9.4748985 | 9.4767062 | 9.4584285 | 2997.134 | 2873.615 | 27 |
| 28 | 2863.419 | 2986.759 | 9.4578849 | 9.4752002 | 9 4764052 | 9.4581201 | 2995.058 | 2871.574 | 28 |
| 29 | 2865.457 | 2988.833 | 9.4571938 | 9.4755016 | 9.4761041 | 9.4578114 | 2992 982 | 2869.535 | 29 |
| 30 | 2867.496 | 2990.907 | 9.4575027 | 9.4758029 | 9.4758029 | 9 .4575027 | 2890.907 | 2867.496 | 30 |

# The End of the TABLE of Verſed Sines, &c.

*The*

## The Use of the Table of Versed SINES.

THE Uses of the Table of *Versed Sines* are too numerous to be here all treated of: I shall now only shew how by them more easily to solve some of the most useful Cases of *Spherical Triangles*, which alone is enough to merit their Publication. It has been a long time the Votes and Desires of many able *Men* in the *Mathematicks*, that such a Table might be collected and published, but especially of that ingenious and ancient Student Mr. *John Collins*, who has expressed his desire thereof more than once in his elaborate *pieces*, and from whom I had the *Loan* of some Foreign Tables, which did assist much towards the composing of these.

*Prop.* 1. Two sides of an *Oblique Spherical Triangle*, with the Angle comprehended, being given, to find the 3d de.

*As the Cube of the Radius: Is to the Rectangle of the Sines of the comprehended sides, :: So is the Square of the Sine of half the contained Angle,: To half the Difference of the* Versed Sines *of the 3d side, And of the Arch of Difference between the two including sides.*

Which is thus, double the Log Sine of half the Angle given, and thereto add the Log. Sines of the contained sides, and from the left hand of the Sum, dash out 3 for the *Cube* of the *Radius*, so rests the *Log.* of half the difference of those two *Versed Sines*.

Which half difference doubled, and added to the *Versed Sine* of the difference of the Legs or containing sides, gives the *Versed Sine* of the side sought.

*Exam.* 1. In the Triangle *B P L*, let there be given the side *B P* 77° 00 *l*, the side *P L* 40° 00′, and the contained Angle *BPL* 52° 30 *l*, to find the side *B, L.*

*Figure* 5.

| | |
|---|---|
| *The Log. Sine* 40° 00′ | 9.8080675 |
| *The Log. Sine of* 77° 00′ | 9.9887239 |
| *The Log. Sine of* 26° 15′ *doubled.* | 19.2914116 |
| *The Natural Sine against* : : : | 39.0882030 |
| *Is* 1227355, *whose double* is: | 2454710 |
| *The Natural* Ver. Sine *of* 37° 00′ | 2013645 |
| *the dif. of the two sides is* | |
| *The* Versed Sine *of* 57° 53′ *the side sought.* | 4468355 |

If you make the third Term the Square of the Sine of half the Complement of the contained Angle to 180 Degrees, you will find the half difference of the *Versed Sines* of the third side, and of the Sum of the two including sides to be doubled, and subtracted from the *Versed Sine* of the said Sum.

But instead of the second Term be taken into the Proportion, the double of the Rectangle of the Sines of the containing sides, that is, if the Log. of the Number 2 be added to the Log. of the other middle Terms, you will have the Log. of the whole difference in the last place; having found it, take the Natural Sine that stands against it, and add it to the *Natural Versed Sine* of the difference of the Legs, and the Sum is the *Natural Versed Sine* of the side sought.

*Exam.* 2. Let the two containing sides be 38° 30′ and 66° 30′, and the containing Angle be 20° 00′.

| | |
|---|---|
| *The log. Sine of* 38° 30′ | 9.7941496 |
| *The log Sine of* 66° 30′ | 9.9623978 |
| *The log. of the Number* 2 | 0.3010300 |
| *The log. Sine of* 15° 00′ *doubled is* | 18.8259924 |
| *The nearest Nat. Sine against* | 38.8835698 |
| 660 30′ *Is* | 770091 |
| 38 30 *Which taken from the Nat.* | 1170524 |
| *Versed Sine of* 28° 00′ | |
| 28 00 *There remains* | 300433 |

The Nat. Versed Sine of 53° 10.

This *Prop.* is of great Use to Calculate the Distances of Places on the Earth, according to the Arch of a great Circle by their *Long.* and *Latit.* given; the Distances of Stars, by having their Declinations and Right Ascensions, or Longitudes and Latitudes given, by means whereof the Altitudes of two Stars, or of the Sun with the Difference of Time or *Azimuth* being observed at any time off the *Meridian*, the Latitude may be found.

A TABLE of Difference of Latitude and Departure to every Degree and Quarter-Point of the Compass, for the exact working of a Traverse, when the Distance Run exceeds not (the Radius) 10000.

| Dif. | Lat. 1 D | Dep. 89 D | Lat. 2 D | Dep. 88 D | 1 deg. 45 min. | Lat. 0 p ¼ | Dep. 7 p ¾ | 87 deg. 15 min. | Lat. 3 D | Dep. 87 D | Lat. 4 D | Dep. 86 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9998 | 0.0175 | 0.9994 | 0.0349 | | 0.9988 | 0.0491 | | 0.9986 | 0.0523 | 0.9976 | 0.0698 | 1 |
| 2 | 1.9997 | 0.0349 | 1.9988 | 0.0698 | | 1.9976 | 0.0981 | | 1.9973 | 0.1047 | 1.9951 | 0.1395 | 2 |
| 3 | 2.9995 | 0.0524 | 2.9982 | 0.1047 | | 2.9964 | 0.1472 | | 2.9959 | 0.1570 | 2.9927 | 0.2093 | 3 |
| 4 | 3.9994 | 0.0698 | 3.9976 | 0.1396 | | 3.9952 | 0.1963 | | 3.9945 | 0.2093 | 3.9903 | 0.2790 | 4 |
| 5 | 4.9992 | 0.0873 | 4.9970 | 0.1745 | | 4.9940 | 0.2453 | | 4.9931 | 0.2617 | 4.9878 | 0.3488 | 5 |
| 6 | 5.999 | 0.1047 | 5.9963 | 0.2094 | | 5.9928 | 0.2944 | | 5.9918 | 0.3140 | 5.9854 | 0.4185 | 6 |
| 7 | 6.9989 | 0.1222 | 6.9957 | 0.2443 | | 6.9916 | 0.3435 | | 6.9904 | 0.3664 | 6.9829 | 0.4883 | 7 |
| 8 | 7.9988 | 0.1396 | 7.9951 | 0.2792 | | 7.9904 | 0.3925 | | 7.9890 | 0.4187 | 7.9805 | 0.5580 | 8 |
| 9 | 8.9986 | 0.1571 | 8.9945 | 0.3141 | | 8.9892 | 0.4416 | | 8.9877 | 0.4710 | 8.9781 | 0.6278 | 9 |
| | 5 D | 85 D | 0 p ½ | 7 p ½ | 1 deg. 84 min. 30 sec. | 6 D | 84 D | | 7 D | 83 D | 8 D | 82 D | |
| 1 | 0.9962 | 0.0872 | 0.9952 | 0.0980 | | 0.9945 | 0.1045 | | 0.9925 | 0.1219 | 0.9903 | 0.1392 | 1 |
| 2 | 1.9924 | 0.1743 | 1.9904 | 0.1960 | | 1.9890 | 0.2091 | | 1.9851 | 0.2437 | 1.9806 | 0.2783 | 2 |
| 3 | 2.9886 | 0.2615 | 2.9856 | 0.2940 | | 2.9836 | 0.3136 | | 2.9776 | 0.3656 | 2.9708 | 0.4175 | 3 |
| 4 | 3.9848 | 0.3486 | 3.9807 | 0.3921 | | 3.9781 | 0.4181 | | 3.9702 | 0.4875 | 3.9611 | 0.5567 | 4 |
| 5 | 4.9810 | 0.4358 | 4.9759 | 0.4901 | | 4.9726 | 0.5226 | | 4.9627 | 0.6093 | 4.9513 | 0.6959 | 5 |
| 6 | 5.9772 | 0.5229 | 5.9711 | 0.5881 | | 5.9671 | 0.6272 | | 5.9553 | 0.7312 | 5.9416 | 0.8350 | 6 |
| 7 | 6.9734 | 0.6101 | 6.9663 | 0.6861 | | 6.9617 | 0.7317 | | 6.9478 | 0.8531 | 6.9319 | 0.9742 | 7 |
| 8 | 7.9696 | 0.6972 | 7.9615 | 0.7841 | | 7.9562 | 0.8362 | | 7.9404 | 0.9750 | 7.9221 | 1.1134 | 8 |
| 9 | 8.9658 | 0.7844 | 8.9567 | 0.8822 | | 8.9507 | 0.9408 | | 8.9329 | 1.0968 | 8.9124 | 1.2526 | 9 |
| Dif. | Dep. | Lat. | Dep. | Lat. | | Dep. | Lat. | | Dep. | Lat. | Dep. | Lat. | Dif. |

## A Table of Difference of Latitude and Departure to every Degree, &c.

| Dif. | Lat | Dep | Lat. | Dep. | Lat | Dep. | Lat. | Dep. | Lat. | Dep. | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 p $\frac{3}{4}$ | 7 p $\frac{1}{4}$ | 9 D | 81 D | 10 D | 80 D | 11 D | 79 D | 1 p | 7 p | |
| 1 | 0.9892 | 0.1407 | 0.9877 | 0.1504 | 0.9848 | 0.1736 | 0.9816 | 0.1908 | 0.9808 | 0.1951 | 1 |
| 2 | 1.9784 | 0.2935 | 1.9754 | 0.3129 | 1.9696 | 0.3473 | 1.9633 | 0.3816 | 1.9616 | 0.3902 | 2 |
| 3 | 2.9675 | 0.4402 | 2.9631 | 0.4693 | 2.9544 | 0.5209 | 2.9449 | 0.5724 | 2.9424 | 0.5853 | 3 |
| 4 | 3.9567 | 0.5869 | 3.9508 | 0.6257 | 3.9392 | 0.6946 | 3.9265 | 0.7632 | 3.9231 | 0.7804 | 4 |
| 5 | 4.9459 | 0.7337 | 4.9384 | 0.7822 | 4.9240 | 0.8682 | 4.9281 | 0.9540 | 4.9039 | 0.9754 | 5 |
| 6 | 5.9351 | 0.8804 | 5.9261 | 0.9386 | 5.9088 | 1.0419 | 5.8898 | 1.1449 | 5.8847 | 1.1705 | 6 |
| 7 | 6.9242 | 1.0271 | 6.9133 | 1.0950 | 6.8937 | 1.2155 | 6.8714 | 1.3357 | 6.8655 | 1.3656 | 7 |
| 8 | 7.9134 | 1.1738 | 7.9015 | 1.2515 | 7.8885 | 1.3892 | 7.8530 | 1.5265 | 7.8463 | 1.5607 | 8 |
| 9 | 8.9026 | 1.3206 | 8.8892 | 1.4079 | 8.8833 | 1.5628 | 8.8346 | 1.7173 | 8.8271 | 1.7558 | 9 |

1 deg. 26 m. 15 s. | 1 deg. 33 m. 45 s. | 11 deg. 15 min | 7½ deg. 15 min

| Dif. | 12 D | 78 D | 13 D | 77 D | 14 D | 76 D | 1 p $\frac{1}{4}$ | 6 p $\frac{3}{4}$ | 15 D | 75 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9781 | 0.2079 | 0.9746 | 0.2250 | 0.9703 | 0.2419 | 0.9700 | 0.2430 | 0.9659 | 0.2588 | 1 |
| 2 | 1.9563 | 0.4158 | 1.9487 | 0.4499 | 1.9406 | 0.4838 | 1.9401 | 0.4860 | 1.9319 | 0.5176 | 2 |
| 3 | 2.9344 | 0.6237 | 2.9231 | 0.6749 | 2.9108 | 0.7258 | 2.9101 | 0.7289 | 2.8978 | 0.7765 | 3 |
| 4 | 3.9126 | 0.8316 | 3.8975 | 0.8998 | 3.8812 | 0.9677 | 3.8801 | 0.9719 | 3.8637 | 1.0353 | 4 |
| 5 | 4.8907 | 1.0396 | 4.8718 | 1.1248 | 4.8515 | 1.2096 | 4.8502 | 1.2149 | 4.8296 | 1.2941 | 5 |
| 6 | 5.8689 | 1.2475 | 5.8462 | 1.3497 | 5.8218 | 1.4515 | 5.8202 | 1.4579 | 5.7956 | 1.5529 | 6 |
| 7 | 6.8470 | 1.4554 | 6.8205 | 1.5746 | 6.7921 | 1.6935 | 6.7902 | 1.7009 | 6.7615 | 1.8117 | 7 |
| 8 | 7.8252 | 1.6633 | 7.7950 | 1.7996 | 7.7624 | 1.9354 | 7.7602 | 1.9438 | 7.7274 | 2.0706 | 8 |
| 9 | 8.8033 | 1.8712 | 8.7693 | 2.0246 | 8.7327 | 2.1773 | 8.7303 | 2.1868 | 8.6933 | 2.3294 | 9 |

14 deg. 3 min. 45 s. | 75 deg 56 min 15 s

| Dif. | 16 D | 74 D | 1 P $\frac{1}{2}$ | 6 p $\frac{1}{2}$ | 17 D | 73 D | 18 D | 72 D | 19 D | 71 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9513 | 0.2756 | 0.9569 | 0.2903 | 0.9563 | 0.2924 | 0.9511 | 0.3090 | 0.9455 | 0.3256 | 1 |
| 2 | 1.9225 | 0.5513 | 1.9139 | 0.5806 | 1.9126 | 0.5847 | 1.9021 | 0.6180 | 1.8910 | 0.6511 | 2 |
| 3 | 2.8838 | 0.8269 | 2.8708 | 0.8709 | 2.8689 | 0.8771 | 2.8532 | 0.9271 | 2.8366 | 0.9767 | 3 |
| 4 | 3.8450 | 1.1025 | 3.8278 | 1.1611 | 3.8252 | 1.1695 | 3.8042 | 1.2361 | 3.7821 | 1.3023 | 4 |
| 5 | 4.8063 | 1.3782 | 4.7847 | 1.4514 | 4.7815 | 1.4619 | 4.7553 | 1.5451 | 4.7276 | 1.6278 | 5 |
| 6 | 5.7676 | 1.6538 | 5.7416 | 1.7417 | 5.7378 | 1.7542 | 5.7063 | 1.8541 | 5.6731 | 1.9534 | 6 |
| 7 | 6.7288 | 1.9295 | 6.6986 | 2.0320 | 6.6941 | 2.0466 | 6.6574 | 2.1631 | 6.6186 | 2.2790 | 7 |
| 8 | 7.6901 | 2.2051 | 7.6555 | 2.3223 | 7.6504 | 2.3390 | 7.6084 | 2.4721 | 7.5642 | 2.6045 | 8 |
| 9 | 8.6513 | 2.4807 | 8.6125 | 2.6126 | 8.6067 | 2.6313 | 8.5595 | 2.7812 | 8.5097 | 2.9301 | 9 |

16 deg. 52 min. 30 s. | 73 deg 7 min 30 sec

| Dif. | 1 P $\frac{3}{4}$ | 6 p $\frac{1}{4}$ | 20 D | 70 D | 21 D | 69 D | 22 D | 68 D | 2 p | 6 p | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9415 | 0.3369 | 0.9397 | 0.3542 | 0.9336 | 0.3584 | 0.9272 | 0.3746 | 0.9239 | 0.3827 | 1 |
| 2 | 1.8831 | 0.6738 | 1.8794 | 0.7084 | 1.8672 | 0.7167 | 1.8544 | 0.7492 | 1.8478 | 0.7654 | 2 |
| 3 | 2.8246 | 1.0107 | 2.8191 | 1.0626 | 2.8007 | 1.0751 | 2.7816 | 1.1238 | 2.7716 | 1.1480 | 3 |
| 4 | 3.7662 | 1.3476 | 3.7588 | 1.4168 | 3.7343 | 1.4335 | 3.7087 | 1.4984 | 3.6955 | 1.5307 | 4 |
| 5 | 4.7077 | 1.6844 | 4.6985 | 1.7710 | 4.6679 | 1.7918 | 4.6359 | 1.8730 | 4.6194 | 1.9134 | 5 |
| 6 | 5.6493 | 2.0213 | 5.6382 | 2.1252 | 5.6015 | 2.1502 | 5.5631 | 2.2476 | 5.5433 | 2.2961 | 6 |
| 7 | 6.5908 | 2.3582 | 6.5779 | 2.3941 | 6.5351 | 2.5086 | 6.4923 | 2.6222 | 6.4672 | 2.6788 | 7 |
| 8 | 7.5324 | 2.6951 | 7.5175 | 2.7362 | 7.4686 | 2.8669 | 7.4175 | 2.9969 | 7.3910 | 3.0615 | 8 |
| 9 | 8.4739 | 3.0320 | 8.4572 | 3.0782 | 8.4022 | 3.2253 | 8.3447 | 3.3715 | 8.3149 | 3.4441 | 9 |

1 deg. 41 min. 15 s. | 1 deg. 48 m. 45 s. | 22 deg 30 min | 67 deg 30 min

| Dif. | 23 D | 67 D | 24 D | 66 D | 25 D | 65 D | 2 p. $\frac{1}{4}$ | 5 p $\frac{3}{4}$ | 26 D | 64 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.9205 | 0.3907 | 0.9135 | 0.4067 | 0.9063 | 0.4226 | 0.9040 | 0.4276 | 0.8988 | 0.4384 | 1 |
| 2 | 1.8410 | 0.7815 | 1.8270 | 0.8135 | 1.8126 | 0.8452 | 1.8080 | 0.8551 | 1.7976 | 0.8767 | 2 |
| 3 | 2.7615 | 1.1722 | 2.7406 | 1.2202 | 2.7189 | 1.2679 | 2.7120 | 1.2827 | 2.6964 | 1.3151 | 3 |
| 4 | 3.6820 | 1.5629 | 3.6542 | 1.6269 | 3.6252 | 1.6905 | 3.6160 | 1.7102 | 3.5952 | 1.7535 | 4 |
| 5 | 4.6025 | 1.9537 | 4.5677 | 2.0337 | 4.5315 | 2.1131 | 4.5199 | 2.1378 | 4.4940 | 2.1919 | 5 |
| 6 | 5.5230 | 2.3444 | 5.4813 | 2.4404 | 5.4678 | 2.5357 | 5.4239 | 2.5653 | 5.3928 | 2.6302 | 6 |
| 7 | 6.4435 | 2.7351 | 6.3948 | 2.8472 | 6.3442 | 2.9583 | 6.3279 | 2.9929 | 6.2916 | 3.0686 | 7 |
| 8 | 7.3640 | 3.1258 | 7.3084 | 3.2539 | 7.2505 | 3.3809 | 7.2315 | 3.4204 | 7.1904 | 3.5070 | 8 |
| 9 | 8.2445 | 3.5166 | 8.2219 | 3.6606 | 8.1568 | 3.8036 | 8.1359 | 3.8480 | 8.0891 | 3.9453 | 9 |
| | Dep. | Lat | Dep. | Lat | Dep. | Lat. | Dep | Lat | Dep. | Lat | |

25 deg. 18 min. 45 s. | 64 deg. 41 min. 15 s. | 67 deg 30 min

## A Table of Difference Latitude and Departure to every Degree, &c.

| Dif. | Lat 27 D | Dep 63 D | Lat. 28 D | Dep. 62 D | Lat 2 p ½ | Dep. 5 p ½ | Lat. 29 D | Dep. 61 D | Lat. 30 D | Dep. 60 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.8910 | 0.4540 | 0.8829 | 0.4695 | 0.8819 | 0.4714 | 0.8746 | 0.4848 | 0.8660 | 0.5000 | 1 |
| 2 | 1.7820 | 0.9080 | 1.7659 | 0.9389 | 1.7638 | 0.9428 | 1.7492 | 0.9695 | 1.7320 | 1.0000 | 2 |
| 3 | 2.6730 | 1.3620 | 2.6488 | 1.4084 | 2.6458 | 1.4142 | 2.6239 | 1.4544 | 2.5981 | 1.5000 | 3 |
| 4 | 3.5640 | 1.8160 | 3.3218 | 1.8779 | 3.5277 | 1.8856 | 3.4985 | 1.9392 | 3.464 | 2.0000 | 4 |
| 5 | 4.4550 | 2.2699 | 4.4147 | 2.2474 | 4.4096 | 2.3570 | 4.3731 | 2.4240 | 4.3301 | 2.5000 | 5 |
| 6 | 5.3460 | 2.7239 | 5 2977 | 2.8168 | 5.2915 | 2.8184 | 5.2477 | 2.9089 | 5.1961 | 3.0000 | 6 |
| 7 | 6.2370 | 3.1779 | 6.1806 | 3,2863 | 6.1734 | 3.2998 | 6.1223 | 3.3937 | 6.0622 | 3.5000 | 7 |
| 8 | 7.1280 | 3.6319 | 7.0636 | 3.7558 | 7.0554 | 3 7712 | 6.9970 | 3.8785 | 6.9282 | 4.0000 | 8 |
| 9 | 8.0191 | 4-0859 | 7.9465 | 4.2252 | 7,9373 | 4.2426 | 7.8716 | 4.3633 | 7.7942 | 4.5000 | 9 |

| Dif. | 2 P ¾ | 5 P ¼ | 31 D | 59 D | 32 D | 58 D | 33 D | 57 D | 3 P | 5 P | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0,8577 | 0.5141 | 0.8572 | 0.5150 | 0,8480 | 0.5299 | 0.8387 | 0 5446 | 0.8315 | 0.5556 | 1 |
| 2 | 1.7155 | 1.0282 | 1.7143 | 1.0301 | 1.6961 | 1.0598 | 1.6773 | 1.0893 | 1.6629 | 1.1111 | 2 |
| 3 | 2.5732 | 1.5423 | 2.5715 | 1.5451 | 2.5441 | 1.5896 | 2.5160 | 1.6339 | 2.4944 | 1.6667 | 3 |
| 4 | 3.4309 | 2.0564 | 3.4287 | 2.0602 | 3.3922 | 2.1197 | 3.3547 | 2.1786 | 3.3259 | 2.2223 | 4 |
| 5 | 4.2886 | 2.5705 | 4.2858 | 2.5752 | 4.2402 | 2.6496 | 4.1934 | 2.7232 | 4.1573 | 2.7778 | 5 |
| 6 | 5.1464 | 3.0846 | 5.1430 | 3.0902 | 5.0883 | 3.1795 | 5.0320 | 3.2678 | 4.9838 | 3.3334 | 6 |
| 7 | 6.0041 | 3.5987 | 6.0002 | 3.6052 | 5.9363 | 3.7094 | 5.8707 | 3.8125 | 5.8203 | 3.8890 | 7 |
| 8 | 6.8618 | 4.1128 | 6.8573 | 4.1203 | 6.7843 | 4.2394 | 6.7094 | 4.3571 | 6.6518 | 4.4446 | 8 |
| 9 | 7.7196 | 4.6269 | 7.7145 | 4.6353 | 7.6324 | 4.7693 | 7.5430 | 4.9018 | 7.4832 | 5.0001 | 9 |

| Dif. | 34 D | 56 D | 35 D | 55 D | 36 D | 54 D | 3 p ¼ | 4 p ¾ | 37 D | 53 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.8290 | 0.5592 | 0 8192 | 0.5730 | 0.8090 | 0.5878 | 0.8032 | 0.5957 | 0.7986 | 0.6018 | 1 |
| 2 | 1.6581 | 1.1184 | 1.6383 | 1.1472 | 1.6180 | 1.1756 | 1.6064 | 1.1914 | 1.5973 | 1 2036 | 2 |
| 3 | 2.4871 | 1.6776 | 2.4575 | 1.7207 | 2.4271 | 1.7634 | 2.4096 | 1.7871 | 2.3959 | 1.8054 | 3 |
| 4 | 3.3162 | 2.2368 | 3.2766 | 2.2943 | 3.2361 | 2.3511 | 3.2128 | 2.3828 | 3.1945 | 2.4073 | 4 |
| 5 | 4.1452 | 2.7960 | 4.0958 | 2.8679 | 4.0451 | 2.9389 | 4.0160 | 2.9785 | 3.9932 | 3.0091 | 5 |
| 6 | 4.9742 | 3 3552 | 4.9149 | 3.4415 | 4.8541 | 3.5267 | 4.8192 | 3.5742 | 4.7918 | 3.6109 | 6 |
| 7 | 5.8033 | 3.9144 | 5.7341 | 4.0150 | 5.6631 | 4 1145 | 5.6224 | 4.1699 | 5.5904 | 4.2127 | 7 |
| 8 | 6.6323 | 4.4735 | 6.5532 | 4.5886 | 6.4721 | 4.7023 | 6.4257 | 4.7656 | 6.3891 | 4.8145 | 8 |
| 9 | 7.4613 | 5.0327 | 7.3724 | 5.1662 | 7.2812 | 5.2901 | 7.2289 | 5.3613 | 7.1877 | 5.4163 | 9 |

| Dif. | 38 D | 52 D | 39 D | 51 D | 3 p ½ | 4 p. ½ | 40 D | 50 D | 41 D | 49 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.7880 | 0.6157 | 0.7771 | 0.6293 | 0,7730 | 0.6344 | 0.7660 | 0.6428 | 0.7547 | 0.6561 | 1 |
| 2 | 1.5760 | 1.2313 | 1.5543 | 1.2586 | 1 5460 | 1.2688 | 1.5321 | 1.2856 | 1 5094 | 1.3121 | 2 |
| 3 | 2.3640 | 1.8470 | 2.3314 | 1.8880 | 2.3190 | 1.9032 | 2 2981 | 1.9284 | 2.2641 | 1.9082 | 3 |
| 4 | 3.1520 | 2.4626 | 3.1086 | 2.5173 | 3.0920 | 2.5376 | 3.0642 | 2.5712 | 3.0188 | 2.6242 | 4 |
| 5 | 3.9401 | 3.0783 | 3.8857 | 3.1466 | 3.8650 | 3.1720 | 3.8302 | 3.2139 | 3.7736 | 3.2803 | 5 |
| 6 | 4.7281 | 3.6940 | 4.6629 | 3.7759 | 4.6381 | 3.8064 | 4.5963 | 3.8567 | 4.5283 | 3.9363 | 6 |
| 7 | 5.5161 | 4.3096 | 5.4400 | 4.4052 | 5.4111 | 4.4408 | 5.3623 | 4.4995 | 5.2830 | 4.5924 | 7 |
| 8 | 6.3041 | 4 9253 | 6.2172 | 5.0346 | 6.1841 | 5.0751 | 6.1284 | 5.1423 | 6.0377 | 5.2085 | 8 |
| 9 | 7.0921 | 5.5409 | 6.9943 | 5.6639 | 6.9571 | 5.7095 | 6.8944 | 5.7851 | 6.7924 | 5,9045 | 9 |

| Dif. | 42 D | 48 D | 3 P ¾ | 4 ¼ p | 43 D | 47 D | 44 D | 46 D | 45 D | 45 D | Dif. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.7431 | 0.6691 | 0.7410 | 0.6716 | 0.7314 | 0.6820 | 0.7193 | 0.6974 | 0.7071 | 0,7071 | 1 |
| 2 | 1.4863 | 1.3383 | 1.4819 | 1.3431 | 1.4628 | 1.3640 | 1.4387 | 1.3894 | 1.4142 | 1.4142 | 2 |
| 3 | 2.2294 | 2;0074 | 2.2229 | 2.0147 | 2.1941 | 2.0460 | 2.1580 | 2.0840 | 2.1213 | 2.1213 | 3 |
| 4 | 2.9726 | 2.6765 | 2.9638 | 2.6862 | 2,9254 | 2 7280 | 2.8774 | 2.7786 | 2.8284 | 2.8284 | 4 |
| 5 | 3.7157 | 3,3457 | 3.7048 | 3.3578 | 3.6568 | 3 4100 | 3.5967 | 3.4733 | 3.5355 | 3.5355 | 5 |
| 6 | 4.4589 | 4.0148 | 4.4457 | 4.0294 | 4-3881 | 4.0920 | 4 3160 | 4.1679 | 4.2426 | 4.2426 | 6 |
| 7 | 5.2020 | 4 6839 | 5.1867 | 4.7009 | 5 1195 | 4.7740 | 5.0354 | 4.8626 | 4.9497 | 4.9497 | 7 |
| 8 | 5.9452 | 5.3530 | 5.9276 | 5.3725 | 5,8508 | 5.4560 | 5.7547 | 5.0573 | 5.6569 | 5.6569 | 8 |
| 9 | 6.6883 | 6.0222 | 6,6686 | 5.0440 | 6,5822 | 6.1380 | 6.4741 | 6.5519 | 6 3640 | 6.3640 | 9 |
| Dif. | Dep | Lat | Dep | Lat | Dep. | Lat. | Dep | Lat | Dep | Lat | Dif. |

*The*

# *The Nature, Conſtruction, and Uſe of the* TABLE *of Difference of Latitude and Departure.*

THE Table of Difference of Latitude and Departure, is deſigned principally for the more exact and expeditious working of Traverſes, but may be applied to the Solution of the ſeveral Caſes of *Plane Sailing*.

It ſhews by Inſpection the Alteration of the Latitude and Departure to every Degree, Point, and Quarter point of the Compaſs, for any Diſtance not exceeding 10000, and may be made to ſerve for any greater Diſtance, provided it be firſt divided into Parts, not exceeding the Limits of the Table.

In the uppermoſt Rank are placed the Courſes and their Complements from one Degree to 45, including the Points, Half-points, and Quarter-points, which are plac'd in their proper Columns between their next greateſt and leaſt Degree, and in the right and Left hand Columns are the Miles of Diſtance, and in the common Area the correſponding Difference of Latitude and Departure, and which are found from the Courſe and Diſtance by the Subſequent Proportion.

*For the Difference of Latitude.*

As the Radius, to the Sine of the Courſe 1. 2. 3. *&c.* Deg. ſo is the Diſtance run 1. 2. 3. *&c.* Miles the Difference of Latitude.

*For the Departure.*

As the Radius to the Co-ſine of the Courſe 1. 2. 3. *&c* Degrees, ſo is the Diſtance run 1. 2. 3. *&c.* Miles to the Departure.

By the Tables thus formed, no more is requiſite to find the Alteration of Latitude and Departure; but to ſeek for the Courſe in the Head, and the Diſtance in the Side, and the Requiſites in the Common Area.

*A few Examples will render it very plain.*

Suppoſe a Ship ſails N.N.E. $\frac{3}{4}$ Eaſterly 7 Miles, and the Difference of Latitude and Departure be required.

In the Column under Latitude and Departure, I ſeek for 2 p. $\frac{3}{4}$ (becauſe the diſtance of the Rumb N.N.E. $\frac{3}{4}$ E. is 2 p. from the Meridian) and in the Right-hand Column for the Diſtance 7 Miles, and in the common Area I find 6.0041 for the Difference of Latitude, and 3.5987 for the Departure.

If the Courſe had been the ſame, and the Diſtance 70, it is but removing the Prick one place backwarder in the former Anſwers, and the thing is done. So that in this Caſe the Difference of Latitude would be 60 041, that is 60 Miles and $\frac{041}{1000}$ of a Mile, and the Departure 35.987, that is 35 Miles and $\frac{987}{1000}$ of a Mile. In like manner, If the Diſtance had been 700 Miles, and the Courſe the ſame, then the Difference of Latitude would be 600.41, and the Departure 359.87.

If the Diſtance propoſed does not conſiſt of any Number of 10's, as ſuppoſe 753, then the proper Requiſites may be thus found.

From the dif. of Lat. anſwering to 800 686.18
Take the dif. of Lat. anſwering to 700 600.41

85.77

And, ſay, as 100 to 53, ſo is 8577 the Difference 45.46, which therefore added to the Difference of Latitude 600.41, anſwering to the Diſtance 700, gives 645 87, the Difference of Latitude to the Diſtance 753, and Courſe as before, N. N. E. $\frac{3}{4}$ E. after the ſame manner, and it will be as 100 to 53. So is 51.41 to 272.17, which added to 35987, gives 387.117, the Departure required.

But the Difference of Lat. and Departure in the former Caſe, may be more readily found by dividing the Diſtance into ſuch Parts as may be found in the Table, and adding up the ſeveral Differences of Latitude and Departure in one Sum to find the Total: Thus,

Suppoſe the Courſe as before NNE. $\frac{3}{4}$ E. and Diſtance 753.

| | | | |
|---|---|---|---|
| The dif. of Lat. anſwering to | 700 | is | 600.41 |
| to | 50 | is | 42.886 |
| to | 3 | is | 2.573 |
| The Dif. of Lat. anſwering to | 753 | | 645.869 |

*After the ſame manner may be found.*

| | | | |
|---|---|---|---|
| The Departure belonging | to | 700 | 359.87 |
| | to | 50 | 25.705 |
| | to | 3 | 1.542 |
| | | | 387.117 |

The ſame Difference of Latitude and Departure anſwering to 75, $\frac{3}{0}$, by placing the Prick one place forwarder, that is, inſtead of 645.869, for the Difference of Latitude take 64.5869, and for the Departure, inſtead of 387.117: 38.7117, alſo by placing it two places forwarder, they ſerve for the $\frac{5}{100}$, by placing of it three places forwarder for $\frac{75}{1000}$.

In like manner, If the Diſtance had been any Number greater than 1000, as ſuppoſe 86753, by diving it as in the former Example, into its component Parts 80000. 6000. 700. 50. 3, and ſumming up each particular difference of Latitude and Departure into one Sum, the proper Difference of Latitude and Departure will be had.

Keeping the Diſtance 753, as before the ſame difference of Latitude 645.87, and the Departure 387.117 will ſerve for any Courſe that makes an Angle with the Meridian of $2\frac{3}{4}$, as the NNW. $\frac{3}{4}$ W the SSE. $\frac{3}{4}$ E. or the SSW. $\frac{3}{4}$ W. and the difference of Latitude in this Caſe would be the Departure alſo, the Departure would become the difference of Latitude for any Courſe that makes an Angle of 5 p $\frac{1}{4}$ with the Meridian

As ſuppoſe a Ship Sails 753 Miles either NE. by E. $\frac{1}{4}$ E or N. W. by W. $\frac{1}{4}$ W. or S. E. by E. $\frac{1}{4}$ E. or S. W. by W. $\frac{1}{4}$ W. or E. N

E N E N. *&c.* the proper difference of Latitude to each, or any of theſe will be the ſame with the Departure in the former Example 387.117, and the Departure in this 645.869, the ſame with the Alteration of the Latitude in the former.

If the Courſe cannot be found exactly in the Table, then the difference between the differences Latitude and Departure, proper to the whole Degrees next above and below the Courſe muſt be found, and the Proportional Increment inveſtigated, as in the following Example.

Suppoſe a Ship ſails North 38° 20′ weſterly 600
Then againſt 6 and under 38°, the dif. Lat is 472.81
Againſt 6, and under 39, the differ Lat. is 466.29

The difference to the Alteration of 1 deg. is 6.52

Therefore as 60 to 30, ſo is 652 to 3.26, which therefore ſubſtracted from 47.281, leaves 469.55 the difference of Latitude.

In like manner for the Departure.

Againſt 6, and under 38° the departure is 369 40
Againſt 6, and under 39 the Departure is 377 59

8.19

Therefore as 60′ to 30′, ſo is 819 to 4.095, which therefore added to 369.40, gives 373.495, for the departure required.

### *A Traverſe*

Admit a Ship from the Latitude of 48° 30′ N. Sails NNW half W. 79 miles, then N W half W. 86, then N by E ¾ E. 108, then N 48° East, 112, then E. 5° ſoutherly 70, then East 50° Northerly 84, then North 48; And it be required to find the Latitude the Ship is in, her direct Courſe and Diſtance, and how much ſhe has departed from her firſt Meridian.

Having ſet down the Courſes and Diſtances, as in the following Table, proceed to find out the difference of Latitude and Departure for each (according to the directions already given) in the Table placing each in its proper Column, *viz.* If the Courſe be Northerly the difference of Latitude muſt be placed in the North Column, if Southerly, in the South Column, if Eaſterly, the departure muſt be put in the East Column, if Weſterly, in the Weſt Column; which done, add up the Columns of difference of Latitude and departure, and ſubſtract the leſſer difference of Latitude from the greater, as alſo the leſſer departure from the greater, and the Remainders will be the difference of that Latitude and departure the Ship has made.

## *The* TABLE.

| Courſes | Diſt | Dif. of Lat | | Departure | |
|---|---|---|---|---|---|
| | | N | S. | E | W |
| N N W, ½ W | 79 | 69.67 | — | — | 37.24 |
| N W ½ W | 86 | 54.56 | — | — | 66.47 |
| N by E ¾ E | 108 | 101.68 | — | 36.39 | — |
| N 48° E | 112 | 74.94 | — | 83.23 | — |
| E 55° | 70 | — | 6.10 | 69.73 | — |
| E 50° N | 84 | 64.35 | — | 53.99 | — |
| North | 48 | 48.00 | — | — | — |
| | | 413.20 | 6.10 | 243.34 | 103.71 |
| | | 6.10 | | 103.71 | — |
| Northing | | 407.10 | | 139.63 | E. ing |

Hence it appears, that the Ship has departed from her firſt Meridian, 139.63 miles Eaſterly, and altered her Latitude 407.1 miles, which reduced into degrees and minutes, makes 6° 47′, which therefore added to the Latitude ſhe came from 48° 30′, becauſe ſhe ſail'd from a North Latitude Northerly makes 55° 17′, the Latitude the Ship is come into.

Entering the Table with the Difference of Latitude, thus deduced, *viz.* 407.01, and the Departure 139.63, I find the Courſe is greater than 18°, and leſs than 19, and the Diſtance greater than 400.00, and leſs than 500.00 and after working the neceſſary Proportion (by the reverſe of the Method made uſe of in the former *Examples*) the Courſe out North 18° 56′ *E.* or *E.* by *N.* 70° 41′ *Eaſt*, and the direct Diſtance 430.305 Miles.

The chief Uſe of this Table being for the Solution of Traverſes, it would be needleſs to give an *Example* of each particular Caſe in Plane-Sailing, eſpecially ſince he that is but moderately apprehenſive of what has been ſaid, will find it not difficult to do it himſelf, by the Directions given in *Vol.* 1. under the words *Plain Sailing*.

AN

# Alphabetical INDEX

## To Both VOLUMES.

*Navigation* and *Sea-Terms.*


A.

ABaft.
Abaſe.
Affretamentum.
After-Sails.
Aloofe.
Amain.
Anchor.
Anchoring.
Ancient.
Animated Needle.
Armed.
Armings.
Avaſt.
Azimuth Magnetical.

B.

Back Stayes.
Baile *or* Bale.
Ballaſt.
Barco Long'd.
Bark.
Barr of the Port.
Bay.
Beacons.
Beak-head.
Beams of a Ship.
Bear.
Bearing.
Belander.
Belay.
Bend.
Bends.
Beneip'd.
Bertying of a Ship.
Bildge.
Bite.
Birth.
Bittocle.
Bitter.
Bitts.
Blocks.
Bluff-headed.
Board.
Boat-Rope.
Boatſwain.
Bolt-Rope.
Bolts.
Bomb Ketch.
Bon Grace.
Bonnets.
Boom.
Bow.
Bower.
Bowlines.
Bowling.
Bowling Bridles.
Bowling Knot.
Bowſe.
Bowſprit.
Bowſprit Ladders.
Boy.
Braces.
Brackets.
Brails.
Brakes.
Breaming.
Breaſtfaſt.
Breaſt Hooks.
Breaſt Ropes.
Breechings.
Breeze.
Brigantine.
Brooming.
Bulk of a Ship.
Bulk-heads.
Bunt of a Sale.
Bunt Lines.
Buoy.
Burton.
Butt.
Buttock of a Ship.
Bylander.

C.

Cable of a Ship.
Caburns.
Calking *or* Cauking.
Cambring.
Cap.
Capſquares.
Capſtand.
Cardinal Points.
Careen.
Carling-Knees.
Carlings.
Carnell.
Caskets.
Caſt a Point of Traverſe.
Catharpings.
Catt-Holes.
Chafe.
Chain-ſhot.
Chain-Wales.
Chains.
Chaloup.
Charts.
Chaſe.
Guns.
Of a Gun.
Cheeks.
Cheſt-Rope.
Cheſt-Trees.
Chevils.
Clamp-Nails.
Clamps.
Cleat.
Clew.
Clew Garnet.
Clinch.
Clinch-Bolts.
Clinching.
Cloathed.
Cloſe Fights.
Cloyed.
Coach.
Coamings.
Coaſting.
Coats.
Cocks.
Coins.
Collar.
Comb.
Compaſs.
Cond.
Conn.
Cook-Room.
Cordage.
Corporal.
Counters.
Courſe.
Courſes.
Crabb.
Cradle.
Craft.
Crane-Lines.
Crank.
Cringles.
Croſs-Staff.
Jack.
Piece.
Trees.
Tree-Yard.
Crow-feet.
Cubbridge Heads.

Cuddy.
Culvertaile.
Cun.
Currents.
Cut a Feather.
Cut-Water.

D.

*Davis* Quadrant.
David or Davit.
Deadmens Eye.
Reckoning.
Riſing.
Water.
Dead Ropes.
Deck.
Deck-Nails.
Declination of the Compaſs.
Deep Sea-Line.
Deflection.
Departure.
Dipping-Needle.
Diſtance run.
Dock.
Dogger.
Doubling a Cape.
Drabler.
Draggs.
Draw.
Drift-Sail.
Drift-Way.
Drive.
Duckup.

E.

Earing
Eaſe.
Eddy.
End for End.
Entring-Ladder.
Eye.

F.

Fack.
Fake.
Fall.
Fall off.
Falls.
Farthelling.
Faſhion Pieces.
Fatt.
Feazing
Fend.
Fenders.
Fidd.
File Rails.
Fiſh Block.
Fiſhes.
The Fiſh.
Flags.
Flair.
Flat.
Flie.
Floor.
Flotſon.
Flown Sheets.
Fluſh.
Fly-Boat.
Fore-Caſtle.
Cocks.
Foot.
Maſt.
Reach.
Foul.
Water.
Founder.
Free.
Freſh Shot.
Frigat.
Frigatoon.
Furle.
Furling-Line.
Furring.
Futtocks.

G.

Gage.
Gale.
Galeaſſe.
Galleons.
Galley.
Gallery.
Gang.
Way.
Garboard Plank.
Strake.
Garland.
Garnet.
Gate of the Sea.
Gift-Rope.
Girding-Girt.
Goaring.
Gooſe-Wing.
Grapnell.
Gratings.
Graving.
Great Circle Sailing.
Gripe of a Ship.
Gromet.
Ground Tackle.
Timber.
Grounding.
Gudgions.
Gueſt-Rope.
Gulph.
Gunnel.
Gun-Room.
Gunwale.
Guy.
Rope.

H.

Hail.
Halliards.
Handſpike.
Harpings.
Hatches.
Hatchway.
Hawſer.
Hawſſes.
Head-Lines.
Sails.
Sea.
Heave.
Heel.
Heliſpherical.
Helm.
Hitch.
Hodometrical Method of finding Longitude.
Hoiſe.
Hold-off.
Hoordings.
Hooks.
Horſe.
Hounds.
Howker.
Howſed.
Howle.
Hoy.
Hoyſe.
Hulks.
Hull.
Hullock.

J.

Jeer.
Capſtan.
Iron-Sick.
Jury Maſt.
Jack.

K.

Keckle.
Kedging.
Kedger.
Keel.
Keelſon.
Kenks.
Kennets.
Ketch.
Kevels.
Knave Line.
Kneck.
Knees.
Knee-Timber.
Knettles.
Knights.
Knots.

L.

Ladders.
Land-full.
layed.
locked.
ſhut in.
to.
Langrel Shot.
Lanniards.
Lanniers.
Larboard.
Large.
Laſh.
Laſhes.
Laskers.
Lasking.
Latches.
Latitude.
of a Place.
Launch.
Lay the Land.
Lead.
Ledges.
Lee.
Shore.
Way.
the Helm.
Latch.
ward.
Fang.
Leetch of a Sail.
Lines.
Legs of the Marnets.
Let-fall.
Lie under the Sea.
Lifts.
Lights.
Limber Holes.
Locker.

Log.
Line.
Long Boat.
Longitude.
Loof.
Hooks.
of a Ship.
Tackle.
Loom.
Loom Gate.
Loop Holes.
Loxodromicks.
Luff.
Luft.

M.

Magnetical Needle.
Main Maft.
Top Maft.
Manger.
Marline.
Spike.
Martnets.
Maſts of a Ship.
Matts.
Meridian Line.
Mercators Chart.
Sailing.
Middle Latitude.
Mid-Ship Men.
Miſſen Maft.
Mizzon Maft.
Monks Seam.
Moor.
Murderers.

N.

Navigation.
Nautical Chart.
Compaſs.
Planiſphere.
Needle.
Neipe Tides.
Nettings.
Nippers.
Naval Architecture.
Near.
Nocturnal.

O.

Oakum.
Oazy.
Oblique Sailing.
Obſervation.
Offin, *or* Offing.
Off-ward.
Orlope.
Orthodromicks.
Over-Rake.
Out-Licker.

P.

Pallet.
Parallel Sailing.
Parbuncle.
Parcelling.
Parrels.
Partners.
Paſſarado-Rope.
Paunch.
Pawle.
Paying.
Peek.
Pillow.
Pink.
Pinnace.
Pintles.
Plain Chart.
Sailing.
Platform.
Plow.
Point of the Compaſs.
Pointing the Cable.
Poop.
Port-laſt.
Port-Nails.
Portoiſe.
Ports.
Port the Helm.
Preddy.
Preſt Sail.
Preventer Rope.
Prick.
Proper Navigation.
Proviſo.
Provoſt-Marſhal.
Prow.
Puddings.
Pumps.
Pump-Brake.
Can.
Vale.
Purſer.
Puttocks.
Shrowds.

Q.

Quadrant of *Davis*.
Quarter.
Quartering.
Quoile.
Quoin.
Quarter Wind.

R.

Rake of a Ship.
of the Rudder.
Ram-head.
Ranges.
Rate of a Ship.
Ratlines.
Reach.
Rectifier.
Reef.
Reeve.
Rends.
Rhumbs.
Ribs of a Ship.
Ride.
a-croſs.
a-peek.
a-thwart.
between Wind and Tide.
Hawſeful.
Portoiſe.
Riders.
Rigging.
Right Sailing.
Right the Helm.
Riſing Timbers.
Riſings.
Ropes, their Names.
Rope Yarn.
Round-houſe.
Round in.
Rother Nails.
Rowle.
Rowſe.
Rudder.
Rudder Irons.
Rope.
Rumb.
Line.
Scale.
Rungheads.
Rungs.
Runner.

S.

Sail.
Sails } of a Ship.
Sailing }
Scarfed.
Scoper-hele.
Scupper-Nails.
Scuttles.
Sea Gate.
Sea Quadrant.
Sea Yoke.
Seams of a Ship.
Seel.
Seizing.
Send.
Separation.
Serve.
Sett.
Settle a Deck.
Sew.
Shackles.
Shallop.
Shank.
Sheering.
Sheer Hooks.
Shanks.
Sheers.
Sheathing.
Sheets.
Shifters.
Shivers.
Shoale.
Short Sails.
Shot of a Cable.
Shrouds.
Signals.
Sinnet.
Skarfed.
Skuppers.
Slatch.
Sleepers.
Sling.
Slope.
Smack.
Smiting Line.
Snatch Block.
Sound.
Sounding.
Spell.
Spent.
Spikes.
Spiking the Ordnance.
Spindle.
Splice.
Split.
Spooning.
Spring a Maſt.
Tides.
Spurn Yard.
Spurkets.
Squadrons.
Stanchions.
Standing Part of the Sheet.

# An Alphabetical INDEX


Standing Ropes.
Part of the Tackle.
Starboard.
Stays.
Steady.
Steer.
Steerage.
Steeve.
Stem.
Step.
Stern.
Stern-faſt.
Poſt.
Steward of a Ship.
Stirrup of a Ship.
Stoaked.
Stocks.
Stopper.
Straits.
*Streights.*
Strake.
Strap.
Stream Anchor.
Stretch.
Strike.
Studding.
Surge.
Swabber.
Sweep.
Sweeping.
Swifters.
Swifting of a Boat.
Ship.

T.

Tack.
about.
Tackles.
Tafferel.
Take and Leave.
Tally the Sheets.
Tampkin.
Tampion.
Tarpaulin.
Tartane.
Taught.
Taunt.
Thaughts.
Thoughts.
Thowles.
Tide.
Ties.
Tiller.
Tire.
Tite.
Top-Gallant.
Armours.
Maſts.
Ropes.
Topping the Lifts.
Tornade.
Tow.
Trail Board.
Treenels.
Treſſel Trees.
Trie.
Try.
Trim.
Trip.
Triſe.
Trough of the Sea.
Trucks.
Trunnions.
Truſſes.
Tuck.

V.

Vale of a Pump.
Vane.
Variation.
Veer.
Viol.
Unmoor.

W.

Waft.
Waggoner.
Wake.
Wale.
Knot.
reared.
Walt.
Wapp.
Warp.
Waſt.
Boards.
Cloaths.
Trees.
Watch.
Glaſs.
Water-born.
Line.
Shot.
Way.
Way of a Ship.
Wear.
Weather Coyle.
Gage.
Weight.
Wending.
Whelps.
Whip-Staff.
Whoodings.
Wind Taught.
Winding-Tackle Block.
Windlaſs.
Wood and Wood.
Worming.
Woulding.
Wreck.
Wrack.
*Wright*'s Sailing.

Y.

Yards of a Ship.
Yare.
Yatches.
Yaws.
Yoke.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*Mathematical and Philoſophical Inſtruments, and Practical Mathematicks.*


A.

Æolipile.
Air Pump.
Alidada.
Almacanters Staff.
Analemna.
Anemoſcope.
Areometer.
Armillary Sphere.
Aſtrolabe.
Aſtronomical Quadrant.
Calendar.
Azimuth Compaſs.

B.

Back-Staff.
Ball and Socket.
Beam Compaſs.
Bow.
Box and Needle.
Brachiolum.
Burning-Glaſſes.

C.

Characters Mathematical.
Chords.
Chronometers.
Circumferenter.
Clepſydra.
Compaſs Dial.
Croſs-Staff.

D.

Decimal Scales.
Declinatory.
Declining Dials.
Demi-croſs.
Diagonal Scale.
Dialling Globe.
Scales.
Sphere.
Dials.
Diopter.
Direct Dials.
Double Horizontal Dials.
Draught Compaſſes.

E.

Elliptical Dial.
Engyſcope.
Equated Bodies of the Lines.
Equinoctial Dial.
Erect Direct Dials.
Erect Declining Dials.

F.

Fore-Staff.

G.

Gnomon.
*Gunter*'s Line.
Quadrant.
Scale.

H.

Half Tangent Lines.
Heliſcope.
Horizontal Dial.
Hour Lines.
Hygrometer.
Hygroſcope.
Hydroſtatical Ballance.

J.

*Jacob*'s Staff.
Imperial Table.

L.

Label.
Level.
Levelling.
Limb.
Line of Numbers.
Line of Lines.
Solids.
Superficies.
Chords.
Secants.
Metals.

M.

Maps.
Mesolabium.
Micrometer.
Mine-Dial.
Microscopes.
Millains.

N.

Needle
*Neper*'s Bones.
Nocturnal.
Numbring Rods.

P.

Parallel Ruler.
Parallelogram.
Perambulator.
Perpendiculum Chronometrum.
Plain Scale.
Table.
Plow.
Plumb Line.
Portable Barometer.
Protracting Pin.
Protractor.
Primes.
Prism.
Proportional Scales.

Q.

Quadrant.
Triangular.
Quadrat.
Quadrant of *Davis*.
Quadrature Lines.

R.

Reducing Scale.
Reflecting Telescope.
Regulator.
Ring Dial.
Rule Sliding.
Rumb Scale.

S.

Satellite Instrument.
Scales.
Proportional.
Sector.
Segments.
Sinical Quadrant.
Sines.
Sliding Rule.
Square.
Station Staff.
Statical Baroscope.
Stentrophonick Tube.
Surveying Scale.
Superficies Line.
Surface Line.

T.

Tangent Lines.
Telescope.
Theodolite.
Thermometer.
Thermoscope.
Three-legg'd Staff.
Travelling Barometer.
Triangular Compasses.
Quadrant.

U.

Universal Equinoctial Dial.

W.

Way-Wiser.
Wheel.
Wheel Barometer.
Wind Gun.

## *Arithmetick* and *Algebra*.

ABacus.
Absolute Numbers.
Abundant Numbers.
Addition.
of Logarithms.
of Vulgar Fractions.
of Decimals.
Aggregate.
Algebra.
Algebraick Curve.
Algorithm.
Algorism.
Aliquant Part.
Aliquot Part.
Alligation.
Medial.
Alternate.
Alternation.
Amiable Numbers.
Analysis of Infinites.
Anatocism.
Anti-Logarithm.
Approximation.
Arithmetick.
Arithmetical Complement.
Progression.
Article.
Artificial Numbers.

B.

Bimedial.
Binomial.

C.

Calculus Differentialis.
Integralis.
Canon.
Canonical Equations.
Carat.
Central Rule.
Characteristick of a Logarithm.
Characters Algebracial.
Chiliads.
Circular Numbers.
Climacterical Year.
Coefficients.
Combinations.
Commensurable Numbers.
Surds.
Common Divisor.
Composition of Proportion.
Compound Interest.
Quantities.
Concrete Numbers.
Consequent.
Construction of Equations.
Continual Proportion.
Conversion of Equations.
Cosse.
Cossick Quantities.
Cross Multiplication.
Cubick Equations.
Cubical Number.
Cubocube.
Cypher.

D.

Dactylonomy.
Deficient Numbers.
Decimal Fractions.
Degree Parodick.
Denominator.
Depression of an Equation.
Difference.
Digits.
Discontinual Proportion.
Discrete Proportion.
Quantity.
Dividend.
Dividual.
Division.
in Decimals.
Vulgar Fractions.
of Logarithms.
by Logarithms.
of Proportion.
Divisor.
Duplicate Proportion.
Duplication.

E.

Election.
Eminential Equation.
Equations.
Equimultiples.
Even Numbers.
Evenly Even.
Odd.
Evolution.
Exegesis Numerosa.
Exponent of the Ratio.
Exponential.
Extraction of Roots.

F.

Factors.
False Position.
Fellowship.
Figurate Numbers.
Figures.
Fluxions.
Fractions.
Decimal.
Sexagesimal.
Algebraick.

G.

Geodetical Numbers.
Golden Number.
Rule.

H.

Harmonical Proportion.
Heterogeneal Numbers.
Surds.
Homogeneum Comparationis.
Hypobibasmus.

I.

Imperfect Numbers.
Improper Fractions.
Incommensurables.
Incomposite Numbers.
Index.
Ineffable Numbers.
Infinite Series.
Integers.
Interest.
Interruption of Proportion.
Inverse Proportion.
Involution.

Irrational

Irrational Numbers.
Iſomeria.

L.

Lateral Equation.
Laws of Chance.
Like Signs.
Quantities.
Linear Numbers.
Literal Algebra.
Logarithms.
Logiſtical Arithmetick.
Logiſticks.

M.

Magick Squares.
Medial Alligation.
Millains.
Mixed Number.
Multinomial.
Multiple Proportion.
Multiplication.
Multiplicator.

N.

Negative Quantities.
Signs.
*Neper*'s Bones.
Numbers.
Numeration.
Numerator.
Numeral Algebra.

O.

Original Equations.

P.

Paraboliſmus.
Parodical Degrees in an Equation.
Partnerſhip (*a Rule.*)
Part Proportional.
Plane Number.
Permutation of Quantities.
Play.
Political Arithmetick.
Polygonal.
Polynomial Root.
Poſition (*Rule.*)
Poſitive Quantities.
Powers.
Practice.
Prime Numbers.
Product.
Progreſſion Arithmetical.
Geometrical.
Proper Fraction.
Proportion.

Q.

Quadratick Equations.
Quadripartition.
Quotients.

R.

Rebate.
Reciprocal Proportion.
Reduction.
of Equations.
Decimals.
Vulgar Fractions.
Money.
Renewing of Leaſes.
Reſidual Root.
Reſolvend.
Reverſions.
Root
Binomial.
Rule of Falſe.
Three.

S.

Secundans.
Series.
Sexageſimal Fractions.
Similar Plane Numbers.
Solid Numbers.
Simple Quantities.
Solid Numbers.
Species.
Spherical Number.
Square Number.
Root.
Subduction.
Subduple Proportion.
Submultiple.
Subſtitution.
Subſuper Particular.
Subtraction.
in Algebra.
of Indexes.
Integers.
Logarithms.
Vulgar Fractions.
Decimals.
Subtriple Proportion.
Sum.
of an Equation.
Superficial Numbers.
Superparticular Proportion.
Superpartient.
Surds.

T.

Tariff.
Terms of an Equation.
Proportion.
Tetragoniſtick Calculus.
Tranſpoſition.
Trinomial Root.
Tripartition.

U.

Variable Quantities.
Vinculum.
Unciæ.
Unit.
Unlike Quantities.
Signs.
Vulgar Fractions.


## *Natural Philoſophy* and *Phyſicks.*


A.

Abyſs.
Academy.
Academicks.
Acceleration of the Deſcent of Bodies.
Accenſion.
Accretion.
Acerb.
Acidity.
Acids.
Acidulæ.
Acouſticks.
Acrimonious.
Actinobiliſm.
Active Principles.
Ad Octo.
Æolipile.
Æther.
Agitation.
Air.
its Reſiſtance.
its Weight.
Air Pump.
Airy Meteors.
Alteration.
Ambient.
Anacampticks.
Anemoſcope.
Animation.
Animals.
Animalcula.
Antediluvian.
Antipathy.
Antiperiſtaſis.
Apporrheæ.
Aporhea's.
Aquatick.
Architectonick.
Areometer.
Argyrocomus.
Armed Load-ſtone.
Asbeſtine.
Aſpetity.
Atmoſphere.
of Conſiſtent Bodies.
Atom.
Attraction.
Attrition.

B.

Balani.
Barometer.
Wheel.
Bile.
Biolychnium.
Bivalve.
Blackneſs.
Blood.
Body.
Bolonian-Stone.
Bolus.
Burning-Glaſs.

C.

Camera Obſcura.
Capræ Saltantes.
*Caſtor* and *Pollux*.
Catacauſticks.
Cataphonicks.
Celerity.
Centre of Gravity.
Centrifugal Force.
Centripetal Force.
Centro-Barrical.
Ceratias.
Chaos.
Chyle.
Circulation of the Blood.
*Carteſian* Syſtem.
Circumſcription.
Clouds.
Clypei-formis.
Coagulate.

Coalition.
Coacervate Vacuum.
Cohesion of the Parts of Matter.
Conatus Centri-fugus.
Concoction.
Cohesion.
Constituent Particles.
Coition.
Colature.
Cold.
Coldness Potential.
Collision.
Colour.
Comets.
Comminution.
Commissures.
Composition of Motion.
Conatus recedendi ab Axe motus.
Concatenation.
Concentration.
Concretion.
Condensation.
Congregation.
Congruity.
Consistent Bodies.
Constipation.
Constriction.
Contiguity.
Continuum.
Contractile.
Convexity.
*Copernican* System.
Corporeity.
Corpuscles.
Corpuscular Philosophy.
Corrosibility.
Corrosiveness.
Corruption.
Coruscation.
Crepusculum.
Crowns of Colours.
Crustaceous.
Currents.

D.

Damps in Mines.
Deflexion of the Rays of Light.
Deluge.
Density.
Descent of heavy Bodies.
Deterration.
Dew.
Diacousticks.
Diaphaneity.
Difform.
Diffusion.
Digestion.
Discus *sive* Disciformis.
Divisibility.
Draco Volans.
Ductility.

E.

Earth.
Quakes.
Ebbing and Flowing.
Ebullition.
Echo.
Effervescence.
Effluviums.
Elastick Force.
Elasticity.
Elaterists.
Electricity.
Elements.
Emeticks.
Emphatical.
*Epicurean* Philosophy.
Equable Motions.
Equinus Barbatus.
Equivocal Generation.
Evanid Colours.
Exhalation.
Exhausted Receiver.
Expansion.
Experimentum Crucis.
Expiration.
Explosion.
Extramundane Space.
Exuviæ.

F.

Faculæ.
Faculty.
Natural.
Vital.
Animal.
Fantastical Colours.
Fasciæ of *Mars*.
Fermentation.
Ferrugineous Waters.
Figure.
Filaments.
Fire.
Firmness.
Fissures.
Fits of easy Reflexion.
Transmission.
Fixity.
Flamma Vitalis.
Fluid Body.
Fluidity.
Fluores.
Flux and Reflux of the Sea.
Form.
Formed Stones.
Fossils.
Freezing.
Friable.
Fuga Vacui.
Function.
Funicular Hypothesis.

G.

Generation.
Globules.
Gravitas Acceleratrix.
Gravity.
Specifick.
Gravity.
its Centre.
Gun-Powder.

H.

Hail.
Halo.
Halo's.
Heat.
Heavy Bodies Descent.
Heterogeneal Light.
Particles.
Homoiomerical Principles.
Humidity.
Hydraulicks.
Hydrostaticks.
Hygrometer.
Hygroscope.
Statical.
Hypothesis.

I.

Ice.
Ignis Fatuus.
Incalescence.
Incongruity.
Incorporate.
Incurvation of the Rays of Light.
Inergetical.
Inflection of Light.
Influence of the Planets.
Intension.
Interspersum Vacuum.
Isacrone.
Juxta-Position.

L.

Lampadias.
Lapidescent.
Lation.
Laws of Motion.
Levitation.
Leight.
Levity.
Light.
Line of Gravitation.
Direction.
swiftest Motion.
Liquids.
Load-stone.
Locus.
Lonchites.
Longitude of Motion.

M.

Machina *Boyleana*.
Maculæ Solares.
Magnetism.
Magnify.
Malleable.
Marchasite.
Marine Barometer.
Masse.
Materia Subtilis.
Maturation.
Mechanical Philosophy.
Medium.
Memory.
Mephitical Exhalations.
Mercurial Phosphorus.
Metals and Minerals.
Metallurgy.
Meteors.
Microcousticks.
Microphones.
Minima Naturalia.
Mixt.
Moments.
Motion.
its Laws.
Motion compounded.
Motrix Vis.

N.

Nature.
Natural Philosophy.
Neutral.
Nutrition.



Oblique

O.

Oblique Force.
Odour.
Odours.
Opacous.
Opacity.

P.

Parafelene.
Pelagiæ.
Penetration of Dimenſions.
Pendulums.
Peripateticks.
Permeating.
Perpetual Motion.
Petrifications.
Phantaſtick Colours.
Phænomenon.
Philtration.
Phoſphorus.
Phyſicks.
Phyſiology.
Pithias.
Place.
Pneumatical Experiments.
Polarity.
Pores.
Poſitive Lenity.
Potential Coldneſs.
Pragmatical.
Preſſure.
Prima Naturalia.
Principle.
Priſm.
Projectiles.
Pulſe.
Pulſion.
Purgative Medicines.
Putrefaction.

Q.

Qualities.
Quantity of Matter.
Quantitatis Acceleratrix.
Quantity of Motion.

R.

Rainbow.
Rare Bodies.
Rarefaction.
Rays.
of Light.
Reaction.
Redintegration.
Reflection.
Reflexibility.
Reflux of the Sea.
Refraction.
Refrangibility of the Rays of Light.
Regions.
Relative Gravity.
Remiſſion.
Renitency.
Repelling Force.
Reſiſtance of the Medium.
Reſiſtance of a Fluid Medium.
the Air to project.
Reſpiration.
Reſtitution.
Rigorous.
Roundneſs.
Ruminant Animals.

S.

Saporifick Particles.
Saporous.
Seeing.
Senſation.
Smelling.
Snow.
Solidity.
Sound.
Space.
Abſolute.
Relative.
Specifick Gravity.
Sphere of Activity.
Spring of the Air.
Spots in the Sun.
Spring-Tide.
Springs and Fountains.
Springy Bodies.
Stalactitæ.
Statical Baroſcope.
Hygroſcope.
Stones.
Strata.
Striæ.
Subſtance.
Subterraneous.
Suction.
Sulphur.
Sun.

T.

Tactile Qualities.
Tangible Qualities.
Taſte.
Taſtes.
Tautological Echo's.
Teſtaceous.
Tetragonius.
Texture.
Thermoſcope.
Thermæ.
Thunder.
Tides.
Time.
*Torricellian* Experiment.
Tranſmutation.
Tranſparency.
Tubuli Vermiculares.

V

Vacuum.
Vapours.
Variation of the Compaſs.
Vegetables.
Vegetation.
Verticity.
Veru.
Vibrating Motion.
Vibration.
Virgæ.
Virgula Divinatoria.
Vis Centrifuga.
Centripeta.
Vis Centripeta Quantitas Acceleratrix.
Quantitas Motrix.
Viſion.
Vis Inertiæ Materiæ.
Vis Stimulans.
Viſual Faculty.
Viviparous.
Uniforme.
Union.
Volatility.
Vomits.
Vortex.

W.

Water.
Waves of the Sea.
Weight of the Air.
of Bodies in the Planets.
Whiteneſs.
Wind.

X.

Xiphias.

Z.

Zoography.

---

*Geography* and *Chronology*.

ÆRa.
Æquator.
Æſtuary.
Angle of Longitude.
Angle of the Diſtance of two Places.
Anomaly.
Anachroniſm.
Archipelagus.
Altitude of the Pole.
Amphiſcii.
Amplitude.
Antartick Pole.
Antæci.
Antichthones.
Antiæci.
Antipodes.
Antiſcii.
Arctick Circle.
Pole.
Aſcii.

B.

Biſſextile.
Boſphorus.
Burning Zone.

C.

Calendar.
Calends.
Callippick Period.
Cape.
Cherſoneſus.
Chorography.
Chronology.
Civil Year.
Climate.
Continent.
Coſmography.
Cycle of the Indiction.

D.

Degree of a great Circle.
Depreſſion of the Pole.
Diſtance of Places.
Dominical Letter.

E.

Earth.
Eclipſes.
Elevation of the Pole.
Emboliſm.
Epact.
Epocha.
Ephemeris.

Equation of Time.
Equator.
Equinoxes.

F.

Frozen Zone.

G.

Geographical Miles.
Geography.
Globe.
Golden Number.
*Gregorian* Year.
Gulf.

H.

Hegyra.
Height of the Pole.
Heteroſcii.
Horizon.
Hydrographical Charts.

I.

Ides.
Intercalary Days.
*Julian* Year.
Period.

L.

Latitude of a Place.
Leap Year.
Levant.
Longitude of a Place.
Lunar Cycle.
Months.
Luni-Solar-Year.

M.

Magnetical.
Meridional Diſtance.
Parts.
Miles.
Metonick Year.
Months.
Monſoons.

N.

Nadir.
Natural Day.
Nones.
Northern Signs.
Nycthemeron.

O.

Ocean.
Olympiad.

P.

Parallels of Latitude.
Peninſula.
Periæci.
Period.
Progrometer.
Periodical Month.
Periſcii.
Pole of the World.
Proceſſion of the Equinoxes.

R.

Rational } Horizon.
Real }
Receſſion of the Equinoxes.
Retroceſſion of the Equinoxes.

S.

Senſible Horizon.
Siderial Year.
Solar Year.
Solſtices.
Sunday Letter.
Syderial Year.
Synodical Month.

T.

Temperate Zone.
Terreſtrial Globe.
Torrid Zone.
Tropicks.
Twilight.

V.

Variation.
Viſible Horizon.
Vertical Circles.

W.

Winter Solſtice.

Y.

Year.

Z.

Zenith.
Zone.

## *CHYMISTRY.*

A.

A Brick.
Acetum Radicatum.
Acetum Philoſophorum.
Achamech.
Acids.
Active Principles.
Adaridge.
Adept. Adeptiſts.
Adiapherous.
Æs Uſtum.
Æthiops Minerale.
Alchymiſt.
Alembick.
Alcohol.
Algoret.
Alkaheſt.
Alkali.
Alkalizate Sp. of Wine.
Aludels.
Amalgama.
Amanſes.
Amouſes.
Anima Hepatis.
Saturni.
Animated Mercury.
Antihecticum Poterii.
Antimonium Diaphoreticum.
Medicamentorum.
Reſuſcitatum.
Aqua-fortis.
Aquila alba.
Arbor Dianæ.
Martis.
Arcanum.
Duplum.
Jovis.
Ardent Spirits.
Armoniack Salt.
Volatile Spirit.
Athanor.
Auripigmentum.
Aurum Fulminans.
Moſaicum.
Potabile.
Azoth.
Alman Furnace.
Athenatorium.



B.

Balon.
Balneum.
Mariæ.
Vaporis.
Arenæ.
Balſam.
of Jupiter.
of Sulphur.
Bamma.
Bezoardicum Minerale.
Joviale.
Martiale.
Bizmuth.
Body.
Bolonian Stone.
Bolt-head.
Butter of Antimony.
of Tin.

C.

Calcination.
of Copper.
Flints.
Lead.
Tin.
Vitriol.
Calx.
of Antimony.
Gold.
Caput Mortuum.
Cement.
Cementation.
Ceruſs.
Chalcanthum.
Chryſocoraunius Pulvis.
Chryſtal Mineral.
Chryſtals of Copper.
Tartar.
Silver.
Chryſtallization.
Chymia.
Chymiſtry.
Cinefaction.
Cinnabar.
of Antimony.
Circulate.
Circulatorium.
Circulus.
Crocus Martis.
Metallorum.
Cuppel.

D.

Damnata Terra.
Decrepitation.
Degrees of Fire.
Deliquium.
Depart.
Dephlegmated.
Dew of Vitriol.
*Diana*'s Tree.
Digeſtio Chymica.
Diſtillation.
Dome.
Double Veſſel.

E.

Elaboratory.
Elixir.
Empyreuma.
Enixum Sal.
Ens Primum.
Veneris.

Essence.
Essential Oil.
Essential Salt.
Esurine Salts.
Etherial Oil.
Evaporation.
Expression.
Express'd Oils.
Extract.

F.

Fermentation.
Filtration.
Fixed Nitre.
Flowers.
Flux Powder.
Fulminating Powder.
Fulmination.
Fumigatio Chymica.
Furnace.
Fusion.

G.

Gas.
Gilla Vitrioli.
Golden Sulphur of Antimony.
Granulation.
Gravelling Ashes.

H.

Helm.
Hermetical Philosophy.
Physick.
Seal.
Art.
Hypostatical Principles.

I.

Ignis Rotæ.
Incalescent Mercury.
Incorporate.
Infernal Stone.
Irradiation.

K.

Kingdom.

L.

Laborant.
Lac Lunæ.
Lapis Infernalis.
Prunellæ.
Medicamentosus.
Levigation.
Lingot.
Liquor of fixed Nitre.
Litharge.
Liver of Antimony.
Lixivious.
Lotion.
Luna Cornea.
Lutation.
Lute.

M.

Magistery.
of Bismuth.
Lead.
Scammony.
Tartar.
Magnesia Opallina.
Martial Regulus of Antimony.
Matrass.
Menstruum.
Peracutum.
Mercury.
Mercurius Dulcis.
Vitæ.
Minium.
Moors-head.
Mortify.
Muffle.

N.

Naked Fire.
Noctiluca.

O.

Offa Alba.
Oil.
of Philosophers.
Sulphur per Campanam.
Tartar per Deliquium.
Vitriol.

P.

Passive Principles.
Pelican.
Pellicle.
Peracutum Menstruum.
Per Minima.
Perpetual Caustick.
Philosophical Egg.
Phlegm.
of Vitriol.
Phosphorus.
Philosophers Tree.
Plumbum Ustum.
Præcipitate.
White.
Yellow.
Rosy.
Green.
Red.
Precipitation.
Principles.
Process.
Projection.
Prunellæ Sal.
Pulvis Fulminans.
Purification.
Pyrotechnick Art.
Pyrotechnia.

Q.

Quartation.

R.

Receivers.
Recipients.
Rectify.
Redintegration.
Red-Lead.
Refrigeratory.
Registers.
Regulus.
of Antimony.
Resina.
Retort.
Reverberate.
Reverberatory Furnace.
Revive.
Rostrum.

S.

Saccharum Saturni.
Saffron of Gold.
of Steel.
Salamanders Blood.
Sal Armoniac.
Circulatus.
Polychrestum.
Prunellæ.
Volatile Oleosum.
Salt.
Fix'd.
Volatile.
Essential.
Common.
of Saturn.
Steel.
Sulphur.
Tartar.
Stratification.
Sublimation.
Sublimate Corrosive.
Subliming Pots.
Sugar of Lead.
Sulphur.
Sulphureous Spirit of Vitriol.
Sulphur of Antimony.
Sympathetical Inks.
Sympathetick Powder.

T.

Tartar Emetick.
Soluble.
Vitriolate.
Terra Damnata.
Test.
Tincture.
Transmutation.
Tria Prima.
Turbith Mineral.

V.

Vaporosum Balneum.
Vesica.
Vitrification.
Vitriol of Copper.
Mats.
Silver.
Vitriolate Tartar.
Volatile Salt.
Spirit.
Urinous Salts.

W.

Water.
Wheel-fire.
White-Lead.
Worm.

## HERALDRY.

Abatement of Honour.
Accidence.
Agresses.
Amethist.
Ankred.
Annulet.
Argent.
Armed.
Armory.
Atchievement.
Attire.
Avelane.
Azure.

B.

Balls.
Ballets.
Barr.
Barrulet.
Barry Bendy.
Paly.

Base

Baſe Point.
Battoon.
Bear.
Beaſants.
Bend.
Bendlet.
Bendy.
Bevile.
Beſants.
Bezants.
Billet.
Blazoning.
Bordure.
Bottony.
Brace.
Brusk.

C.

Caboſed.
Canton.
Chapeau.
Chappe.
Charge.
Checky.
Chief.
Chevron.
Chevronel.
Cloſet.
Cogniſance.
Combatant.
Coſt.
Couchant.
Counter-changed.
componed.
paſſant.
ſalient.
tripping.
Couped.
Couple cloſe.
Coward.
Crenele.
Creſcent.
Creſt.
Croſs.
Croſlets.

Dancette
Debruiſed.
Delf.
Devouring.
Dexter.
Diaper.
Differences.
Diſplay'd.
Dormant.

E.

Embattelled.
Enalyron.
Endorſed.
Endorſe.
Engrailed.
Entoyre.
Enurny.
Eraſed.
Ermine.
Erminees.
Eſcutcheon of Pretence.
Eſcutcheon.

F.

Field.
Fer-du-Mouline.
Feſſe.
File.
Fillet.
Fimbriated.
Fitchee.
Flanche.
Flask.
Flory.
Formee.
Frett.
Furchee.
Furrs.
Fuſil.
Fuſilly.

G.

Garb.
Garter.
Gemelles.
Gobonated.
Gorged.
Guardant.
Gutte.
de l'Eau.
de l'Armes.
d' Or.
de Sang.
Gyron.

H.

Hauriant.
Heaume.
Heawme.
Honour Point.
Humid.
Hurts.

I.

Jeſſant.
Impaled.
Indented.
Ineſcutcheon.
Invected.
Iſſuant.

L.

Lioncells.
Lozenge.

M.

Mantle.
Martlet.
Marſhalling.
Maſcle.
Maunch.
Membred.
Moline, *a Croſs.*
Mound.
Mullet.

N.

Naiant.
Naiſſant.
Nebuloſe.
Nombril Point.

O.

Ogreſſes.
Or.
Ordinaries.
Orle.

P.

Pale.
Pall.
Pallet.
Paly.
Paly-bendy.
Paſſant.
Patee.
Patonce.
Pean.
Pellets.
Peirced.
Perforated.
Phæons.
Pile.
Plates.
Point in.
Points.
Point.
Campion.
Dexter.
Plain
in Point.
Potent.
Counter Potent.
Pretence.
Purliew.
Purpure.

Q.

Queen.

R.

Raguled.
Rampant.
Rebuſſes.
Regardant.
Ribbon.
Rundles.

S.

Sable.
Salient.
Saltier.
Sanguine.
Scarp.
Segreiant.
Sejant.
Shapournet.
Siniſter.
Supporters.
Surmounted.

T.

Tenny.
Timbre.
Tincture.
Toiſon d' Or.
Torce.
Torteauzes.
Tranche.
Traverſe.
Treſſure.
Tripping.

V

Vairy.
Copy.
Verdoy.
Verry.
Vert.
Voided.
Voider.

W.

Waved.
Wreath.

*ARCHI-*

# An Alphabetical INDEX

## ARCHITECTURE.


A.

ABacus.
Abreuroirs.
Acroteriæ.
Adz.
Alcove.
Amphiproſtyle.
Amphitheatre.
Anaglyptick Art.
Anchors.
Annulets.
Antæ.
Antes.
Anticks.
Antique.
Antipagments.
Apertions.
Apophyge.
Aquæduct.
Arches.
Architecture.
Architrave.
Areoſtyle.
Aſhlar.
Aſtragal.
Attick.

B.

Back and Bottom Nails.
Balliſter.
Balluſtrade.
Bandelet.
Bank.
Barbican.
Baſe.
Baſil.
Baſilica.
Baſs-Relief.
Baſton.
Batten.
Battlements.
Bend.
Beam.
Bearer.
Bed-moulding.
Binding Joiſts.
Boulting.
Brace.
Brads.
Breſt.
Sommers.
Bricks.
Building.
Butments.

C.

Cantilivers.
Capital.
Carcaſe.
Cantoures.
Cariatides.
Carſcade.
Caſting of Drapery.
Cathetus.
Cavette.
Chamber-Beam.
Chambranle.
Channel of the Ionick.
Chapiters.
Chapitrals.
Cima.
Cimatium.
Colonnade.
Column.
Compartition.
Conge.
Conſole.
Corbett.
*Corinthian* Order.
Cornich.
Coronæ.
Couch.
Coving Corniſh.
Crown Poſt.
Culvertail.
Cupulo.
Cymatium.
Cyncture.

D.

Dentils.
Dipteron.
Dome.
*Dorick* Order.
Dormant Free.
Dormer.
Double Aſpect.
Doucile.
Dove-tailing.
Dragon-Beams.
Drip.
Drops.
Dye.
Dypteron.

E.

Echinus.
Embraſure.
Epiſtyle.
Eves Lath.
Eye.

F.

Face.
Faſcia's.
Faſtigium.
Fillet.
Flutes.
Flat-Crown.
Flyers.
Foliage.
Fornication.
Furring.
Fuſarole.
Fuſh.

G.

Gable End of a Houſe.
Gain.
Girders.
Gorge.
Gothick Manner.
Grand Gaſto.
Ground Plates.
Groteſque Work.
Grouppe.
Gulte.
Guttæ.

H

Hances.
Hatching.
Heads.
Height of the Eye in Perſpective.
Hexaſtyle.
Hips.
Hip-Roof.
Hypethre.
Hypethron.
Hyperthyron.
Hypotrachelion.

I.

Ichnography.
Impoſts.
*Ionick* Order.
Iſles.
Intercolumniation.
Inter-Columns.

L.

Larmiers.
Layman.
Ledgers.
Line of the Section.
Liſt.
Liſtel.
Local Colours.
Lutheran Windows.

M.

Manner.
Maſſes.
Membretto.
Metopa.
Mitre.
Model.
Modillions.
Module.
Monotryglyph.
Moreſque } Work.
Moriſco }
Mortiſe.
Moſaick Work.
Munnions.
Mutule.

N.

Nave.
Newel.
Niche.
Nucleus.

O.

Obelisk.
Octoſtyle.
Order.
Ordonance.
Orle.
Ornaments.
Orthography.
Oval.

P.

Painting.
Pallier.
Pallification.
Paradigrammatice.
Paraſta.
Pargetting.
Pedeſtal.
Peers.
Periptere.
Periſtyle.
*Perſick* Order.
Perſpective.
Lineal.
Areal.
Practical.
Speculative.
Piazza's.

Piazza's.
Piedouche.
Pied-droit.
Pilæ.
Pillar.
Pillaſters.
Pitch.
Plancere.
Plane.
Plaſtice.
Plat-form.
Plinth.
Plot-bund.
Portico.
Portrails.
Prick Poſts.
Principal Poſts.
Prints.
Profile.
Projecture.
Pronaos.
Pſeudoppiteron.
Prychoſtyle.
Pulvinata.
Punchins.
Purlings.

Q.

Quarters.
Quirk.
Quoins.

R.

Rafters.
Raiſing Pieces.
Raked Table.
Reaſon.
Relief.
Relievo.
Reſon.
Repoſe.
Riglet.
*Roman* Order.

S.

Sapheta.
Scamilli Impares.
Scheme.
Scenography.
Scribing.
Scotia.
Scratch-Work.
Scrowles.
Sculpture.
Section of a Building.
Sell.
Skene.
Suffito.
Stucco.
Stereobata.
Stercography.
Stiles.
Striæ.
Striges.
Strutt.
Stylobata.
Stylobaton.
Stylobatum.
Symmetry.
Syſtyle.

T.

Table.
Projecting.
Raked.
Tænia.
Taille Douce.
Tailloir.
Talon.
Taſſels.
Teint.
Tenon.
Tetraſtyle.
Thorus.
Tige.
Tondino.
Tore.
Tornice.
Torus.
Trabeation.
Tranſom.
Triglyph.
Trimmers.
Tringle.
Trochyle.
Trophy.
*Tuſcan* Order.
Work.
Tympan.

V.

Veſſels.
Vivo.
Union.
Voluta.

W.

Water Table.
Winding-Stairs.

Z.

Zacco.
Zocco.
Zocle.
Zoperus.

---

*Hiſtory, Antient Cuſtoms,* &c.

A.

ABacot.
Abacy.
Abbat.
Aborigines.
Academy.
Acholite.
Acre of Land.
Advent.
Alba Firma.
Ale-Taſter.
Almoner.
Alnager.
Alterage.
Amabyr.
Amneſty.
Amphora.
Anachroniſm.
Angaria.
Angel.
Angild.
Annals.
Annalia.
Anniverſary.
Annualia.
Anomaly.
Archives.
Arch-Deacon.
Arch-Presbyter.
Arietum Levatio.

B.

Banneret.
Bedrip.
Beſantine.
Biſſextile.
Board Half-Peny.
Bordarii.
Bordlode.
Bordlands.
Boſphorus.
Bouge.
Bowche.
Bredewyte.

C.

Cade.
Calcage.
Caract.
Carke.
Carucate.
Caſtellorum Operatio.
Cert Money.
Chamberlain.
Chauntry.
Chorepiſcopi.
Chriſm.
Chriſom.
Chyrographum.
Clerk.
Clove.
Cocket.
Coins.
Conſervator.
Continent.
Coronare Filios.
Corſned.
Coſmography.
Cuſtumarius.

D.

Dakir.
Damnum.
Dane-Gelt.
Danger.
Day-Work of Land.
Deciners.
Decinniers.
Defend.
Denarii de Charitate.
Denarius.
Dom-Boc.
Domeſday-Book.
Drenches.
Drenges.
Drengage.

E.

Ealdermen.
Earl.
Earth.
Ebdomadarius.
Ember-Week.
Ember.
Embring-Days.
Englecery.
Epact.
Epocha.
Epiſcopaleonus.
Epiſcopalia.
Eſquire.
Eſterling.
Eſtovers.
Evenings.
Exaction Secular.
Exhibition.

Faggot.

# *An Alphabetical* INDEX


F.

Faggot.
Faldage.
Faldfey.
Fardles of Land.
Farding.
Fardingdeal.
Fafting-Men.
Feodary.
Firme.
Florens.
Folk-Land.
Folk-Mote.
Foot-Geld.
Formella.
Fortingles.
Foffatorum Operatio.
Fot Mell
Framgild.
Frozen Zone.

G.

Gabel.
Gainagium.
Gallehalpens.
Gar-fume.
Gavel-Bread.
Ceſter.
Earth.
Mede.
Rep.
Gavelling Men.
Geld.
Gemote.
General.
Gentleman.
Geographical Miles.
Geography.
George Noble.
Globe.
Graſs-hearth.
Groſs.
Gule of *Auguſt*.

H.

Habentes Homines.
Hadbote.
Hail-work Folk.
Hallage.
Haly-Mote.
Hambling.
Ham-ſoken.
Hand-borow.
Hand-Grith.
Hand-Habend.
Hang-wite.
Hanſe.
Harbinger.
Harmitage.
Haro.
Haw.
Headborow.
Head-Pence.
Hebber-Thef.
Hebdomadius.
Hedagium.
Herald.
Hermitorium.
Hey-bote.
Hidage.
Hide of Land.
Hoblers.
Hogen-hine.
Hoke-Day.
Homagium reddere.
Honour.
Courts.
Honorary Service.
Hoſpitallers.
Hundredi Secta.
Huſe-bote.
Hyde-Land.

I.

Icenild.
Ich Dien.
Ikenild-Street.

L.

Lacerta.
Lachrymatories.
Lada.
Lafords Wich.
Laga.
Lage Dayum.
Lagen.
Lagon.
Laſh-Bote.
Lammas-Day.
Land-Box.
Land-Cheap.
Land-Gable.
Landirecta.
Lanoniger.
Laſhlite.
Laſt.
Laſtage.
Lathe Latta.
Lath-Reeve.
Latrocinium.
Laurets.
Lawes.
Lea of Yarn.
Left-Silver.
*Levant*.
Libera.
Libertas Eccleſiaſtica.
Librata Terra.
Ligula.
Lourgulary.
Lundreſs.
Luſhburg. } Luſhborrow. }
Lyff-Yeld.

M.

Macegrief.
Mag-bote.
Maile.
Man-bote.
Manca.
Manuali Beneficia.
Manumiſſion.
Manu-opera.
Manu-paſtus.
Manu-pes.
Manus.
Marcheta Mulierum.
Marches.
Maritagium habere.
Mark.
Marqueſs.
Martyrology
Matricula.
Maund.
Metonick Year.
Menſals.
Menſalia.
Merchan Lage.
Merchetum.
Metteſhap.
Mint.
Mitred Abbots.
Mitta.
Molmutan } Laws.
Molmutin }
Moniers.
Month.
Monſoons.
Moors.
Mother Tongues.
Moveable Feaſts.
Multa.
Multura Epiſcopi.
Multones Auri.

N.

Natural.
Nones.
Nycthemeron.
Noble.
*Norroy*.
Nummata Terræ.

O.

Obedientia.
Obit.
Obituary.
Oblata.
Oblatæ.
Oblationes Altarii.
Funerales.
Obolus.
Ocean.
Octaves.
Oeconomicus.
Offertorium.
Olympyad.
Ora.
Ordeal.
Originalia.
Outfangthef.

P.

Pack of Wood.
Palls.
Pannage.
Pavimenta Teſſellata.
Peny.
Peny-Weight.
Peninſula.
Penſa.
Pentecoſtalia.
Perch.
Period.
Peſa.
Peſage.
*Peter*-Pence.
Picage.
Pleas of the Sword.
Plebania.
Plebanus.
Plebiſcitum.
Plow-Land.
Pocket of Wool.
Poleine.
Pollards.
Port Reeve.
Portiforium.

Port-mannimote.
Port-mote.
Pork-ſoken.
Pound.
Precaria.
Preceptory.
Presbyterium.
Prepoſitus Villæ.
Preſt-Money.
Preſtation Money.
Prodes Hommes.
Promontory.
Providence.
Proviſor.

Q.

Quadragata Terræ.
Quadrageſimals.
Quadrans.
Quadranta Terræ.
Quæſta.
Quarentine.
Quaſi-modo-Sunday.
Quinquageſima.
Quintal.
Quinque Portus.

R.

Rachat.
Radechiniſtors.
Radman.
Repe Towel.
Reaſonable Aid.
Rebellum.
Recluſe.
Recta Priſa Regis.
Rectatio.
Rectitudo.
Red Book of the *Exchequer*.
Reeve.
Refectory.
Referendary.
Regarders of the Foreſt.
Regius Profeſſor.
Rehabiliation.
Relief.
Rents of Aſſize.
Repoſition of the Foreſt.
Rep-Silver.
Reve.
Rod-Knights.
*Rome*-Scot.
Runcinus.
Rural Deans.

S.

Sac.
Saka.
Saccus cum Brochia.
Sack of Wool.
Sagibaro.
Salt Silver.
Salute.
Salus.
Sanctuary.
Sapler.
Scarage.
Scaragium.
Scata.
Sceppe.
Schar-peny,
Schire-mote,
Schire-wyte.
Scutage
Seme.
Summa.
Seneſchal.
Septuageſima.
Sexar.
Sheriff-Tooth.
Shilling.
Smoak-Ferthings.
Soveraign.
Stable.
Stand.
Stallage.
Starr.
Star Chamber.
Sterling Money.
Synodales Teſtes
Synodale Inſtrumentum.

T.

Taberders.
Tabitors.
Tallage.
Taxers.
Terræ.
Teſtamentales.
Teſſellata Pavimenta.
Teſtons.
Thane.
Theave.
Thrimſa.
Tod of Wool.
Trentels.
Tricennalia.
Trigentalia.
Trinoda-neceſſitas.
Terræ.
Tronage.
Tumbrell.
Troy-Weight.

V.

Valvaſor.
Vavaſor.
Virgate.
Uncuth.
Urbicariæ Regiones.
Utfangthef.

W.

Waga.
Wardage.
Wardecom.
Ward-peny.
Staff.
Warrecta Terra.
Warrectum.
Waſſel-Bowl.
Water Ordeal.
*Watling-Street*.
Weald.
Weight.
Wedbedrip.
Weights.
Wherlicots.
*Whitſon*-Farthings.
Wold.

Y.

Years-Day.
Mind.
Yeoman.

## ANATOMY.

A.

ABdomen.
Abductor Indicis.
Oculi.
Minimi digiti.
Pollicis.
Pollicis pedis.
Minimi digiti pedis.
Abductores.
Abducent Muſcles.
Abomaſus.
Abortion.
Abortive.
Acantha.
Acceleratores Urinæ.
Acceſſorius Willeſii.
Acetabulum.
Acini-formis Tunica.
Acromion.
Acromphalon.
Acros.
Adducent Muſcles.
Adductores.
Adductor Oculi.
Pollicis.
Pollicis pedis.
Aden.
Adeps.
Adipoſa Membrana.
Vena.
Adipoſi Ductus.
Adnata Tunica.
Aiſteterium.
Albuginea Oculi.
Teſtis.
Album Oculi.
Aiopecy.
Alphus.
Aliformes Muſculi.
Proceſſus.
Allantois.
Allantoides.
Almonds of the Ears.
Alopex.
Alvearium.
Amnion.
Amnios.
Amphileſtroides.
Amphibranchia.
Amphidæum.
Anaſtomoſis.
Anatomy.
Anchile.
Anchyle.
Ancon.
Anconæus.
Ancyroides.
Andratomy.
Androgyne.
Androgynus.
Animal Secretion.
Animation.
Aniſcalptor.
Annuates Muſculi.
Annular Cartilage.
Annularis Proceſſus.
Annular Protuberance.
Antagoniſta.

# An Alphabetical INDEX


Anthelix.
Antias.
Antiades.
Anticardium.
Antiperistaltick.
Antithenar.
Antitragus.
Anus.
Aorta.
Aperiens Palpebra rectus.
Aponeurosis.
Apophysis.
Appendicula Vermi-formis.
Aquæductus.
Aqualiculus.
Aqueous Humour.
Aranea Tunica.
Arcualia Ossa.
Areola Papillaris.
Arteria Bronchialis.
Venosa.
Vena.
Artery.
Arthrodia.
Arthrosis.
Articulation.
Arytænoideus.
Assimilation.
Atlas.
Attollens Auriculam.
Attollens Oculos.
Nares.
Attollentes Musculi.
Auditory Nerve.
Auriculæ Cordis.
Axillar Veins.
Arteries.
Axis.
Azugos.
Azygos.

B.

Balanus.
Barrel.
Basilare Os.
Basilica Vena.
Basio Glossum.
Basis.
Bathmis.
Belenoides.
Bibitorius Musculus.
Biceps.
Bile.
Biventer.
Bladder.
Blood.
Bones.
Brachiæus Externus.
Internus.
Brain.
Breasts.
Bregma.
Breve Vas.
Brevis.
Bronchus.
Buccinator.

C.

Cæcum Intestinum.
Calamus Scriptorius.
Calcaneus.
Calcis.
Calva.
Calx.
Canal.
Canini Dentes.
Caninus,
Canthus.
Capillary Vessels.
Capreolaria Vasa.
Capsulæ Communis.
Atrabilariæ.
Seminales.
Cardiacus Plexus.
Carina.
Caro.
Carotides.
Carpus.
Cartilage.
Cartilago Ensiformis.
Carunculæ.
Myrtiformes.
Oculi.
Papillares.
Cataclida.
Cava Vena.
Cellulæ Intestini.
Cephalica.
Cephalopharyngæi.
Cercis.
Cerea.
Cerebellum.
Cerebrum.
Cervical Arteries.
Cerumina.
Chalaza.
Choana.
Choledochus Ductus.
Chondrosyndesmus.
Chorda Membrana.
Tympani.
Chorion.
Chorides.
Chrystalline Humour of the Eye.
Chyle.
Chylification.
Chyli Receptaculum.
Chymus.
Cicatricula.
Cilia.
Ciliare Ligamentum.
Cion.
Circulation of the Blood.
Circumagentis Musculi.
Claudent Muscles.
Caviculæ.
Cleidion.
Clinoides.
Clitoris.
Clypeal Cartilage.
Coat.
Coccygis Os.
Coccygæus.
Coccyx.
Cochlea.
Cœcum Intestinum.
Coelia.
Cœliack Artery.
Cœlum.
Colliciæ.
Collum minus Uteri.
Colon.
Columnæ Cordis.
Columna Nasi.
Oris.
Columetta.
Commissura Crassioris Nervis æmula.
Common Receptacle of the Chyle.
Common Sensory.
Complexus.
Conarion.
Concha.
Condyli.
Condylomia.
Congeneres Musculi.
Conglobate.
Conglomerate.
Conjunctiva Tunica.
Conniventes Glandulæ.
Conoides.
Constrictor.
Constrictores.
Cor.
Coracobrachialis.
Coracoides.
Cornea Tunica Oculi.
Corona.
Cornua Uteri.
Cornicularis Processus.
Coronale Os.
Coronalis Sutura.
Coronaria Vasa.
Corone.
Corpora Carnosa.
Olivaria.
Pyramidalia.
Striata.
Corpus Callosum.
Glandulosum.
Corrugant Muscles.
Corrugator Supercilii.
Coryphe.
Costæ.
Cotyle.
Cotyledon.
Cotyledones.
Coxæ Os.
Coxendix.
Cranium.
Cremaster.
Cribrosum Os.
Cribrum Benedictum.
Cricoarytenoides.
Cricoides.
Cricothyroides.
Crista Galli.
Cristæ.
Crotaphick Artery.
Cruor.
Crura Medulla Oblongata.
Crural Artery.
Vein.
Crureus.
Crus.
Chrystalline Humour.
Chrystalloides Tunica.
Cubical Artery,
Cubi-forme.
Cubit.
Cubitæus Internus.
Externus.
Cubital Muscles.

Cuboides.
Cucullaris.
Cunei-forme Os.
Ossa.
Cutaneous Glands,
Vessels.
Cuticle.
Cutis.
Cyema.
Cymbæ-forme Os.
Cynodesmus.
Cynodentes.
Cysticæ Gemelli.
Cystis.
Choledous.

D.

Dartos.
Dartus.
Declivis (*Musculus.*)
Deferentia.
Deltoides.
Depressor.
Deprimens,
Auricularum,
Labii inferioris.
Labiorum,
Oculi.
Humilis.
Detrusor Urinæ.
Diæresis.
Diaphragm.
Diaphrattontes.
Diastole.
Digastrick Muscles.
Digastricus.
Digestion.
Digitorum Tensor.
Dilatation.
Dilatores Alarum.
Diploe.
Diffimilar Parts.
Dodecadactylon.
Dorsi Longissimus (*Musculus.*)
Dorsum.
Ductus Adiposi.
Alimentalis.
Bilarius.
Choledocus.
Epaticus.
Chyliferus.
Cysticus.
Pancreaticus.
Roriferus.
Salivales.
Thoracicus.
Umbilicalis.
Urinarius.
Duodenum.
Dura Mater.

E.

Ear.
Elevator Labii Inferioris.
Superioris.
Labiorum.
Oculi.
Elevatores.
Elythroides.
Embryotomy.
Emissary of a Gland.
Emporium.
Emulgents.
Emunctories.
Enarthrosis.
Encathis.
Encephalos.
Encranlum.
Ensi-formis Cartilago.
Enthrodes.
Epar.
Ephelæum.
Ephiptium.
Epidermis.
Epigastrick Artery.
Epigastrium.
Epiglottis.
Epigonasis.
Epiphysis.
Epiplois Dextra.
Sinistra,
Postica.
Epiploon.
Epision.
Episphæria.
Epistrophæus.
Epomis.
Erectores Penis.
Ethmoidalis.
Ethmoides.
*Eustachian* Tube.
Exanastomosis.
Extensor Carpi Radialis.
Extensor Carpi Ulnaris.
Indicis,
Primi Internodii.
Secundi Internodii.
Minimi Digiti.
Pollicis Pedis brevis.
longus.
Externus Auris.
Extravasated.
Eye.
-Lids.

F.

Fallopian Tubes.
Falx.
Farciminalis Tunica.
Fascia Lata.
Fascialis Musculus,
Fatt.
Fauces.
Femoreus.
Femur.
Fenestra Ovalis.
Rotunda.
Fibra Auris.
Fibræ.
Fibres.
Fibula.
Filaments.
Fistula Lacrymalis.
Pulmonis.
Sacra.
Urinaria.
Flesh.
Flexor Carpi Radialis.
Ulnaris.
Secundi Internodii digiti.
Tertii Internodii.
Pollicis pedis longus.
Primi & Secundi Ossis Pollicis.
Focile Majus.
Minus.
Focile.
Fodina.
Fœtus.
Folliculus Fellis.
Foramen Lacrymale.
Arteriæ duræ.
Matris Lacerum.
Fornix.
Fovea Cordis.
Frænulum.
Frænum.
Frontalis.
Frontis Os.
Funiculus Intestinorum.
Furcale Os.
Furcella.
Furcula Superior.

G.

Gall.
Bladder.
Galactophori.
Gargareon.
Gasterochnemium.
Gasterochnemius Externus.
Internus.
Gastero Epiploica.
Gemellus.
Gemini.
Geminous Arteries.
Gena Mala.
Generation.
Genioglossum.
Geniohyoideus.
Genitura.
Ginglimus.
Glacialis Humor.
Glandulæ Miliares.
Myrtiformes,
Sebaceæ.
Glands.
Glandula Pinealis.
Pituitaria.
Glandulæ Lumbares.
Odoriferæ.
Renales.
Glanduloſum Corpus.
Glandulosa Tunica.
Glassy Humour of the Eye.
Tunick of the Eye.
Glene.
Glenoides.
Globulus Nasi.
Glottis.
Glutæi.
Glutæus Major.
Minor.
Medius.
Glutia.
Glutos.
Gracilis.
Graphoides.
Gula.
Gullet.
Gurgulio.
Guttal Cartilage.
Guts.

H.

Hæmorrhoidal Veins.
Heart.
Helix.

Hepar.
Hepatica Vena.
Hircus.
Hirquus.
Homoplata.
Humerus.
Humilis.
Humours of the Eye.
Hyaloides.
Hydatoides.
Hymen.
Hyoides.
Hyothyroides.
Hyperoon.
Hypochondrium.
Hypogaſtrick Artery.
Hypogaſtrium.
Hypoſiloides.
Hypotenar.
Hypozoma.
Hypoſilogloſſus.

I.

Janitor.
Jecur.
Uterinum.
Jejunum Inteſtinum.
Ile.
Ilium.
Ilia.
Iliac Veſſels.
Iliacus Internus.
Ilium Os.
Inciſivus.
Inciſores Dentes.
Inciſivi.
Incus.
Indicator.
Indignatorius.
Indurantia.
Induſium.
Infimus Venter.
Infra-Spinatus.
Infundibulum Cerebri.
Renum.
Inguen.
Inium.
Inominata Tunica.
Oſſa.
Inominatus Humor.
Inoſculation.
Intercoſtal Arteries,
Veſſels.
Intercoſtales Externi,
Interni.
Interforaminium.
Internus Auris,
Interoſſei Manus.
Pedis.
Interſcapularia.
Interſpinales Colli.
Inteſtinales.
Involucrum Cordis.
Iſchias Major,
Minor.
Iſchium.
Ithmoidea Oſſa.
Jugale Os.
Jugular Veins.
Jugulum.

K.

Kidneys.

L.

Labyrinth,
Lacertus.
Lacrymæ.
Lacrymale Punctum.
Lacunæ.
Lamdoides.
Laminæ.
Latiſſimus Dorſi.
Leno.
Lentiform Prominences.
Lepidoides.
Levatores Ani.
Lien.
Ligamentum.
Ciliare.
Linea Alba.
Lingua.
Lingualis.
Liquidum Nervorum.
Liver.
Lobe.
Longanon.
Longiſſimus Pollicis,
Femoris.
Longus (*Muſculus*).
Cubiti,
Radii,
Tarſi,
Colli.
Lophia.
Lumbales Muſculi.
Lumbaris Vena.
Arteria.
Lumbrical Muſcles.
Lumbricales.
Lumbriculi Pedis.
Lungs.
Luxator Externus.
Lympha.
Lymphatick Veſſels.
Lymphæducts.

M.

Malleolus Pedis.
Mamma.
Mammary Veſſels.
Mammæ-formes Proceſſus.
Mandibula.
Marrow.
Marſupialis.
Maſſeters.
Maſtication.
Maſtoidei.
Mater Dura.
Tenuis.
Matrix.
Maxilla.
Superior,
Inferior.
Meatus Auditorius.
Urinarius.
Mediana Vena.
Mediaſtina.
Medius Venter.
Medulla Cerebri,
Oblongata,
Spinalis,
Oſſium.
Medullary Vein.
Membrana.
Muſculor. Communis
Adipoſa,
Carnoſa,
Nictitans.
Membrana Urinaria.
Membranoſus.
Memory.
Mendoſa Sutura.
Meninges.
Meninx.
Meſaraick Veins.
Meſaræum.
Meſentery.
Meſenterick Arteries.
Meſo-Colon,
Meſo-Pleuri.
Meta-Carpus.
Meta-Condyli.
Meta-Pedium,
Meta-Tarſus.
Miliares Glandulæ.
Mitrales Glandulæ.
Mola Gena.
Molares Dentes.
Monocolum.
Morſus Diaboli.
Motorii Muſculi Oculi.
Mucilaginous Glands.
Mucro Cordis
Mucronatum Os.
Muſcle.
Muſculus Stapidis.
Muſculus Tubæ Novus Valſalvæ,
Auriculæ Anterior,
Tragi,
Ante-Tragius.
Muſcle Vein.
Muſculus Nauticus.
Myelos.
Myloglosſum.
Mylohoideus.
Myodes Platiſma.
Myologia.
Myrach.
Myrinx.

N.

Naſalis Muſculus.
Naſi Os.
Nates Cerebri.
Naviculare Os.
Nerve.
Neurology,
Neurotomy.
Nictitans Membrana.
Nothæ Coſtæ.
Nucha.
Nuckianæ Glandulæ.
Nutrition.
Nymphæ.
Nymphatomy.

O.

Obelæ.
Obliquus (*Muſculus.*)
Inferior,
Superior,
Major,
Acclivis,
Aſcendens.
Auris.
Obturator Externus,
Internus.
Occipitalis.
Occipitis Os.
Occip. Frontal.
Oculus.

Oculorum Motores.
Odoniodes.
Oesophagus.
Oesophagæus.
Olecranon.
Olfactory Nerves.
Olivaria Corpora.
Omentum.
Omoplata.
Omphalmicus.
Optick Nerve.
Orbicular Bone.
Orbicularis.
Palpebra.
Orbiter Externus.
Internus.
Organical Part.
Organs.
Os.
Os Calcis.
Mali.
Unguis.
Occipitri.
Palati.
Sphænoides.
Tineæ.
Oscula.
Ossa Parietalia.
Tempora.
Osteologia.
Ovalis Fenestra.
Ovaria.
Oviductus.

P.

Palati Os.
Palato Salpingæus.
Staphyllinus.
Palatum.
Palmaris Brevis, } Musculus.
Longus, }
Palpebræ.
Pancreas.
Panniculus Carnosus.
Papilla.
Papillæ Intestinorum.
Papillarum Processus.
Parameſus.
Parastatæ.
Parencephalos.
Parenchymata.
Parenchymous.
Parietal Bones.
Paristmia.
Parotides.
Parvagum.
Parvum & Crassum.
Pathetick Nerves.
Pectineus.
Pectinis Os.
Pectoralis.
Pedium.
Pecten.
Pelvis.
Aurium.
Cerebri.
Renum.
Perforans Musculus.
Digitorum.
Pedum.
Perforatus.
Pedes.
Pericardium.
Pericranium.
Periophthalmium.
Perinæum.
Periodus Sanguinis.
Periostium.
Peristaltick Motion.
Peristaphylinus.
Peristerna.
Peristonæum.
Peritonæum.
Perona.
Peronæus Primus.
Secundus.
Petrosum Os.
Phalanx.
Pharyngetrum.
Pharynx.
Phyltrum.
Phrenes.
Phrenetick Veins.
Phrenick Vessels.
Pia Mater.
Pinealis Glandulæ.
Pinguedo.
Pinna Auris.
Pituitaria Glandula.
Placenta Uterina.
Plantaris.
Planta Pedis.
Pleura.
Plexus Choroides.
Nervosus.
Reticularis.
Pneumonica Vena.
Pomum Adami.
Pons Cerebri.
Poplitæa.
Poplitæus.
Porta Vena.
Porus Bilarius.
Primæ Viæ.
Pronator Radii Quadratus.
Teres.
Prostatæ.
Prostomia.
Psoas Magnus.
Parvus.
Pterigo Palatinus.
Pharingæus.
Staphilinus Externus.
Internus.
Pterigium.
Pterygoideus.
Pterystaphilini.
Pubis Os.
Pulmonaria Arteria.
Vena.
Pulmonary Vessels.
Pulmones.
Punctum Lachrymale.
Saliens.
Pupilla.
Puppis Vena.
Pylorus.
Pyramidales.
Pyramidalis Musculus.
Pyri-formis Musculus.

Q.

Quadratus Femoris.
Genæ.
Lumborum.
Quadragemini.

R.

Rabdoides.
Rachitæ.
Radiales.
Ramifications.
Ramus Anterior.
Posterior.
Ranula.
Ranulares.
Rapha.
Rasetta.
Receptaculum Chyli.
Receptacle of the Chyle.
Recti Minores.
Rectum Intestinum.
Rectus internus Major.
Minor.
Rectus Lateralis.
Major.
Musculus.
Palebræ Superioris.
Recurrent Nerves.
Regio.
Renal Artery.
Respiration.
Rete Mirabile.
Reticularis Plexus.
Reticulum.
Retiformis Plexus.
Tunica.
Retina.
Retractores Alarum.
Retrahens Auriculam.
Right Muscles of the Head.
Rinæus.
Roriferus Ductus.
Rostriformes Processus.
Rotator Femoris Major.
Minor.
Rotula.
Rotundus.

S.

Sacculus Chyliferus.
Cordis.
Saccus.
Sacer Musculus.
Sacro Lumbalis.
Sacrum Os.
Sagittalis Sutura.
Saliva.
Salvatella.
Sanguification.
Saphæna.
Sartorius.
Scaleni.
Scapha.
Scaphoides.
Scapularis Externus.
Internus.
Sclerotica Tunica.
Scrobiculus Cordis.
Scutiforme Os.
Scutum.
Scyphos.
Seeing.
Secretion.
Secundinæ.
Segmoidales.
Sella Equina.

Semi-

Semi-Lunares Valvulæ.
Semi-Membranoſus.
Spinatus.
Tendinoſus.
Senſorium Commune.
Septum Cordis.
Lucidum.
Tranſverſum.
Serratus Anticus Major.
Minor.
Poſticus Inferior.
Superior.
Serum.
Seſamoidea Oſſa.
Sigmoides.
Similar Parts.
Sinciput.
Sinus.
Meningium.
Oſſium.
Skeleton.
Skin.
Soleus.
Speculum Lucidum.
Oculi.
Spermatick Veſſels.
Sphænoidalis Sutura.
Sphænoides.
Sphænopalatinus.
Sphænopharingæus.
Sphenois.
Shænopterigo-Palatinus.
Spagitides.
Sphincter.
Ani.
Gulæ.
Veſicæ.
Spina Dorſi.
Spinalis Colli.
Medulla.
Spine.
Spirits Animal.
Spleen.
Splenetick Artery.
Spongeoidea Vaſa.
Spuriæ.
Stapes.
Sternohyoides.
Sternothyroides.
Sternum Os.
Stomach.
Stomachus.
Stylo-Chondro-Hoidæus.
Styloceratohyoides.
Styloeides.
Stylogloſſum.
Stylohyoideus.
Stylopharingæus.
Subcartilagineum.
Subclavian Veſſels.
Subclavius.
Subcutaneus.
Sublimis.
Sublinguales.
Subſcapularis.
Subſtantia Corticalis.
Succenturiati Renes.
Succus Pancreaticus.
Sudor.
Sunarthroſis.
Superbus Muſculus.
Supercilium.
Superfœtation.
Superſcapularis.
Supinator Radii Brevis.
Longus.
Supra-Spinatus.
Scapularis.
Sura.
Suralis.
Sural Vein.
Suſpenſor Teſticuli.
Suſpenſorium.
Sutura.
Oſſium.
Sweet-Bread.
Synarthroſis.
Synchondroſis.
Syneuroſis.
Syntenoſis.
Syntheſis.
Synymenſis.
Syſtole.

T.

Talus.
Tarſus.
Teeth.
Temporalis Muſc.
Temporalia Oſſa.
Tenar.
Tendon.
Tenſors.
Terebrum.
Teres Major.
Minor.
Terſor.
Teſtes.
Cerebri.
Tetragonus.
Thalami Opticorum Nervorum.
Thenor.
Thorax.
Thymus.
Thyroarytænoides.
Thyreodæte.
Thyreoſtaphilinus.
Thyroideæ Gland.
Tibia.
Tibialis Anticus.
Poſticus.
Tonſillæ.
Torcular Herophili.
Trachæa.
Tragus.
Tranſverſalis Colli.
Muſculus.
Pedis.
Penis.
Sutura.
Trapezius.
Triangulare Officulum.
Triangularis.
Triceps.
Tricuſpides.
Trigeminum.
Trochanter.
Trochlea.
Trochlearis.
Tunicle.
Tubæ Fallopianæ.
Euſtachianæ.
Tubuli Lactiferi.
Tunica Vaginalis.
Tympanum.

V.

Vaginalis Gulæ.
Tunica.
Valvula Major.
Valves.
Valvulæ Conniventes.
Varicoſum Corpus.
Vas breve.
Vaſa.
Deferentia.
Lactea.
Lymphatica.
Vaſti Muſculi.
Vaſtus.
Vaſtus Externus.
Internus.
Vein.
Venæ Lacteæ.
Lymphaticæ.
Pneumonicæ.
Præputii.
Venter Infimus.
Venters.
Ventres.
Ventricle.
Ventriculus.
Ventriculi Cerebri.
Cordis.
Vermiculares.
Vermiformis Proceſſus.
Vertebræ.
Vertex.
Veſica Urinaria.
Veſicula Follis.
Veſiculæ Seminales.
Veſpertilionum Alæ.
Veſtibulum.
Vibriſſæ.
Viſcera.
Viſion.
Viſorious Nervus.
Vitrious Humours.
Tunicle.
Ulna.
Umbelical Region.
Veſſels.
Umbelicus.
Unguis.
Vocal Nerves.
Volvulus.
Vomer.
Urachus.
Ureter.
Urethra.
Uterus.
Uva.
Uvea Membrana.
Uvigena.
Uvula.

W.

Watry Humour.

X.

Xyphoides.

Z.

Zootomy,
Zugomaticus.
Zygoma.
Zygomaticum.

*Painting* and *Sculpture.*

A.

ALtitude of the Eye.
Attitudes.
Aſpect Double.

B.

Baſs-Relief.
Buſt.

C.

Cariatides.
Carnation.
Cartons.
Cement.
Claro-Obſcuro.
Compartment.
Contours.
Caſting of Drapery.
Compoſition.
Contraſt.
Crayons.

D.

Decorum.
Degradation.
Deſſein.
Deſign.
Diſtemper.
Drapery.
Diſtance of the Eye.
Double Aſpect.

E.

Etching.
Eaſil-Pieces.
Extremities.

F.

Freſco.

G.

Grand Guſto.
Groteſque Work.
Grouppe.

H.

Hatching.
Height of the Eye.

I.

Ichnography.

L.

Layman.
Line of the Section in Perſpective.
Local Colours.

M.

Manner.
Maſſes.
Moreſque Work.

O.

Ordonnance.
Orthographick View.

P.

Perſpective.
Aerial.
Lineal.
Practical.
Speculative.
Plane.
Plaſtice.
Pourtraits.
Prints.
Profile.

R.

Relief.
Repoſe.

S.

Scenography.
Symmetry.
Sculpture.
Stucco.

T.

Taille Douce.
Teint.

U.

Union.

*Agriculture* and *Hortulane Terms.*

A.

ABlactation.
Ablaqueation.
Abnodation.
Agriculture.
Ampelite.
Averruncation.

C.

Carbunculation.

*Opticks* and *Perſpective.*

A.

ACidental Point.
Altitude of the Eye.
Anacampticks.
Anaclaticks.
Angle of Incidence.
Reflection.
Refraction.
Refracted.
Aperture.
Apparent Place.
Axis.

B.

Broken Ray.
Burning Glaſs.

C.

Camera Obſcura.
Catacauſticks; *or,*
Cauſticks by Reflection.
Catadioptrical Teleſcope.
Cathetus.
of Incidence.
of Reflection.
Cauſtick Curves.
Common Axis.
Ray.
Concave Glaſſes.
Cone of Rays.
Confuſed Viſion.
Converging Rays.

D.

Darkned Room.
Tent.
Dioptricks.
Direct Ray.
Diſtance of the Eye.
Diſtinct Baſe.
Viſion.
Divergence Point.
Diverging Rays.
Double Aſpect.

F.

Faint Viſion.
Focus.
Virtual.
Front.
Line.

H.

Height of the Eye.
Horopter.
Horizontal Line.

I.

Ichnography.
Image.
Incidence.
Incident Point.
Ray.
Inclination of a Ray.
Inflection.

L.

Lens.
Line Horizontal.
Geometrical.
Terreſtrial.
of the Front.
Vertical.
of the Station.
Objective.
Section.
Locus Apparens.

M.

Magick Lantern.
Mean Axis.
Meniſcus Glaſs.
Microſcope.

O.

Object Glaſs.
Obſcura Camera.
Opticks.
Optick-Glaſſes.
Pyramid.
Triangle.

P.

Parallel Rays.
Pencil of Rays.
Plane of the Horopter.
Reflection.
Refraction.
Geometrical.
Vertical.
Perſpective.
Lineal.
Aerial.
Practical.
Speculative.
Plane of the Projection.
Point of Concourſe.
Divergence.
Incidence.
Principal.
Pole of a Glaſs.
Presbitæ.
Principal Ray.
Point.
Priſm.

R.

Radiation.
Rainbow.
Ray Common.

# *An Alphabetical* INDEX


Ray Direct
of Incidence.
Reflection.
Rays Convergent.
Divergent.
Parallel.
Reflection.
Reflected Ray.
Reflecting Telescope.
Refraction.
Refracted Angle.
Refraction from the Perpendicular.
to the Perpendicular.

S.

Scenography.
Sciography.
Sciopticks.
Sensible Point.
Species Visibiles.
Scenographick Projection.
Similar Light.

T.

Table.
Projecting.
Raked.
Telescopes.
Aerial.
Reflecting.

V.

Vertex of a Glass.
Vertical Line.
Plane.
Virtual Focus.
Visible Species.
Vision.
Visual Angle.
Point.
Rays.


## *Botany, Natural History,* and *Meteorology,* &c.


A.

AByss.
Acidulæ.
Acrospire.
Æther.
Æschynomenous Plants.
Air.
Ala.
Alabastrum.
Animals.
Animalcula.
Antheræ.
Anthology.
Apetalous.
Apices.
Aquatick.
Aquatile.
Arboreous.
Arborist.
Attire.
Aurelia.
Arista.
Asparagus.
Asperifoliate.
Atmosphere.
of Consistent Bodies.
Auripigmentum.
Aurora Borealis.
Awme.

B.

Bacciferous.
Baccivorus Creature.
Birds.
Bivalves.
Blood.
Botanicks.
Botanist.
Botany.
Bulbous Roots.
Bulbus.

C.

Calyx.
Capillamenta.
Capillary Plants.
Capitatæ Plantæ.
Capitulum.
Capræ Saltantes.
Capreolus.
Capreolatæ Plantæ.
Capsula Seminalis.
Capsulate Plants.
Carbunculation.
Carina.
Caro.
*Castor* and *Pollux.*
Cauliferous Herbs.
Caulis.
Chrysalis.
Chives.
Cirri.
Claspers.
Compounded Flower.
Coniferous Plants.
Convolution.
Cor.
Corniculate Plants.
Corpuscles.
Croci.
Corymbus.
Corymbiferous.
Culmiferous.
Culmus.
Currents.
Cyma.

D.

Damps in Mines.
Deciduous Flowers.
Defluvium.
Deterration.
Dew.
Diaphaneity.
Difform Flowers.
Digitatum Folium.
Discus.
Dissimilar Leaves.
Dorsiparous Plants.
Draco-Volans.

E.

Earth.
Earthquakes.
Ebbing and Flowing of the Sea.
Echinus.
Empalement.
Epiphyllospermous.
Equinus Barbatus.
Equivocal Generation.

F.

Faculæ.
Ferrugineous Waters.
Fishes.
Flower of a Plant.
Fluores.
Flux and Reflux of the Sea.
Foliation.
Folliculus.
Formed Stones.
Fossils.
Frontatum.
Frumentaceous.
Fundus Plantæ.

G.

Gemma.
Geniculum.
Glans.
Gramineous Herbs.
Gregarious Birds.

H.

Hail.
Halo.
Halo's.
Harmitan.
Hippeus.
Hurrican.
Hypophyllospermous.

I.

Ice.
Ignis Fatuus.
Imbricated.
Inoculation.
Imperfect Flowers.
Plants.
Insitio.
Internodium.
Juba.
Julus.

L.

Lampadias.
Lead.
Legumen.
Legumeneous Plants.
*Levant.*
Load-stone.
Loculamentum.
Lonchites.
Locustæ.

M.

Maculæ Solares.
Magnet.
Magnetism.
Malleolus.
Marchasite.
Medulla, Cor.
of a Plant.
Mercury.
Metals and Minerals.
Meteors.
Mimosæ Plantæ.
Monopetalous Flower.
Monsoons.
Mudsuckers.

N

Natural History.
Necydalus.
Nervus.
Nitre.
Nucamentum.
Nuciferous Plants.
Nucleus.
Nympha.

O.
Oculus.
Officulum.
P.
Panicula.
Papillionaceous Flower.
Pappoſe.
Pappus.
Paraſelene.
Paraſytical Plants.
Parhelii.
Particles.
Pediculus.
Pennata Folia.
Pelagiæ.
Petala.
Petrifaction.
Pinnata Folia.
Piſcivorous Animals.
Pithias.
Plants.
Plume.
Polypetalous.
Polyſpermæ.
Pomiferous Plants.
Herbs.
Pruniferous Trees.
Pryan Tin.
Pudicæ Plantæ.
Q.
Quadrupeds.
R.
Radicle.
Rainbow.
Rays of Light.
Roots of Plants.
Rubigo.
S.
Sagitta.
Salt.
Scapus.
Semets.
Seminal Leaves.
Senſitive Plants.
Siliqua.
Silver.
Snow.
Solidity.
Sound.
Spots in the Sun.
Springs and Fountains.
Stalactitæ.
Stamina.
Stamineous.
Stellatæ Plantæ.
Stile.
Stoloneſis.
Stones.
Strata.
Striæ.
Style.
Suffrutex.
Sulphur.
T.
Tergiſœtus.
Tetrapetalous.
Thermæ.
Thunder.
Thyrſus.
Tides.
Tornado.
Trees.
Trunk Roots.
Tuber.
Tuberous.
Tubuli Vermiculares.
Turriones.
V.
Vaſculiferous.
Vegetables.
Vermiculation.
Verticillate Plants.
Veru.
Villi.
Virgæ.
Vitriol.
Viviparous Animals.
Umbeliferous Plants.
Uniform Flowers.
W.
Water.
Waves of the Sea.
Wind.
X.
Xiphias.

## LAW,
*Common, Civil,* and *Canon.*

A.
Abactors.
Abalienation.
Abate.
Abator.
Abrochment.
Abdication.
Abdicere.
Abettors.
Abeyance.
Abiſherifing.
Abjuration.
Abolition.
Abrenunciation.
Abridgment.
Abrogate.
Abrogation.
Abſolute.
Abſtenſion.
Abuttals.
Accedas ad Curiam, (*a Writ.*)
Vice-Comitem, (*a Writ*)
Acceptance.
Acceptilation.
Acceſſary.
Account.
Accord.
Acquietandis Plægiis.
Acquietantia de Shiris & Hundredis.
Acquittal.
Acquittance.
Action.
of a Writ.
upon the Caſe.
mix'd.
upon the Statute.
Perſonal.
Real.
Action Popular.
Civil.
Penal.
Prejudicial.
Anceſtral.
Actor
Actuary.
Addictio in Diem.
Addiction.
Addition.
Ad Inquirendum, (*a Writ.*)
Adjournment.
Adjudge.
Ad Jura Regis.
Admeaſurement.
Adminiſtration.
Adminiſtrator.
Admittendo Clerico.
Admittendo in Socium.
Ad quod Damnum.
Adramire.
Ad Terminum qui præteriit.
Ad Ventrem inſpiciendum.
Adventitia Bona.
Advocates.
Advocatione Decimarum.
Advowell.
Advower.
Advowſon.
Ætate Probanda, (*a Writ.*)
Affeerors.
Affiance.
Affidavit.
Afforeſt.
Affray.
Affrayment.
Age.
Ageprier.
Agent and Patient.
Aggreſſor.
Agild.
Agiſt.
Agiſters.
Agiſtors.
Agnation.
Aid.
Aile.
Alba Firma.
Ale-Taſter.
Alien.
Alienation.
Alimony.
Allegiance.
Allegation.
Allegiare.
Aller ſans jour.
Alliance.
Allocatione facienda.
Allocation.
Allodial.
Allodium.
Alterage.
Alto & Baſſo.
Ambi-dexter.
Amendment.
Amercement.
Royal.
Amittere Legem Terræ.
Amneſty.
Amortiſe.



Ampli-

Ampliation.
Amy.
Anarchy.
Anceſtor.
Anchorage.
Ancient Demeſne.
Angaria.
Angild.
Anhelote.
Aniente.
Anjour and Waſte.
Annates.
Anniented.
Annua Penſione.
Annualia.
Annuity.
Anoyſance.
Antinomy.
Apertura Feudi.
Apoſtata Capiendo.
Apoſtare Leges.
Appeal.
Appellant.
Appellor.
Appendants.
Appertinences.
Apportum.
Apportionment.
Appoſale.
Apprendre.
Appropriare Communem.
Honorem.
Appropriation.
Approvement.
Approvers.
Appurtenances.
Arbitrator.
Arbitrement.
Arch-Deacon.
Arches.
Arraign.
Array.
Arrentation.
Arrearages.
Arreſt.
Arreſtandis.
Arreſtando.
Arreſted.
Aſſart.
Aſſault.
Aſſets.
Aſſign { in Deed. / in Law. }
Aſſiſa cadere.
Magna.
Judicium.
Nocumentis.
Continuando.
Proroganda.
de Mort d'Anceſtor.
Aſſize.
d'Arrain Preſentment.
of Novel Diſſeizin.
of the Foreſt.
of Bread and Beer.
Aſſociation.
Aſſoyle.
Aſſumpſit.
Attachimenta Bonorum.
de Spinis & Boſco.
Attachments.
Attachment of Privilege.
Attachment Foreign.
Attachment of Foreſt.
Attaindure.
Attaint.
Attainted.
Attainder by Proceſs.
Attendant.
Attornato Faciendo *vel* Recipiendo.
Attornment.
Attorney.
Audience Court.
Averdupois.
Audiendo & Terminando.
Audita Querela.
Auditor.
Auditors.
of the Receipts.
Ave.
Aventure.
Average.
Averiis captis in Withernam.
Averment.
Averpeny.
Augmentation.
Aumone.
Avowee.
Avowry.
Authenticks.
Auxilium Curiæ.
Auxiliun ad Filium Militem faciendum.
Auxilium petere.
Regis.
Vice-Comitum.
Award.
Ayde.
Ayel.
Ayſiamenta.

B.

Baccerind Thief.
Badger.
Baile.
Bailement.
Bailiff.
Bailiff Errant.
Bailiff Franchiſes.
Bailiwick.
Ballivo Amovendo.
Ban.
Bank.
Bankrupt.
Bannimus.
Bargain.
Baron.
Baron and Femme.
Barr.
Barſee.
Barretor.
Barretry.
Barriſters.
Baſſe Fee.
Court.
Tenure.
Baſilical Conſtitutions.
Batchellors.
Battel.
Battery.
Beadle.
Beaupleaders.
Benefices.
Beneficio primo Eccleſ. habend.
Benevolentia.
Beneficiarum Cedendarum Act.
Beneficium Diviſoris.
Ordinis.
Beſaile.
Bigamy.
Bilanciis Deferendis.
Bilinguis.
Bill.
of Store.
of Sufferance.
Billa vera.
Biſhop.
Black-mail.
Black Rod.
Blench.
Blood-wit.
Bloody-Hand.
Bock-land.
Bona Notabilia.
Patria.
Bonis non Amovendis.
Bord-Lands.
Borough *Engliſh*.
Borow, Borough, *or* Burgh.
Borow-Head.
Bottomry.
Bredwite.
Breve.
Breve Perquirere.
Breve Recto.
Brevibus & Rotulis liberandis.
Bribers.
Brief.
Broad Half-peny.
Brugbote.
Bulſe.
Burbreach.
Burgage.
Burg-bote.
Burg-mote.
Burglary.
By-Laws.

C.

Canon
Common } Law.
Civil
Cape Parvum.
Cape ad Valentiam.
Capias.
Capias conductos ad Profiſc.
Capias Profine.
ad ſatisfaciend.
Utlegatum.
in Withernam de Homine.
de Averiis.
Caption.
Caſu conſimili.
Caſu proviſo.
Catallis Captis.
Reddendis.
Cauſa Matrimonii Prelocuti.
Cauſam nobis ſignifices.
Cautione admittenda.
Cepi Corpus.
Certificate.
Certification of Aſſize.
of Novel Diſſeiſin.
de Recogn. Stapul.
Certifi-

Ceritficando de Recognitione.
Certiorari.
Ceſſavit.
Ceſſion.
Ceſſionary.
Ceſſor.
Challenge.
Champarty.
Champion of the King.
Chancellor of the *Exchequer.*
Chancellor of the Dutchy of *Lancaſter.*
*Chancery.*
Chance-Medly.
Chapel.
Chapters.
Charta Pardonationi ſe Defend.
Charta Pardonationis Utlegariæ.
Charter.
Party.
Land.
Chartis Reddendis.
Chafe-Wax.
Chattels.
Chicanry.
Chirographer.
Chivalry.
Church-Scot.
Circuity of Action.
Civil.
Law.
Clamea admittenda in itinere Atturnatum.
Clarigatio.
Clauſum fregit.
Clerico admittendo.
capto per Stat. Mercat.
convicto Commiſſ. Eccleſ.
infra Sacros Ordines, *&c.*
Clerk.
Controuler.
of the Acts.
of Aſſize.
of the *Cheque.*
of the Crown.
of the Crown in *Chancery.*
of the Errors in the *King's-Bench.*
of the Errors in the *Exchequ.*
of the Errors in the *Common Pleas.*
of the Eſſoigns.
of the Extracts.
of the Hanaper.
of the Juries.
of the Wardrobe.
of the King's Silver.
of the Market.
Marſhal of the King's Houſe.
of the Nichils.
of the Outlawries.
of the Parliament.
of the Peace.
of the Pell.
of the Petty-Bag.
of the Pipe.
of the Pleas.
of the Privy-Seal.
of Sewers.
of the Signet.
Clerk of the Treaſury.
of the Warrants.
Cocket.
Code.
Codicil.
Cofferer.
Cognatione.
Cogniſance.
Cogniſee.
Cogniſor.
Cognitionibus mittendis.
Collateral Aſſurance.
Collatione facta uni poſt mortem alterius.
Collatione Heremitagii.
Collation.
Collegiate Churches.
Colluſion.
Colour of Office.
Com-Barons.
Commendam.
Common.
Common-Pleas.
Communi Cuſtodia.
Communia Placita non tenenda. in Soccaria.
Compertorium.
Computo.
Confiſcate.
Conjuratione.
Conſiſtory.
Conſpiratione.
Conſtable.
Conſtat.
Conſtitum.
Conſtitutions.
Conſultation.
Contentment.
Continual Claim.
Continuando Tranſgreſs.
Contraband Goods.
Contract.
Contra formam Collationis.
Contra formam Feoffamenti.
Contramandatio Placiti.
Contributione facienda.
Controller.
Conventio.
Convention.
Convict.
Convocation.
Conuſant.
Coperceners.
Copia Libelli deliberando.
Copy-hold.
Coram non Judice.
Corodio habendo.
Coronatore eligendo.
Coroner.
Corporation.
Corpus cum Cauſa.
Corrector of the Staple.
Coſenage.
Coſhering.
Covenants.
Covertures.
Covine.
Counts.
Counter-Plea.
Counting-Houſe.
County-Court.
Courts.
Court-Baron.
Court of Chivalry.
Delegates.
Peculiars.
Requeſts.
Courteſy of *England.*
Couteulaugh.
Cranage.
Cui ante Divortium.
in Vita.
Culprit.
Curator.
Curia.
aviſare vult.
claudenda.
Curſitor.
Cuſtode admittendo & amovendo.
Cuſtodes Libertatis Angliæ authoritate Parliamenti.
Cuſtom.
Cuſtoms and Services.
Cuſtos Brevium.
Placitorum Coronæ.
Rotulorum.
Spiritualium.
Temporalium.
Cutter of the Tallies.

D.

Damage.
Clear.
Feaſant.
*Darreine.*
Dative Tutelage.
Day.
Days in Bank.
Dean.
Rural.
De bene eſſe.
Debenture.
Debito.
Debet & Solet.
Decem Tales.
Deceptione.
Decies tantum.
Decimis ſolvendis.
Declaration.
Decree.
Decretals.
De Deoneranda pro Rato Portionis.
Dedi.
Dedimus Poteſtatem.
Deeds.
De Eſſendo quietum de Tolonio.
Deemſters.
De Expenſis Militum.
Default.
Defeizance.
Defendant.
Defendemus.
Deforcement.
Deforceor.
Degrading.
Deforciatio.
Delegates.
Delegation.
Demain.
Demeſne.
Demandant.
Demiſe.

Democracy.
Demurrer.
Denizen.
Deodand.
Departer.
Departure.
Departure in Deſpight of the Court.
Depoſition.
Depoſitum.
Deprivation.
De quibus ſur Diſſei.
Deraigne.
Derelicts.
Deſcent.
De ſon Tort Demeſne.
Deſpotick.
Debt *or* Debts.
Detinue.
Devaſtaverint Bona Teſtatoris.
Devenerunt.
Deviſe.
Diem clauſit extremum.
Dies Datus.
Dieu ſon Act.
Digeſt.
Dilapidation.
Dimiſſory Letters.
Diſability.
Diſcent.
Diſclaimer.
Diſcontinuance,
Diſcontinuance of Poſſeſſion of Plea or Proceſs.
Diſmes.
Diſparage in.
Diſpaupered.
Diſpenſation.
Diſſeiſin.
Diſſeiſin upon Diſſeiſin,
Diſtreſs.
Diſtringuas.
Divorce.
Docket.
Dominicum.
Domo reparanda.
Dote aſſignanda.
Dote unde nihil habet.
Double Plea.
Quarrel.
Dower.
Ducestecum.
Dum fuit intra ætatem.
Dum fuit non compos mentis.
Duplex Querela.
Duplicate.
Dureſſe.

E.

Eaſements.
Edict.
Ejectione Cuſtodiæ.
firmæ.
Eire *or* Eyre.
Election de Clerk.
Elopement.
Emancipation.
Emblements.
Embraceur.
Embracery.
Emendatio.
Panni.
Emendatio Panis & Cereviſiæ.
Empannel.
Emparlance.
Emphyteuſis.
Emphyteata.
Emptio, Venditio.
Encheſon.
Encroachment.
Enditement.
Endorſe.
Endowment.
Enfranchiſe.
Enqueſt.
Entayle.
Enterpleder.
Entire Tenancy.
Entruſion.
de Gard.
Entry.
Entry ad Communem Legem.
Entry ad Terminum qui præteriit.
Entry causa Matrimonii prælocuti.
Entry in Caſu Proviſo.
Conſimili.
Entry ſine aſſenſu Capitali,
Enure.
Eques Auratus.
Equity.
Errant.
Error.
Eſcambio.
Eſcape.
Eſcheat.
Eſcheator.
Eſnecy.
Eſpicurnantia.
Eſplees.
Eſſendi Quietum.
Eſſoigne.
Eſtrangers.
Eſtray.
Eſtreat.
Eſtoppel.
Eſtrepe.
Etate probanda.
Eviction.
Examiners in *Chancery*.
Exception.
Exchange.
*Exchequer*.
Excommunicato Capiendo.
Deliberando.
Recipiendo.
Execution.
Executione facienda.
Executione in Withernam.
Executor.
Executor de ſon Tort.
Exemplifications of Letters Patents.
Exemplificatione.
Ex Gravi Querela.
Exhibit.
Exigendary.
Exigent.
Exigenter.
Ex mero motu.
Ex Officio.
Exoneratione Sectæ.
Ex Parte Talis.
Expectant Fee.
Expenſis militum Levandis.
non Levandis.
Ex Promiſſor.
Extend.
Extendi facias.
Extent.
Extirpatione.
Extinguiſhment.
Extortion.
Extra-Judicial.

F.

Fabrick Laws.
Faculty.
Fait.
Falſe Claim.
Impriſonment.
Falſo Judicio.
Falſo retorno Brevium.
Failing of Record.
Faint-pleader.
Fealty.
Fee.
Abſolute,
Conditional.
General.
Tail Special.
Fee-Farm.
Fee-Simple.
Fee-Tail.
Felo de ſe.
Felony.
Feod.
Feodary.
Feoffee.
Feoffment.
Feoffer.
Feude.
Feudes.
Fieri facias.
Filacer.
Fine.
adnullando Levato.
capiendo de Terris.
Force.
levando de Tenementis.
non Capiendo pulchre.
Placitando.
pro Rediſſeiſina capienda.
Fines for Alienation.
Firſt Fruits.
Fled-wite.
Flames-wite.
Force.
Forcible detaining.
Entry.
Fore-judg'd the Court.
Fore-judger.
Forreign Attachment.
Matter.
Oppoſer,
Plea.
Service.
Forreſt
Forreſter.
Forfeiture.
of Marriage.
Forger.
Forgery.
Formedon.

Foreſtalling.
Fourch.
Franchiſe.
Royal.
Frank Almoin.
Chaſe.
Fee.
Form.
Fold.
Law.
Marriage.
Pledge.
Tenement.
Free-Bench.
Free-hold.
in Deed.
in Law.
Freſh Diſſeiſin.
Fine.
Force.
Suit.
Frod-mortel.
Fugitives Goods.
G.
Gabel.
Gage.
Gager Deliverance.
Garbler.
Gardeyne de l'Egliſe.
Garniſhment.
Garter.
Gavelet.
Gavel-kind.
Gauger.
Gaynage.
General Iſſue.
Generoſa.
Gild.
Good-a-bearing.
Grand Days.
Diſtreſs.
Cape.
Grant.
Gree.
Green-Cloth.
Green-Wax.
Guardian.
of the Spiritualities.
of the Cinque-Ports.
Gwaife.
H.
Habeas Corpora.
Corpus.
Habendum.
Habere facias Seiſinam.
Viſum.
Habitation.
Half-Tongue.
Hamper.
Happe.
Herald.
Hærede abducto.
diliberando alii qui habet Cuſtodiam Terræ.
Heretare.
Hæretico comburendo.
Hariot *or* Heriot.
Heir.
Heriditaments.
Heriot.
Cuſtom.
Service.
Homage.
Anceſtral.
Homagio Reſpectuando.
Homicide.
Voluntary.
Caſual.
Homine Capto in Withernamium.
Elegendo ad Cuſtodiam.
Replegiendo.
Hors de ſon fee.
Hotch-pot.
Hue and Cry.
Huſtings.
I.
Illeviable.
Identitate Nominis.
Ideota Inquirenda.
Jeofail.
Jetſon.
Ignoramus.
Imparlance General.
Special.
Imparſonee.
Impeachment of Waſte.
Implead.
Impoſt.
Impropriation.
In Caſu conſimili.
Incident.
Incumbent.
Indenture.
Indicavit.
Indictment.
Induction.
In forma Pauperis.
Informatus non ſum.
Ingreſſu.
ad Communem Legem.
ad Terminum qui preteriit.
cauſa Matrimonii.
cui ante Divortium.
dum fuit intra Ætatem.
dum fuit non compos Mentis.
in caſu conſimili.
in caſu proviſo.
in le per.
ſine aſſenſu capitali.
ſuper Diſſeiſina in ſe quibus.
ſur cui in Vita.
Ingroſſator Magni Rotuli.
Ingroſſer.
Ingroſſing.
Inheritance.
Inhibition.
Injunction.
Inlagary.
Innoteſcimus.
Inns of Court.
Innuendo.
Inquirendo.
Inquiſition.
Inquiſitors.
Inrolment.
Inſimul tenuit.
Inſpeximus.
Inſtitutes.
Inſtitutiones.
Intenſion.
Interlocutory Order.
Inteſtates.
Intruſion.
Intruſione.
Invadiatus.
Invoyce.
Inventory.
*Journey*'s Accounts.
Joynture.
Iſſue.
Judge.
Judgment.
Jurates.
Juriſdiction.
Juris ultrum.
Juror.
Jury.
Juſtice.
of the Common-Pleas.
of the Forreſt.
of the *Queens-Bench.*
of Aſſize.
in Eyre.
of Goal-Delivery.
of Niſi Prius.
of Oyer and Terminer.
Juſtices.
K.
Keeper of the Great-Seal.
Privy Seal,
Forreſt,
*King's-Bench.*
Knights-Service.
L.
Label.
Laborariis.
Laches.
Lagon.
Land-Tenant.
Lanis de Creſcentia Walliæ, &c.
Lapſe.
Larcenary.
Laſt Heyre.
Latitat.
Laudimium.
Laudum.
Law.
of Arms.
Merchants.
Spiritual.
of the Staple.
of Repriſals or Marque.
Day.
Lawleſs Court.
Leaſe.
Leet.
Legacy.
Legan.
Leſſee.
Leſſor.
Letters Patents.
of Attorney.
Levant and Couchant.
Levari facias.
Damna.
Quando.
Libel.
Libello habendo.
Libera choſea habendo.
Liberate.
Libertatibus allocandis.
Libertatibus.

Libertatibus exigendis.
Libertine.
Licence to ariſe.
Licentia Surgendi.
Transfretandi.
Liege.
Life-Rent.
Liegeancy.
Limitation of Aſſize.
Liquid.
Livery.
of Seiſin.
Locatio Conductio.
Loquela fine Die.
Lord.
Lourgulary.
Lucrative Intereſt.
M.
Magna Aſſiſa.
Charta.
Maim.
Mayheim.
Mannor.
Mainpernable.
Mainpernors.
Mainpriſe.
Maintainer.
Majus Jus.
Make.
Male tent.
Male tolte
Mandamus.
Mannopus.
Mannor.
Man-ſlaughter.
Manu-captio.
Manu-tenentia.
Maritagio amiſſo.
foris facto.
Marſhal.
*Marſhalſea.*
Martial Law.
Maſter of the *Rolls.*
*Chancery.*
the Court of Wards.
the Horſe.
Armory.
Ordnance.
Houſhold.
Faculties.
Wardrobe.
Meaſures.
of Capacity.
of the *Exchequer.*
Melius inquirendum.
Meſn.
Meſſuage.
Minor.
Mint.
Miſ-adventure.
Miſe.
Miſerecordia
Miſ-priſion.
Mittendo Manuſcripto.
Mittimus.
Mix'd Tythes.
Moderata Miſerecordia.
Modo & Forma.
Modus Decimandi.
Monopoly.
Monopolizers.
Monſtrans de droit.
de faits, &c.
Monſtraverunt.
Moot.
Moot-Men.
Moratur.
Mortgage.
Mortmain.
Statute.
Mortuary.
Mulier.
Multa.
a Multo fortiori.
Muniments.
Murage.
Murder.
Mute.
Mutuum.
N.
Naam.
Namation.
Nativo habendo.
Naturalization.
Ne admittas.
Negative pregnant.
Neiſe.
Ne Injuſte vexas.
Neint Compriſe.
Nichol.
Nihil.
Dicit.
Capiat per Breve.
Billam.
Niſi Prius.
Nomination.
Non-ability.
Non-admittas.
Non-age.
Non-claim.
Compos-mentis.
Diſtringuendo.
Eſt-Culpabilis.
Factum.
Non Implacitando.
Intromittendo.
Mercandizanda.
Moleſtando.
Obſtante.
Omitt. propter aliquam, &c.
Ponendis in Aſſiſ. & Jurat.
Procedendo.
Reſiſtentia.
Reſidence.
Sane Memory.
Solvendo Pecuniam.
Suit.
Sum Informatus.
Tenure.
Notary.
Novation.
Novel Aſſignment.
Diſſeiſin.
Nude Contract.
Matter.
Nuper Obiit.
Nuſance.
Nuncupative Will.
O.
Oath.
Obedientiales.
Oblations.
Obligation.
Oblata.
Obligee.
Obligor.
Obventions.
Occupant.
Occupancy.
Occupation.
Occupavit.
Occupiers.
Octo Tales.
Odio & Atia.
Office.
Official.
Oleron Laws.
Onerando pro Rato Portionis.
Oni.
Option.
Orando pro Rege & Regno.
Ordinance.
of the Foreſt.
Ordinary.
Ordinatione
Originalia.
Ovelty of Services.
Overt Act.
Ouſter la Main.
Out-law.
Out-lawry.
Out-riders.
Owelty.
Oyer and Terminer de Record.
P.
Pactum Commiſſorium.
Pain fort & dure.
Pannel.
Paper-Office.
Panage.
Paracium.
Paramount.
Paraphanulia.
Paravaile.
Parcel-Makers.
Parceners.
Parcinary.
Parco Tracto.
Parliament.
Parſon.
Parſonage.
Partes Finis.
Parties.
Partitione facienda.
Partition.
Party-Jury.
Parvo Nocumento.
Paſcha Clauſum.
Paſchal Rents.
Pas de Sourris.
Paſſagio.
Patents.
Patron.
Peculia.
Peers.
Penſion.
Order.
Writ.
Penticoſtals.
Perambulation of the Foreſt.
Perambulatione facienda.
Peravayle.
Perch.

Peny.
Peny-Weight.
Perdonatio Utlegariæ.
Peremptory.
Perinde Valere.
Perjury.
Permutatione Archidiaconatûs.
Per My & Per Tout.
Pernance.
Per quæ Servitia.
Perque Servitia.
Perquisite.
Perquisites of Court.
Perpetuity.
Personable.
Personal.
Services.
Tythes.
Personality.
Petit Cape.
Larcenary.
Sergeantry.
Treason.
Pie-powder Court.
Pipe.
Placard.
Plaintiff.
Plaint.
Plea.
Pleadings.
Pleas of the Sword.
Plebania.
Pledges.
Plegiis Acquittandis.
Plena foris factura.
Plenarty.
Pluries.
Pone.
per Vadium.
Ponendis in Assisis.
Ponendum in Ballium..
Ponendum Sigillum ad Except.
Pontage.
Pontibus reparandis.
Portioner.
Port-mote.
Port-Reeve.
Posse Comitatus.
Possession.
Postea.
Post Diem.
Disseisin.
Fine.
Term.
Nati.
Postulation.
Pound.
Pour faire Proclamee.
Party.
Seiser Terres la Feme.
Pourfivant.
Pourveyance.
Pourveyor.
Power of the County.
*Poyning*'s Law.
Præcipe.
in Capite.
Quid reddat.
Pragmatick.
Sanction.
Præamble.
Præmunicentes.
Precariæ.
Premunire.
Prayage.
Prebend.
Prebendary.
Precepartium.
Precept.
Pre-contract.
Predial Tythes.
Pre-Fine.
Premises.
Premium.
Peremption.
Premunire.
Prendre.
de Baron.
Prepensed.
Prerogative.
Prescription.
Presentation.
Presentee.
Presentment.
President.
Pressing to Death.
Prest.
Money.
Presumption.
Presented Tythe.
Rights.
Prevaricate.
Prevarication.
Primage Primitiæ.
Primier Seisin.
Primogeniture.
Principal.
Priority.
Prisage.
Privilege.
Personal.
Real.
Privy-Seal.
Probate of Testaments.
Probator.
Procedendo.
Process.
Processio.
Processum Continuando.
Prochein Amy.
Proclamation.
of a Fine.
of Rebellion.
Pro Confesso.
Proctor.
Proctors of the Clergy.
Procurators.
Procuratory.
Procurations.
Profene Vice-Comitis.
Profer.
Prohibitio Devasto.
Prohibition.
Pro indiviso.
Prolocutor.
Promoters.
Promulge.
Pronotary.
Pro partibus Liberandis.
Property.
Propriety.
Proporcitas.
Proprietate probanda.
Pro Rata.
Prorogue.
Prosecutor.
Protection.
Protest.
Protestation.
Protonotary.
Proviso.
Provisions.
Punitory Interest.
Puny.
Purchase.
Purgation.
Purlue.
Purparts.
Pursuivant.
Purveyance.
Purveyor.

Q.

Quæ plura.
Servitia.
Quale Jus.
Quamdiu bene se gesserint.
Quantum Meruit.
Ejecit infra Terminum.
Quare Impedit.
Incumbravit.
Intrusit.
Non admisit.
Non permittit.
Non obstruxit.
Quarentina habendo.
Quarrantine.
Que Estate.
Que est mesne.
Quem reditum debet.
Querela.
Freshiæ fortice.
Coram Rege.
Quærens non invenit.
Quest.
Men.
Questus.
est nobis.
Qui Improvide.
Juris Clamat.
Quid pro Quo.
Quietus.
Quint Exact.
Quite Claim.
Quit-Rent.
Quo Jure.
Warranto.
Quod Clerici non obligentur.
Beneficiarii.
Quod ei deforcet.
permittat.
Quorum.

R.

Rageman.
Ranger.
Rapines.
Raptu Hæredis.
Rate Tythes.
Ratification.
Rationabili parte Bonorum.
Rationabilibus Divisis.
Re-attachment.
Rebutter.
Recaption.

Raviſhment de Guarde.
Reafforeſted.
Rebellious Aſſembly.
Receiver.
of the Fines.
General of the Dutchy of *Lancaſter*.
Recognizance.
Recogniſee.
Recognitio.
Recognitione admittenda.
Recognitors.
Records.
Recordare facias.
Recorder.
Recordo & Proceſſu.
Recovery.
feign'd.
true.
with a Double Voucher.
with a Treble Voucher.
Recoupe.
Recta priſa Regis.
Recto.
de Advocat. Eccleſiæ.
Cuſtodia.
Dote.
Dote unde nihil debet.
de Rationabili Parte.
Quando dans remiſit.
Sur Diſclaimer.
in Curia.
Reddendum.
Reddition.
Rediſſeiſin.
Redubbors.
Re-entry.
Reputatio Fondi.
Regalia.
Regio Aſcenſu.
Regrator.
Rejoinder.
Releaſe.
Relegation.
Releviſh.
Relicta verificatione.
Remainder.
Remembrancers.
of the King.
of the *Treaſury*.
Firſt-Fruits.
Remitter.
Render.
Rent.
Reparatione Facta.
Repleader.
Replegiare.
Replevin.
Replication.
Report.
Repriſalia.
Repriſes.
Reprieve.
Reſceit.
Reſcous.
Reſcript.
Reſcue.
Reſcuſſor.
Reſeizer.
Reſervation.
Reſiance.
Reſidence.
Reſort.
Reſpectu Computi.
Vice-Comitis.
Reſpite.
of Homage.
Reſponſalis.
Reſtitutio Integrum.
Reſtitution.
Reſtitutione Extract.
Temporalium.
Reſummons.
Reſumption.
Retaining Fee.
Retraxit.
Return.
Retorno Habendo.
Returnum Averiorum.
Irreplegiable.
Revenue.
Reverſion.
Review.
Reviver, (*Bill.*)
Reviving
Riens arrereare.
paſs par le fait.
par Diſcent.
Right.
*Rolls* Office.
of Parliament.
Rout.
Royal Aſſent.

S.

Sacramento recipiendo.
Sacrilegium.
Safe Conduct.
Pledge.
Salique Law.
Salvage Money.
Salve Gardia.
Saver Default.
Sealer.
Scandalum Magnatum.
Scire facias.
Scutagio habendo.
Second Deliverance.
Secta ad Curiam.
facienda.
Curiæ.
Shira & Hundreda.
Sectis non faciendis.
Secunda Superoneratione.
Secondary.
Securitate Pacis.
Securitatem inveniendi.
Se Defendendo.
Seiſin.
in Fact.
in Law.
Seiſina habenda.
Seneſchallo & Mareſchallo.
Sequelæ Cauſæ.
Sequatur ſub ſuo Periculo.
Sequeſter.
Sequeſtration.
Voluntary.
Neceſſary.
Sequeſtro habendo.
Serjeant.
Sergeantry.
Service.
Services Predial.
Perſonal.
Servientibus.
Servitiis acquittandis.
Servitium Regale.
Seſſions.
of Parliament.
Several Taille.
Tenancy.
Severance.
Sewers.
Shewing.
Sheriff.
Sicut alius.
Side-Men.
Significabit.
Signet.
Simony.
Sine Aſſenſu Capitali.
Die.
Cures.
Si non omnes.
Si recognoſcant.
Soc.
Soccage.
Soc-Mans.
Sole Tenant.
Solet & Debet.
Sollicitor.
Solvendo eſſe.
Solutione Feudi.
Sowne.
Spigurnel.
Spinſter.
Spiritualities.
Spoliation.
Standard.
Staple.
Statute.
Merchant.
Staple.
Statutum de Laborariis.
Statuto Mercatorio.
Statute Stapulæ.
Stellionate.
Sterling Money.
Stipulation.
Subornation.
Subpœna.
Subrogation.
Subſidy.
Suit.
in Law.
of Courts.
Covenant
Cuſtom.
Real, *or* Regal.
Freſh.
of the King's Power.
Suffragan.
Summoneas.
Summoner.
Summons in Com. Law.
in Terra petita.
ab Warrantizand.
Sumptuary Laws.
Super Inſtitution.
Super Oneratione Paſturæ.
Supremacy.

Super-Prerogativ. Reg.
Statuto.
Statuto de Articuli.
facto pour.
Superſedeas.
Super-Statutum *Edv.* Tertii.
Statuto de *York.*
Superviſor.
Supplicavit.
Sur cui in Vita.
Surety of the Peace.
Surpluſage.
Sur-Rejoinder.
Sur-Rebutter.
Surrender.
Surrogate.
Surviſor.
Suſpenſion.
Swain-mote.
Synodice.
Synod.
General.
Particular.
Dioceſan.

T.

Tabling of Fines.
Tail.
General.
Special.
after Iſſue extinct.
Taint.
Tales.
Tare and Tret.
Teller.
Temporalities.
Tenant.
by Statute-Merchant.
in Frank-Marriage.
by Courteſy.
in Mortgage.
by the Verge.
by Copy of Court-Roll.
by Chapter.
in Chief.
of the King.
Very.
Joint.
in Common.
in Particular.
at Præcipe.
in Demeſne.
in Service.
by Execution.
Tender.
Tenement.
Tenementis Legatis.
Tenentibus in Aſſiſis.
Tenore Indictamenti.
Tenths.
Tenure.
Term.
Terre Tenant.
Terrer.
Terris, Bonis & Catallis.
Liberandis.
Teſtament.
Teſtatum.
Teſte.
Thelonia Rationabili.
Thelonium.
Tipſtaves.
Title of Entry.
Tod of Wool.
Toft.
Toll.
Tolt.
Tonnage.
Tort.
Tout temps priſt.
Tranſcript.
Tranſcriptio Pedis.
Tranſcriptio Record.
Tranſire.
Tranſgreſſione.
Traverſe.
an Office.
Treaſon.
Treaſure Trove.
Treaſurer of the Queen's Houſhold.
Treſpaſs.
Trial.
Trigild.
Trover.
Tunnage.
Turn.
Turno Vice-comitum.
Twigild.

V.

Vacation.
Vadio exponere.
Vadium Mortuum.
Per Vadium ponere.
Valore Marritagii.
Value of Marriage.
Vaſſal.
Vaſto.
Vaſtum.
Vejours.
Venditioni exponas.
Venire facias.
tot Martonas.
Ventre inſpiciendo.
Venue.
Viſne.
Verderor.
Verdict.
Verge.
Vert.
Very Lord.
Veſture.
Vetitum Namium.
Vicar.
Vicario deliberando.
Vidiare.
Vicis & Venellis.
View.
of Frank-Pledge.
Vi & Armis.
Vigil.
Vi Laica amovenda.
removenda.
Villain.
Villanis Regis Sutachi.
Villenage.
Virgate.
Vis.
Viſcount.
Viſcounteil.
Viſidario eligendo.
Viſitation.
Viſne.
Visu Franci Plegii.
Viva Voce.
Uncove Priſt.
Under Com. Baron.
Union of Churches.
Unity of Poſſeſſion.
Unlawful Aſſembly.
Ungues Priſt.
Voir obire.
Volumus.
Volunt.
Voucher.
Voidance.
Uſa fruct.
Uſage.
Uſe.
Uſer.
Uſher.
Uſury.
Utas Octava.
Utlegatio.
Utlary.
Utter Barriſters.

W.

Wife.
Waive.
Wager of Law.
Walviaria Mulieris.
Ward.
Warden.
Ward-mote.
Warrant of Attorney.
Warrantia Chartæ.
Diei.
Cuſtodiæ.
Warrantry.
Warren.
Warrentry.
Waſte.
Water-Bailiff.
Water-Meaſure.
Waveton.
White-hart Silver.
Widow of the King.
Will.
Withernam.
Writs Breve.
Original.
Perſonal.
Real.
Judicial.
of Rebellion.
Aſſiſtance, &c.

Y.

Year.
Day.
Waſte.
Yard Land.


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*Grammar, Rhetorick, Poetry,* &c.


A.

ABlative Caſe.
Abbreviation.
Acatalectick Verſe.
Accent.
Accents.
Acroſticks.
Acute Accent.
Adjectives.
Adonick Verſe.
Adverb.
Alchaicks.

# An Alphabetical INDEX


Alchaicks.
Allegory.
Alliteration.
Ambages.
Amphibology.
Amphybrachys.
Amphimacer.
Amplification.
Anacephaleosis.
Anacreontic Verse.
Anadiplosis.
Anagram.
Analogical.
Analogy.
Analogism.
Analysis.
Anapest.
Anapestick Verses.
Anaphora.
Anarchy.
Anglicism.
Anomaly.
Antanaclasis.
Antibachius.
Antilogy.
Antimetrical.
Antinomasia.
Antiphrasis.
Antiptosis.
Antistrophe.
Antithesis.
Apathy.
Aphæresis.
Aphorism.
Apocope.
Apodioxis.
Apologetical.
Apologue.
Aposiopesis.
Apostrophe.
Appellative.
Apposition.
Aptote.
Archaism.
Article.
Articulation.
Asclepiad.
Aspiration.
Asterisk.
Asyndeton.
Auxiliary Verbs.

B.

Bachius.
Battology.
Brachycataleptic Verse.
Brachygraphy.
Bucolicks.
Bustrophe.

C.

Cæsura.
Catachresis.
Cataleptick Verse.
Chalcography.
Choreus.
Choriambis.
Chemice.
Circumflex Accent.
Colon.
Comma.
Comparative Degree.
Comparison.
Complex Terms.
Compossible.
Conceptio.
Concrete.
Conditional Propositions.
Conjugation.
Conjunction.
Construction.
Contemplation.
Consectary.
Crasis.
Chryptography.

D.

Dactyle.
Dative Case.
Defective Nouns.
Deficient Nouns.
Denominatives.
Diæresis.
Dialect.
Diastole.
Diaglyphicks.
Dichoreus.
Dijambus.
Diptotes.
Dispondeus.

E.

Echlipsis.
Ellipsis.
Enalage.
Encaustice.
Encoluptice.
Enneamimeris.
Epanorthesis.
Epenthesis.
Epiphonema.
Epitritus.
Epitrope.
Exclamation.

G.

Grammar.
Glyphice.
Grave Accent.

H.

Hepthemimeris.
Heteroclites.
Heterogeneal.
Hypallage.
Hyperbaton.
Hyperbole.
Hypercaleptick Verse.
Hyperdissylable.
Hyphen.
Hypobole.

I.

Iambus.
Imperative Mood.
Impersonal Verb.
Indicative Mood.
Infinitive Mood.
Interjection.
Interrogation.

L.

Labial Letters.
Long Accent.

M.

Metaphor.
Metonymy.
Microcosm.
Molossus.
Moods.
Mother Tongues.

N.

Nouns.

O.

Optative Mood.
Orthography.

P.

Pentaptotes.
Period.
Periphrasis.
Perissology.
Personal Verb.
Pleonasmus.
Polemical.
Positive Degree.
Possessives.
Potential Mood.
Præposition.
Pragmatical.
Principle.
Pronoun.
Proposition.
Prosthesis.
Pyrrhicus.

R.

Rhapsody.
Ratiocination.
Repetition.

S.

Semi-colon.
Short Accent.
Spondæus.
Steganography.
Subjunctive Mood.
Substantives.
Superlative Degree.
Syllepsis.
Synalæpha.
Synchysis.
Syncope.
Synechphonesis.
Synezesis.
Synonomy.
Synthesis.
Systole.

T.

Tautology.
Technical.
Tetraptotes.
Tmesis.
Topography.
Tribrachus.
Triemimeris.
Trissyllable.


---

*Mechanicks, Statics, &c.*


ADit.
Æquilibrium.
Agogice.
Ajutage.
Allay.
Alloy.
Altitude of Motion.
Allum Works.
A Mansa.
Ancony.
Anemoscope.
Automata.
Axis in Peritrochio.

B.
Ballance.
Ballista.
Beats.
Bevel.
Blood-red Heat.
Bloom.
Blowing Houses.
Bonny.
Brass.
Brazing.
Buddle.
Burning Glasses.
C.
Calculation of Clock-work.
Case-hardning.
Casualty.
Catches.
Centre.
of Gravity.
of Magnitude.
of Oscillation.
Cerus.
Charge of Lead.
Chemice.
Chimes.
Chissels.
Chronometron Perpendiculum.
Chronoscope.
Clamped.
Clasp Nails.
Clench Nails.
Clepsydra.
Clocks.
Clock-work.
Cock water.
Cochlea.
Coffer.
Colaptice.
Coldsheir Iron.
Compass Dyal.
Conatus recedendi a Centro motûs.
Concave Glasses.
Contrate Wheel.
Coperas.
Corvus.
Count Wheel.
Crown Wheel.
Creeping Index.
Cross-Staff.
Cruising Mill.
Craze Mill.
Crootes.
Cuneus.
D.
Daze.
Deads.
Declinatories.
Detents.
Detent Wheel.
Diadrome.
Dialling in Mines.
Dilving.
Direction.
Dog Nails.
E.
Embolus.
Engine.
Engyscope.
Equable Motions.
Equilibrium.
Essay Hatch.
Etching.
F.
Fast Country.
Feather Edg'd.
Finery.
Flame-heat.
Flat pointed Nails.
Flight.
Flying Pinion.
Fodder of Lead.
Foliate.
Foliation.
Founday.
Fore-Staff.
Frame.
Friction.
Furnace Almond.
of Assay.
G.
Gage.
Gard du Cord.
Garde de Caut.
Glass Drops.
Gnomon.
Gold Mines.
Greut.
Grove.
Guard-cock.
Gun-powder.
H.
Half Bloom.
Hatch.
Helioscopes.
Hem.
Heterodromus.
Homodromus.
Hook Pins.
Hoop Wheel.
Hydraulicks.
Hydraulo-pneumatical Engines.
Hydrostatical Ballance.
Hygrometer.
Hygroscope.
Statical.
Hypomochlion.
I.
Jamb.
Jett d'Eau.
Inclined Planes.
Incombustible Cloth.
L.
Latches.
Launder.
Lead.
Lead Nails.
Leaves of a Pinion in a Watch.
Level.
Lever.
Lifting Pieces.
Load.
Lock Wheel.
Loop.
Lot or Lothe.
M.
Machine.
Map.
Maxy.
Mechanick Powers.
Mechanicks.
Medals.
Medalions.
Mesolabium.
Microcousticks.
Microphones.
Micrometer.
Microscope.
Mine Dial.
Minium.
*Mosaick* Work.
Movement.
Mount Egg.
N.
Nealing of Steel.
*Neper*'s Bones.
Needle.
O.
O—G— Ogee.
Ogive.
P.
Parting.
Pass.
Pendulum.
Pendulums Royal.
Peritrochium.
Perpendiculum Chronometrum.
Pevets.
Pinion of Report.
Pin-Wheel.
Plane.
of Gravity.
Plasm.
Pneumatick Engine.
Polyacousticks.
Polyscopes.
Polyspastum.
Portable Barometer.
Port Nails.
Potans.
Potence.
Powers.
Mechanick.
Projectiles (*their Laws.*)
Proplasm.
Protracting Pin.
Protractor.
Printing.
*Pryan* Tin.
Pulley.
Q.
Quadrant.
Triangular.
Quadrat.
Quantity of Motion.
Quarters in a Clock.
Quick-Silver.
R.
Ratch.
Ratchet.
Red-seer.
Reducing Scale.
Refining.
Reflecting Telescope.
Regulator.
Rhabdology.
Rim in a Watch.
Ring Dyal.
Rota Aristotelica.
S.
Satellite Instrument.
Scales.
Sector.



Sinica

# An Alphabetical INDEX


Sinical Quadrant.
Siphon
Sliding Rules.
Spring Arbor.
Spring Box.
Square.
Statical Baroſcope.
Staticks.
Station-Staff.
Steel.
Stentrophonick Tube.
Striking Wheel.
Succula.
Suculæ.
Surveying Scale.
Swing Wheel.
Syphon.
Syringe.

T.

Terella.
Tin Work.
Theodolite.
Thermoſcope.
Three-legg'd Staff.
Tongue-Grafting.
Train on a Watch.
Training a Load.
Travelling Barometer.
Trochlea.
Trocholicks.
Turns.
Tympanum.

V.

Vectis.
Verditer.
Vibration.
Vitriol.
Uniform Motion.

W.

Warning Wheel.
Watch-Work.
Way-wiſer.
Weed.
Wedge.
Weight of ſeveral Bodies.
Weights of divers Countries.
Welding-heat.
Wheel Barometer.
White-heat.
Wind Gun.


## CONICKS.


A.

ABſciſſæ.
Acute Angled Section of a Cone.
Ambigenal Hyperbola.
Anguineal Hyperbola.
Applicates.
Applicate Ordinates.
Aſymptotes.
Axis.
Conjugatus.

B.

Baſe.
Binocle.

C.

Centre of an Ellipſis.
of an Hyperbola.
Centre of Gravity of an Hyperbola.
Ellipſis.
Circumſcrib'd Hyperbola.
Cone.
Conick Sections.
Conjugate Diameter.
of the Hyperbola.
Conoid.
Elliptical.
Parabolical.
Hyperbolical.
Contrary legg'd Hyperbola.
Converging Hyperbola.
Cruciform Hyperbola.
Cubical Paraboloid.
Cuſpidated Hyperbola.

D.

Deficient Hyperbola.
Diameter of a Conick Section.
Conjugate.
Diverging Hyperbola.
Double Point.

E.

Eccentricity Double.
Ellipſis.
Equilateral Hyperbola.

F.

Figure.
Focus of an Ellipſis.
Hyperbola.
Parabola.

H.

Helicoid Parabola.
Hyperbola.
Hyperbolick Space.
Hyperbolicum Acutum.
Hyperbolical Cylindroid.
Hyperboli-form Figures.

I.

Intactæ.
Intercepted Axis.

L.

Latus Rectum.
Primarium.
Tranſverſum.

N.

Nodated Hyperbola.

O.

Oppoſite Cones.
Sections.
Ordinate.
Figures.

P.

Parabola.
Paraboloids.
Parabolick Spiral.
Pyramidoid.
Cuneus.
Conoid.
Spindle.
Primarium Latus.
Punctated Hyperbola.
Pure Hyperbola.

Q.

Quadratrix of the Hyperbola.

R.

Rectangular Section of a Cone.
Redundant Hyperbola.

S.

Scalenous Cone.
Section Conick.
Sectiones Sequentes.
Semi-cubical Paraboloid.
Similar Sections.
Sub-contrary Poſition.
Section of a Cone.
Sub-Normal.
Sub-Tangent.

T.

Tangent of a Conick Section.
Tranverſe Axis.
Truncated Cone.
Trident.


## DIALLING.


A.

ÆQuator.
Almacanters.
Altitude.
Amplitude.
Ana-Lemma.
Aſtronomical Hours.
Azimuth.

B.

*Babyloniſh* Hours.

C.

Centre of a Dial.
Colures.

D.

Declination of a Plane.
the Sun.
Declinatory.
Declining Dials.
Dial.
Dialling.
Dial Planes.
Direct Dials.
Double Horizontal Dial.

E.

Ecliptick.
Equinoctial Colure.
Dial.
Erect Declining Dials.
Planes.
Erect Direct Planes.
Eaſt and Weſt Planes.
North or South Planes.

F.

Furniture of Dials.

G.

Gnomon.
Gnomonicks.

H.

Height of the Pole.
Horizon.
Horizontal Dials.
Line.
Hour Circles.
Lines.
Hour of the Day.


Incli-

I.
Inclination of a Plane.
*Jewiſh* Hours.
L.
Latitude of a Place.
Line Horizontal.
Horary.
Subſtilar.
Equinoctial.
Longitude.
M.
Meridian Line.
N.
Nadir.
Nodus.
O.
Oblique Plane.
P.
Parallels of Altitude.
Latitude.
Declination.
Plane of a Dial.
Plane Horizontal.
Polar Dials.
Pole of the World.
Prime Vertical Dials.
Projection of the Sphere.
Projective Dialling.
R.
Reclination of a Plane.
Reclining Dials.
Reflecting Dials.
Reflective Dialling.
Refracted Dials.
S.
South Direct Dials.
Stile.
Style.
Subſtile.
Subſtilar Line.
T.
Trigon.
V.
Vertical Plane.
Circles.
Point.
Line.
Z.
Zenith.

## *Chirurgery, Pharmacy, and Names of Diſeaſes.*

A.
ABaptiſton.
Ablation.
Abluent Medicines.
Abſceſſe.
Abſorbents.
Abſtergent.
Abſterſion.
Acantabolus.
Acceſs.
Acceſſion.
Acerids.
Achor.
Aclys.
Acme.
Acopum.
Acoſmy.
Acraſy.
Acriſy.
Acros.
Acute Diſeaſes.
Additaments.
Aduſt.
Ægylops.
Ætiology.
Agripnia.
Agrypno-coma.
Alba Pituita.
Albugo.
Alcola.
Aloephanginæ.
Alexipharmicks.
Alexiterial.
Alkermes.
Aloeticks.
Allogotrophy.
Alopecy.
Alphus.
Altering Remedies.
Alvus.
Amaracinon.
Amauroſis.
Ambe.
Ambliopia.
Amblotick.
Amethyſta.
Amonton.
Amphiſmela.
Amputation.
Amulet.
Amygdalate.
Ana.
Anabrochiſmus.
Anabroſis.
Anacharſis.
Anacatharticks.
Anacollema.
Anadoſis.
Analepticks.
Anaploroticks.
Anaſarca.
Anaſtomatick.
Anchylops.
Ancyloblepharum.
Ancyloglosſum.
Aneuriſm.
Aniglosſus.
Angina.
Anhelation.
Anodynes.
Anepſy.
Anorexy.
Antaphroditick.
Antarthriticks.
Antaſthmaticks.
Anthelminticks.
Anthracoſis.
Anthrax.
Antidiaphoreticks.
Antiarthriticks.
Antidote.
Antiepilepticks.
Antiemeticks.
Antihypnoticks.
Antinephriticks.
Antipaſis.
Antipharmacum.
Antipilepticks.
Antiſcorbuticks.
Antiſpaſmodicks.
Apepſy.
Aperitives.
Apheresis.
Aphroditanum.
Aphrogeda.
Appetitus Caninus.
Apthæ.
Apnæa.
Apochyliſma.
Apocrouſticks.
Apophlegmatical.
Apoplexy.
Aporrheæ.
Aporrhea's.
Apoſteme.
Apozeme.
Appenſa.
Apyrexy,
Archeus.
Ardor Urinæ.
Areotick Medicines.
Argema.
Armarium Unguentum.
Aromaticks.
Aromatization.
Aromatick Volatile Salt.
Arteriotomy.
Arthritis.
Planetica.
Vaga.
Arthritick.
Aſaphy.
Aſcaris.
Aſcarides.
Aſcites.
Aſcitick.
Aſphatum.
Aſphyxia.
Aſſatium.
Aſſodes Febris.
Aſthma,
Athemora.
Athymia.
Atony.
Atra Bilis.
Atreus.
Atrophy.
Attenuating.
Attenuation.
Attonitus Stupor.
Attracting.
Attractive.
Auriſcalpium.
B.
Bacilli.
Bamma.
Batrachus.
Bechicks.
Benign Diſeaſes.
Bezoar Animale.
Bezoardicks.
Biolychnium.
Bliſters.
Bochet.
Bolus.
Borborygm.

Bothrion.
Bradypesy.
Bronchocele.
Bronchotomy.
Buccellation.
Bulimos.

C.

Caballine Aloes.
Cacatoria Febris.
Cachecticus.
Cachexy.
Cacochymy.
Cacoethes.
*Cæsarian* Section.
Birth.
Callous.
Callus.
Cancer.
Canina Fames.
Capillation.
Carbunculus.
Carcinodes.
Carcinoma.
Cardiaca.
Cardiacum.
Cardialgia.
Cardiagmos.
Caries.
Carpia.
Carus.
Catacathartick.
Catagma.
Catagmatick.
Catalepsis.
Cataplasma.
Cataphora.
Catoptosis.
Cataract.
Catarrhus.
Cathartick.
Catheter.
Cathetarismus.
Cathypnia.
Catoche.
Cauledon.
Causodes.
Causus.
Caustick.
Cauterisation.
Cauterium.
Cele.
Cenchrias.
Ceneangia.
Cephala.
Cephalæa.
Cephalalgia.
Cephalgica.
Cephalick Medicines.
Cephalophonia.
Cerchnos.
Chalastick Medicines.
Chalybeats.
Chemosis.
Chlorosis.
Cholera Morbus.
Cholegogues.
Chordaplus.
Chorea Sancti Vitis.
Chymosis.
Chirurgery.
Cicatrizantia.
Cicatrix.
Cicatrizing Medicines.
Cirsocele.
Circos.
Citta.
Claretum.
Clarification.
Clavus.
Clydon.
Clysma.
Clystus.
Coagulate.
Codia.
Cœliac Passion.
Cœlonia.
Cohobate.
Co-indications.
Colature.
Colcothar.
Colick.
Coliquans Fibris.
Colliquation.
Collution.
Collyrium.
Coloboma.
Colpus.
Coma Somnolentum.
Vigil.
Comitialis Morbus.
Complication.
Condensantia.
Condylomia.
Confections.
Congeal.
Conserve.
Consolidating Medicines.
Consolidation.
Consumption.
Contagion.
Continent.
Continual Fever.
Contra Fissura.
Contra-indications.
Contusion.
Convolvulus.
Conus Fusorius.
Convulsion.
Cophosis.
Copos.
Copell.
Copro-critica.
Cordialia.
Cornachine Powder.
Cornea Lunæ.
Corrosio Chymica.
Corrosive Medicines.
Corrodentia.
Coryza.
Cosmeticks.
Crama.
Cranes Bill.
Crapula.
Craticula.
Cream of Tartar.
Cribration.
Crimnoides.
Crisis.
Cristæ.
Criterion.
Crithe.
Crucible.
Crudity.
Crusta lactea.
Crustula.
Crymodes.
Chrysorchis.
Cucupha.
Cucurbite.
Cucurbitini Lumbrici.
Cucurbitula.
Cutaneous Diseases.
Cylisci.
Cylindrus.
Cyllosis.
Cyllum.
Cynache.
Cynantropia.
Cynicus Spasmus.
Cynodes Orexis.
Cynorexis.
Cyphoma.
Cyphosis.
Cyrtoma.
Cyrtosis.
Cystotomy.

D.

Dacryodes.
Darsis.
Dassyman.
Debility.
Decant.
Declension.
Decoction.
Decupelation.
Decussorium.
Defensatives.
Defensives.
Deflagration.
Defluction.
Deglutition.
Dejection.
Deleterial Medicines.
Deletery Medicines.
Deliquation.
Deliquium Animi.
Delirium.
Dentarpaga, Instr.
Dentiducum.
Dentifrice.
Dentition.
Deobstruent.
Deopilative.
Dephlegmated.
Depilatory.
Depuration.
Descensorium.
Desiccation.
Desiccatives.
Despumation.
Destillation.
Detergent.
Detersives.
Deuteropathia.
Diabetes.
Diabrosis.
Diachisma.
Diacoprægia.
Diacrisis.
Diadoche.
Diatetica.
Diagnosticks.

Diagrydium.
Dialemma.
Diapasma.
Diapedesis.
Diaphoresis.
Diapthora.
Diaplasis.
Diaplasma.
Diapnoe.
Diapyema.
Diapyetica.
Diaria Febris.
Diarrhæa.
Diarthrosis.
Diathesis.
Dicophyia.
Dicrotus.
Didymi.
Dies Critici.
Digester.
Digestion.
Digestive Medicines.
Dilatorium.
Dilute.
Dinus.
Dioptra.
Diorthosis.
Diota.
Diploe.
Dipsacus.
Dislocation.
Discussion.
Dispensatory.
Dissolution.
Distillation.
Districhiasis.
Diuresis.
Diureticks.
Dogmatical Medicine.
Dose.
Dracunculus.
Drastick Medicines.
Dropsy.
Duellists.
Dulcify.
Dysesthesia.
Dyscracy.
Dysentery.
Dysepylotica.
Disorexia.
Dyspathy.
Dyspepsy.
Dysphonia.
Dyspnæa.
Dystherapeutæ.
Dysthriachysis.
Dystichia.
Dystochia.
Dysuria.

E.

Earth.
Ecbolia.
Ecchoprotica.
Ecchyloma.
Ecchymoma.
Ecchymosis.
Eccope.
Eccrimocritica.
Eccrisis.
Eclegma.
Eclipsis.
Eclysis.
Ecmastica.
Ecphracticum.
Ecphraxis.
Ecphythesis.
Ecpyema.
Ecpyesma.
Ecplexis.
Ecrithmus.
Ecthlipsis.
Ecthlima.
Ecthymata.
Ecthymosis.
Ectilotica.
Ectropium.
Eczemata.
Edulcoration.
Effervescence.
Egestion.
Elaboratory.
Elaterium.
Electica.
Electuary.
Eleosaccharum.
Elephantiasis Arabum.
Græcorum.
Elevator.
Elevatorium.
Elixation.
Elixir Proprietatis.
Elminthes.
Elodes.
Elongation.
Embrocation.
Embryothlastes.
Embryulcus.
Emetick, Tartar.
Emmenagogues.
Emmotion.
Emollientia.
Empasma.
Empericks.
Emphracticks.
Emphraxis.
Emphysema.
Emphyton.
Empirical.
Emplastrum.
Emplasticks.
Emplattomena.
Emprosthotonus.
Empyema.
Empyreuma.
Emrods.
Emulsion.
Enæmon.
Enæorema.
Encauma.
Encharaxis.
Enchymona.
Enchysma.
Encope.
Endeixis.
Endemical.
Endemious.
Enema.
Energetical.
Energy.
Engizoma.
Engonios.
Enneatical Days.
Enneatical Years.
Enarthosis.
Enterenchyta.
Enterocele,
Enteromphalus.
Epaphalesis.
Ephelis.
Ephellides.
Ephelcis.
Ephemera.
Ephialtes.
Ephidrosis.
Epiala.
Epicarpium.
Epicauma.
Epiceraftica.
Epicharsis.
Epicrasis.
Epicyema.
Epidemick.
Epilepsy.
Epigonatis.
Epiparoxysmus.
Epiphora.
Epiplasma.
Epilocele.
Epiplomphalum.
Episarcidium.
Episemasia.
Epispasticks.
Epitheme.
Epneumatosis.
Epomphalum,
Epulis.
Epuletick Medicines.
Erodentia.
Erpes.
Errhines.
Erysipelas.
Erysipelatodes.
Erythremata.
Eschar.
Escharotick.
Essere.
Esurine Salts.
Euchymiæ.
Eucrasia.
Euexia.
Eupepsia.
Euphoria.
Eupnoe.
Euporia.
Eusarcos.
Eustomachos.
Euthanasia.
Eutropia.
Exacerbatio.
Exæresis.
Exanthemata.
Exarticulation.
Exceptio.
Excision.
Excoriation.
Excortication.
Excrements.
Excrescence.
Excretion.
Exomphalos.
Exopthalmia.
Exostrosis.
Expectoration.

Extaſy.
Extergent.
Extirpation.
Extract.
Extraction.
Extuberances.
Exulceration.

F.

Facies Hypocratica.
Fæces.
Falling Sickneſs.
Fames Canina.
Faſciation.
Faſciculus.
Faſtidium Cibi.
Favus.
Feaver.
Febrifuge.
Fæculæ.
Fermentation.
Ferruginous.
Ferucæ.
Fibula.
Ficus.
Filtration.
Fiſſura Oſſis.
Fiſtula.
Fluor Albus.
Fluxion.
Fluxus Chyloſus.
Focus.
Fomentation.
Fontanellæ.
Forceps.
Forfex.
Formulæ.
Fotus.
Fractura Oſſis.
Frontale.
Fugile.
Fungus.
Furfuration.
Furfures.
Furunculus.

G.

Galea.
*Galenick* Medicines.
Ganglion.
Gangrene.
Gargariſm.
Gaſteronaphia.
Gaſtrotomy.
Glandula Guidonis.
Glans.
Glaucoma.
Glaucoſis.
Gloſſocomium.
Gomphos.
Gomphoſis.
Gonagra.
Gravedo.
Graphus.
Gumma Gallicum.
Gutta Roſacea.
Serena.
Gymnaſticks.
Gynecia.
Gynæcomaſtum.

H.

Hæloſis.
Hæmalops.
Hæmatoſis.
Hæmodia.
Hæmoptyſis.
Hæmorrhagia.
Hæmorrhoides.
Hectica.
Hegemonicæ.
Helcydra.
Helminthagogues.
Helo's.
Hemeralopia.
Hemicrania.
Hemipagia.
Hemiplegia.
Hemiplexia.
Hemitritæus.
Hepatick Medicines.
Aloes.
Hepaticus Morbus.
Hepiala.
Herculeus Morbus.
Herma.
Herpes.
Heterocrania.
Hidroa
Hidropoſus.
Hidrotick.
Hippus.
Homotona.
Hoplochryſma.
Hordeatum.
Hordeolum.
Horrifica Febris.
Humectation.
Humours.
Hybona.
Hydatides.
Hydragogues.
Hydrenterocele.
Hydroa.
Hydrocele.
Hydrocephalum.
Hydromel.
Hydromphalum.
Hydrophobia.
Hydropica.
Hydrops.
ad Matulam.
Hydroticks.
Hygeia.
Hygeina.
Hygrocircocele.
Hypercatharſis.
Hyperchryſis.
Hyperephidriſis.
Hyperſarcoſis.
Hypnoticks.
Hypochondriaca.
Hypochondriacus.
Hypochyma.
Hypothyſis.
Hypocratis Manica.
Hypogloſſis.
Hypophyalmia.
Hypophoræ.
Hypophyſis.
Hypogon.
Hypoſarca.
Hypoſarcidium.
Hypoſpathyſmus.
Hypoſphagma.
Hypoſtaſis Urinæ.
Hyſteralgia.
Hyſterica.
Paſſio.
Hyſteromotocia.
Hyſterotomia.

J.

Jaundice.
Ichor.
Ichoroides.
Icterus.
Idiocraſy.
Idiopathy.
Idioſyncraſy.
Ignis Perſicus.
Sacer.
Sylveſtris.
Ignition.
Iliac Paſſion.
Ilingus.
Impetigo Celſi.
Plinii.
Inceration.
Incineration.
Incorporate.
Incraſſating.
Incubus.
Indication.
Indications.
Inedia.
Inflammation.
Infuſion.
Ingredients.
Injection.
Inſania.
Inſeſſus.
Inſolation.
Intercus.
Intermiſſio Febrium.
Intermius Morbus.
Intertigo.
Ionthus.
Iſchæma.
Iſchyas.
Iſchuretica.
Iſchuria.
Itinerarium.
Julap.

L.

Labia Leporina.
Laconicum.
Lambative.
Lancette.
Laqueus.
Laryngotomia.
Laſſitudo Ulceroſa.
Lavamentum.
Laudanum.
Laxatives.
Lenientia.
Lenta Febris.
Lentigines.
Lepra Arabum.
Græcorum.
Leproſy.
Leptuntica.
Lethargus.
Leuce.
Leucoma.
Leucophlegmatia.

Lichen.
Lienteria.
Linctus.
Lipothymia.
Lithyasis.
Lithontripticks.
Lithotomia.
Local Medicines.
Loch.
Lochia.
Lohoch.
Lordosis.
Lues Venerea.
Deifica.
Lumbago.
Luxation.
Lupia.
Lupus.
Lycanthropia.
Lygmos.
Lynx.
Lypyria.

M.

Macula Hepatica.
Volatica.
Magdaleones.
Magma.
Malacsa.
Malactica.
Malagma.
Malignus Morbus.
Maltha Code.
Malum Mortuum.
Mania.
Manica Hippocratis.
Manipulus.
Manus Christi.
Marasmodes.
Marisca.
Marmorata Aurium.
Masticatory.
Materia Medica.
Meconium.
Medicine.
Mela.
Melancholy.
Meliceria.
Mellicratum.
Melopes.
Melos
Meningophylox.
Menopegia.
Metaptosis.
Metastasis.
Metrenchyta.
Miasma.
Milliaris Herpes.
Miserere mei.
Mitella.
Mira.
Modiolus.
Mola Carnea.
Morbus Regius.
Mucilage.
Mydriasis.
Mylpha.
Miocephalon.
Miopia.
Myrmecia.

N.

Narcosis.
Narcoticks.
Nasalia.
Nascalia.
Natta.
Nausea.
Necrosis.
Nephelæ.
Nephriticks.
Nephritis.
Nephiros.
Neurodes.
Neuroticks.
Noli me Tangere.
Nomæ.
Non-natural Things.
Nosocomium.
Novacula.
Nubeculæ.
Nuciositas.
Nux.
Nyctalopia.
Nymphomania.

O.

Octhodes.
Odoxysmus.
Odontalgia.
Oedema.
Oligotrophus.
Oligotrophy.
Omphalocele.
Onyx.
Ophiasis.
Opthalmicks.
Opiates.
Opisthotonus.
Opthalmy.
Orexis.
Orgasmus.
Oroboides.
Orthopnæa.
Oscillation.
Ostocopi.
Otalgia.
Otenchyta.
Otica.
Outacousticon.
Ovum.
Oxelæum.
Oxycratum.
Oxydercica.
Oxymell.
Oxyregmia.
Oxyrrhodinum.
Ozæna.

P.

Pachuntick Medicines.
Palindrome.
Palliative.
Palmus.
Palpitation.
Palsy.
Panacæa.
Panchymagogues.
Pandalea.
Pandemius.
Pandiculation.
Papulæ.
Paracentesis.
Parachynance.
Paracmastica.
Paralysis.
Paraphymosis.
Paraplegia.
Paraphrenitis.
Paraphrosine.
Parasynanche.
Paronychia.
Paroxysm.
Parylis.
Pastills.
Pathognomick.
Pathology.
Pectorals.
Pediculosus Morbus.
Pelidnus.
Pemphigodes Febris.
Periamma.
Periaptum.
Pericarpium.
Peripneumony.
Pernio.
Perminima.
Pessary.
Pessulus.
Pessus.
Pestilential Fever.
Pestoloides.
Petechialis.
Petigo.
Phacia.
Phacos.
Phagedæna.
Phagedenick Water.
Phalacrosis.
Phalangosis.
Pharmaceutick.
Pharmacopœia.
Pharmacum.
Pharmacy.
Philonium.
Phimosis.
Phleboragia.
Phlebotomy.
Phlegmagogues.
Phlegmon.
Phlegmonodes Febris.
Phlogosis.
Phlyctæna.
Phrenesis.
Phrenitis.
Phricodes.
Phtharticum.
Phthiriasis.
Phthisis.
Phygethlon.
Phymæ.
Physemæ.
Physiognomicks.
Pica.
Picatio.
Picra.
Pituita.
Pityroides.
Pladarosis.
Platisma.
Plerotica.
Plethora.
Pleuritis.
Pleurisy.

Pleuriſy.
Plica.
Pneumatocele.
Pneumatodes.
Pneumatoniphalus.
Pneumatoſis.
Podagra.
Polypus.
Pomphlygodes.
Porocele.
Porotica.
Probe.
Procatarctica.
Procidentia Ani.
Uteri.
Prodromus Morbus.
Proegumena.
Prognoſis.
Prolapſus Uteri.
Prolepticus.
Prophæſis.
Prophylactica.
Proptoſis.
Proſphyſis.
Proſteſis.
Protopathia.
Prunellæ Sal.
Proſpthalmia.
Pſammiſmus.
Pſyctica.
Ptarmica.
Pterygium.
Ptiſana.
Ptyloſis.
Pugillus.
Pulpa.
Pulſus.
Pulſes, their ſeveral kinds.
Pulverization.
Purgation.
Pyrotica.

Q.

Quartane Ague.
Quinſey.
Quinteſcence.
Quotidian Ague.

R.

Rachitis.
Radical Moiſture.
Rarefacientia.
Raſpatorium.
Recidivus Morbus.
Recrement.
Regius Morbus.
Relaxantia.
Repellent Medicines.
Reſina.
Res-Non-Naturales.
Revulſion.
Rhachitis.
Rhagades.
Rhegma.
Rheumatiſm.
Rhexis.
Rhinenchites.
Rhyos.
Rhyptica.
Rhythmus.
Ros.
Vitrioli.
Roſines.
Roſa.
Rubrica.
Ructation.
Rugitus.
Ryas.

S.

Sacculi Medicinales.
Sacer Ignis.
Morbus.
Salivation.
Sanies.
Saphatum.
Saponea.
Sarcocele.
Sarcoma.
Sarcomphalum.
Sardonian } Laughter.
Sardonick }
Sarpedo.
Scalprum.
Scamnum Hypocratis.
Scarification.
Scelotyrbe.
Schetica Febris.
Schirrus.
Schirroma.
Scholiaſis.
Sciatica.
Sclerophthalmy.
Sclerotica Tunica.
Sclo-Opomacherion.
Scorbutus.
Scotomy.
Scrophula.
Scurvy.
Sectio Cæſaria.
Sedimentum Urinæ.
Semeioſis.
Semeiotica.
Semicupium.
Sephyros.
Septan-Fevers.
Septica.
Seroſities.
Serpigo.
Setaceum.
Seton
Sideratio
Siff Album.
Sinapiſmus.
Singultus.
Sirones.
Soluble Tartar.
Solvent.
Solutio Chymica.
Solutive.
Somniferous.
Sophiſticated.
Spagyrica.
Sparadrapum.
Spaſmodicks.
Spaſmologia.
Spaſmus.
Species.
Specificks.
Specifick Medicines.
Specillum.
Speculum Oris.
Spermatocele.
Sphacelus.
Sphincter.
Spina Ventoſa.
Splanchnica.
Splenia.
Sporadici Morbi.
Squinancy.
Stagma.
Staphyloma.
Status Morbi.
Steatocele.
Steatoma.
Stegnoſis.
Stegnotica.
Stercoroſus Fluxus.
Sternutation.
Sternutatorium.
Stillatitious Oyl.
Stillocidium Urinæ.
Strabiſmus.
Stranguary.
Struma.
Stupa.
Stupea.
Stymma.
Styptick.
Water.
Sub-Luxation.
Succotrine Aloes.
Sudamina.
Sudorificks.
Suffitus.
Suffocatio Uterina.
Suffuſion.
Sunarthroſis.
Super-purgation.
Suppedanea.
Supinaror.
Supplantalia.
Suppoſitory.
Suppuration.
Sycoſis.
Syderation.
Sympathetick Powder.
Sympepſis.
Symptom.
Symptomatical Fever.
Synactica.
Synchyſis.
Syncopalis Febris.
Syncope.
Syncritica.
Syndeſmus.
Synedrenonta.
Synanche.
Syngultus.
Synocha.
Synochus.
Syntaſis.
Syntectoe.
Synterick Medicines.
Syntexis.
Synaloticks.
Syringe.
Syringomata.
Syringotomia.
Syſſarcoſis.

T.

Tabes.
Tabes Dorſalis.
Tablets.
Tabum.
Talpa.

Tartar Emetick.
Soluble.
Vitriolate.
Telephium.
Teneſmus.
Terebrum.
Terminthus.
Tertian Ague.
Teſtudo.
Tetanus.
Tetrapharmacon.
Therapeutica.
Theriaca.
Therioma.
Thermantica.
Thlipſis.
Thrombus.
Tinea.
Tincture.
Tinnitus Aurium.
Tometica.
Tomotocia.
Tophus.
Topick.
Topinaria.
Torrified.
Toxica.
Trachoma.
Tragæ.
Transfuſion.
Tranſpiration.
Traumaticks.
Tremor.
Trepanum.
Triſmus.
Trytæophyes.
Trituration.
Trochiſci.
Tumor.
Turbith Mineral.
Tympanytes.
Typhodes.
Typhomania.
Typus.
Tyroſis.

V.

Vaporarium.
Vapours.
Variolæ.
Varix.
Vehicle.
Venæ-Section.
Ventoſe.
Verdegreſe.
Vertigo.
Veſicatoria.
Veternus.
Vinum Hypocraticum.
Virgins Milk.
Vital Indication.
Vitaligo.
Undimia.
Ungula.
Volſella.
Volvulus.
Vomica.

W.

Weapon Salve.
White Lead.
Worm.

X.

Xeropthalmy.
Xyſter.

Z.

Zymoma.
Zymoſimetre.
Zymoſis.

## MUSICK.

A.

ACcent.
Accord.
Allemande.
Apotome.
Arſis & Theſis.

C.

Cadence.
Canon.
Chaconne.
Cleff.
Cliff.
Cloſe.
Comma.
Concords.
Conſonance.
Cords.
Counter-Fugue.
Part.
Point.
Tenor.

D.

Demi-Diton.
Quaver.
Deſcant.
Double.
Florid.
Plain.
Diapaſon.
Diapente.
Diateſſaron.
Diatonick.
Diazeutick Tone.
Dieſis.
Diminution.
Diſcords.
Dis Diapaſon.
Ditone.
Double Deſcent.

E.

Enharmonical.

F.

Fifth.
Figurate Deſcant.
Flond.
Fourth.
Fugue.
Double.

H.

Harmony.
Hemitone.
Hexachord.

I.

Imperfect Concords.
Inharmonick Relation.
Interval.

K.

Key.

M.

Meaſure.
Modes.
Monochord.
Mood.
Muſick.

O.

Octave.
Opera.
Oracouſticks.
Overture.

P.

Pauſe.
Perfect Concords.
Prelude.

Q.

Quaver.

R.

Relation Inharmonical.
Reſt.

S.

Scale of the Gamut.
Scale of Muſick.
Score.
Semi-Diapaſon.
Diapente.
Ditone.
Tone.
Seſquialter.
Syncopation.
Syncope.
Syſtem.

T.

Tenor.
Tetrachord.
Tetradiapaſon.
Tierce.
Common.
Duple.
Triple.
Tone.
Tranſition.
Treble.
Tris Diapaſon.
Tritone.

U.

Uniſons.

## GEOMETRY.

A.

ACcommodate.
Acute Angles.
angled Triangle.
Adjacent Angles.
Adjoining Angles.
Alternate Angles.
Proportion.
Altern-Baſe.
Altimetry.
Altitudes of Places.
Ambit.
Amblygonial.
Hyperbola.
Analogy.
Angle.
Plane.
Curvilineal.
Rectilineal.
Mix'd.
its Quantity.

Angle Right.
Obtuse.
Acute.
Contiguous.
Adjacent.
Oppofite.
Vertical.
Internal.
External.
Alternate.
at the Centre.
in a Semi-Circle.
in a Segment.
of a Segment.
of Incidence.
of Reflection.
of Inclination.
of Refraction.
Refracted.
Spherical.
of the Chord and Tangent.
Oblique.
Anguineal Hyperbola.
Antecedent.
Aperture.
Apore.
Aporime.
Apotome.
Applicate.
Application.
Apply.
Apomecometry.
Arch.
Ark.
Area.
of a Square.
of Rectangles and Parallelograms.
of Triangles.
Trapezia.
all Right-lin'd Figures.
of a Circle.
of a Sector.
of a Segment.
of an Ellipfis.
of a Parabola.
Artificial Lines.
Aſymetral.
Aſymetry.
Aſymptotes.
Axis.

B.

Baculometry.
*Baker*'s Central Rule.
Baſe.
Bimedial.
Binomial.
Biſection.
Body.
Bodies Regular.

C.

Canon.
Capacity.
Catenaria.
Catheti.
Cathetus.
Celerrimi deſcenſûs Linea.
Central Rule.
Centre of a Circle.
an Ellipfis.
Gravity.
Centre of an Hyperbola.
Gravity of an Hyperbola.
Oſcillation.
Percuſſion.
Phonical.
Phono-camptical.
Characters Geometrical.
Chiliogon.
Chord.
Circle.
Circular Lines.
Circumference.
Circumſcribed.
Hyperbola.
Ciſſoid.
Commenſurable Quantities.
in Power.
Surds.
Common Section.
Complements.
Compoſition of Proportion.
Motion.
Concentrick.
Conchoide.
Concurring, *or*,
Congruing Figures.
Cone.
Congruity.
Conick Sections.
Surface.
Conjugate Diameter.
Conoid.
Elliptical.
Hyperbolical.
Parabolical.
Conjugate Diameters.
Conſcribed.
Conſequent.
Conſtruction.
Contact.
Contrary Flexion.
Content.
Contingent.
Converſe.
Cord.
Corollary.
Conſtruction of Equations.
Contrary-legg'd Hyperbola.
Converging Hyperbola.
Series.
Co-Secant.
Co-Sine.
Co-Tangent.
Co-verſed Sine.
Crown.
Cruci-form Hyperbola.
Cubature.
Cube.
Cubical Paraboloid.
Cuneus.
Curvature.
Curves.
Cuſpidated Hyperbola.
Cycloid.
Cylinder.
Cylindroid.

D.

Data.
Decagon.
Deficient Hyperbola.
Deſcribent.
Determin'd Problem.
Diacauſtick Curve.
Diagonal.
Diagram.
Diameter.
of a Conick Section.
Conjugate.
of Gravity.
Dimenſion.
Dimetient.
Dirigent.
Diverging Hyperbola.
Dodecahedron.
Dodecagon.
Double Point.

E.

Eccentrick Circles.
Effections Geometrical.
Elaſtick Forces.
Ellipſis.
Endecagon.
Epicycle.
Epicycloid.
Epipedometry.
Equated Bodies.
Equilateral Triangle.
Evoluta.
Evolute Figures.
Hyperbola.
Evolution.
Exagon.
Excentrick.
Exhauſtions.
Exponential Curves.
External Angles.
Extreme and Mean Proportion.

F.

Figural Numbers.
Figure.
in Conicks.
in Geometry.
Figures Curvilineal.
Mixed.
Plane.
Rectilineal.
Flection, Retrogreſſion of Curves.
Focus of an Ellipſis.
Parabola.
Hyperbola.
Fruſtrum.

G.

Gage Point.
Gauging.
Gauge Point.
Generating Line or Figure.
Generated Quantity.
Geneſis of a Figure.
Geodeſia.
Geometrical Curves.
Solution of a Probl.
Places.
Geometry.
Globe or Sphere.
Gnomon.
*Gunter*'s Line.

H.

Harmonical.
Head Angles.
Height of a Figure.
Helicoid Parabola.
Helicoſophy.

Helicoſophy.
Hemiſphere.
Hendecagon.
Heptagon.
Heptangular.
Hexagon.
Hexahedron.
Homocentrick.
Homologous.
Horizontal Line.
Hyperbola.
Hyperbolical Cylindroid.
Hyperbolick Space.
Hyperbolicum Acutum.
Hyperboli-form Figures.
Hypotheneuſe.

I.

Icoſihedron.
Inceptive of Magnitude.
Inclination.
of a Right Line to a Plane.
Incommenſurables.
Indetermined Problem.
Indiviſibles.
Infinite Quantity.
Inflexion Point.
Inflexion of a Curve.
Inſcribed.
Bodies.
Inſiſting Angles.
Interruption of Proportion.
Interſection.
Inverſe Proportion.
Involute Figure.
Irrational Quantities.
Irregular Bodies.
Lines.
Curves.
Iſagon.
Iſoperimetrical Figures.
Iſoſceles Triangle.

L.

Latus Rectum.
Tranſverſum.
Primarium.
Legs of an Angle.
a Triangle.
Lemma.
Like Figures.
Solids.
Limited Problem.
Line.
of Meaſures.
Linea Celerrimi Deſcenſûs.
Linear Problem.
Lines, their Properties.
Lines of Chords.
Local Problem.
Locus Reſolutus.
Logarithmick Curve.
Line.
Logiſtica Linea.
Spiral.
Longimetry.
Lunes.
Lunulæ.

M.

Mathematicks.
Maximis & Minimis
Mean Diameter.
Mean and Extreme Ratio.
Mean Proportional.
Meaſures.
Mechanical Solutions.
Meniſcus.
Menſurability.
Menſuration.
Mix'd Figures.
Reaſon or Proportion.
Moments.
Multangular.
Multilateral.

N.

Nodated Hyperbola.
Normal.

O.

Oblique Angles.
Oblong.
Obtuſe.
Angles.
Angled Triangles.
Angular Section.
Octagon.
Octahedron.
Oppoſite Angles.
Cones.
Sections.
Ordinate.
Figures.
Organical Deſcription of Curves.
Orthogonial.
Oſcillation.
Oval.
Oxygone.
Oxygonal.

P.

Parabola.
Parabolick.
Pyramidoid.
Cuneus.
Conoid.
Spindle.
Spiral.
Paraboloids.
Parallel Lines.
Parallelogram.
Parallelopiped.
Pelicoides.
Pendulum.
Pentagon.
Perimeter.
Periphery.
Permutation of Quantities.
Perpendicular.
Place Geometrick.
Plane.
Simple.
Solid.
Surſolid.
Plane Problem.
Plane Geometrical.
Surface.
Planimetry.
Planiſphere.
Plonometria.
Point.
of Inflexion of a Curve.
Pole.
Polyedron.
Polyhedron.
Polygon.
Polyhedrous.
Porime.
Poriſm.
Poriſtick Method.
Poſtulata.
Powers of Lines.
Primarium Latus.
Prime Figures.
Priſm.
Priſmoid.
Problem.
Produce.
Product.
Projectiles, their Laws.
Prolate.
Spheroid.
Proportion.
Proportional Spirals.
Propoſition.
Punctated Hyperbola.
Punctum.
Formatum.
Generatum.
ex Comparatione.
Lineans.
Pure Hyperbola.
Pyramidal.
Pyramidoid.
*Pythagorick* Tetractys.

Q.

Quadrangle.
Quadrant.
Quadrantal Triangle.
Quadratrix.
of the Hyperbola.
Quadrature.
of Curves.
Quadrilateral Figures.
Quantity.
Quindecagon.
Quinquangled.

R.

Radial Curves.
Rainbow.
Ratio.
Rational Quantities.
Reaſon.
Reciprocal Figures.
Recta Directrix.
Rectangles.
Rectangled Triangle.
Rectangular.
Section of a Cone.
Rectification of Curves.
Rectilineal.
Redundant Hyperbola.
Regular Bodies.
Figures.
Curves.
Reſidual Figure.
Reſolution.
Retrogreſſion of Curves.
Rhombus.
Rhomboides.
Right-angled.
Triangle.
Right-Angles.
Line.
Sine.
Roots.
Rotation.

S.

Sagitta.
Scale.
of equal Parts.
Diagonal.
Plain.
Scalenous Triangles.
Cone.
Scheme.
Scholium.
Secant.
Section.
Conick.
Sequents.
Sector of a Circle.
Secundans.
Segment of a Circle.
Sphere.
Similar Sections.
Semi-Circle.
Semi-cubical Paraboloid.
Semi-Diameter.
Seprangular.
Serpentine Line.
Sequialteral Proportion.
Sesquitertial Proportion.
Sexangle.
Similar Arks.
Bodies.
Rectangles.
Triangles.
Polygons.
Right-lined Figures.
Segments.
Simple Place.
Problem.
Sine.
Complement.
Solid.
of leaſt Reſiſtance.
Angle.
Place.
Problem.
Sphere.
Spherick Geometry.
Projection.
Spheroid.
Spiral.
Lines.
Proportional.
Square Figure.
Squaring.
Stereometry.
Stereographick Projection.
Sub-contrary Poſition.
Section of a Cone.
Subnormal.
Subtangent.
Subtenſe.
Superficial Content.
Supplement of an Ark.
Superficies, *or*
Surface.
Plane.
Curved.
Surſolid Place.
Problem.
Surveying.
its Practice.
Symetral.
Symptotes.
Syntheſis.
Synthetical Method.

T.

Tangent.
of a Parabola.
Circle.
Term.
Terms of a Proportion.
Tetractys.
Tetragoniſm.
Tetrahedron.
Theorem.
Univerſal.
Particular.
Negative.
Local.
Plain.
Solid.
Reciprocal.
Tranſcendental.
Curves.
Quantity.
Transformation of Curves.
Tranſmutation.
Tranſverſe Axis.
Trapezium.
Trapezoid.
Triangles, and their Properties.
Trident.
Trigon.
Trigonometry.
Plain.
Spherical.
Trilateral.
Triplicate Ratio.
Trochoid.
Truncated.

V.

Verſed Sine.
Vertex.
Vertical Plane.
Line.
Vertically oppoſite.
Vinculum.
Umbelicus.
Umbelick Points.
Unlimited Problem.


## *Fortification, Gunnery,* and *Art Military.*


A.

ADjutant.
Advance Ditch.
Guard.
Foſſe.
Afforciament.
Aide de Camp.
Aide Major.
Alarm Poſt.
Ammunition Bread.
Angle of the Counterſcarp.
Curtain.
Complement of the Line of Defence.
Diminiſhed.
Exterior Figure.
Interior Figure.
Flanked.
Flanking.
Angle of the Moat.
Re-entring.
Re-entrant.
Saliant.
of the Tenaille.
of a Battalion.
Anteſtature.
Approaches.
Apron.
Areotectonicks.
Arquebuſs.
Arquebus à Cruc.
Arriere Guard.
Arſenal.
Artillery.
Aſſault.
Aſſembly.
Aſtragal.
Attack of a Siege.
Falſe.
in Flank
Avant Foſſe.
Avenue.

B.

Baccule.
Ban.
Banquet.
Barrack.
Barbe.
Barrel.
Barrels of Earth.
Barriers.
Barricado.
Baſe.
Ring.
Baskets of Earth.
Baſtion.
Battalion.
Battery.
Batteries of a Camp.
Croſſe.
d'Enfilade.
en Eſcharp.
de Revers.
Joint.
d'Eſtrade.
Bed of a Canon.
Berm.
Biovac.
Blind.
Blockade.
Bomb-cheſt.
Bombs.
Bombardiers.
Bonnet.
Bonnet à Preſtre.
Boyan.
Brackets.
Branch of the Trenches.
Breach.
Breaking Ground.
Breaſt-works.
Bricolls.
Bridge (flying.)
Bridge of Comunication.
Brigade.
Brigade-Major.
Brigadiers.
Bringers-up.
Briſure.
Budge-Barrels.

Bulruſh-Bridge.
Bulwark.

C.

Caiſſon.
Calibre.
Calliper.
Compaſſes.
Callthorps.
Campaign.
Camp-flying.
Cannon-Royal.
Capital Baſtion.
Line.
Canvas Bags.
Caponiere.
Cap Squares.
Carcaſs.
Carriage.
Cartouche.
Cartridges.
Caſcabell.
Caſcan.
Caſemate.
Caſement.
Caſerne.
Caſe-Shot.
Caſſine.
Cavallier.
Cavin.
Cazemate.
Cazerne.
Centre of a Polygon.
Chamber.
Chandeliers.
Charged Cylinder.
Chaſe of a Gun.
Chauſſe Traps.
Chemin de Ronds.
Chemiſe.
Chevaux de Friſe.
Circumvallation.
Cittadel.
Clayes.
Clours.
Communication.
Complement of the Line of Defence.
Contramure.
Contravallation.
Contre Queve d'Yrondre.
Corbeils.
Cordon.
Corniſh Ring.
Corporal.
Corps de Guard.
Corridor.
Cortine.
Counter-Approaches.
Batteries.
Breaſt-works.
Guards.
Forts.
Mand.
March.
Mine.
Scarp.
Swallow-Tail.
Croſs-bar Shot.
Crown-works.
Crown'd Horn-work.
Crows-feet, or Calthrops.
Culvering.
Cut Baſtion.
Cuvette.
Cylinder.

D.

Decamp.
Defences.
Defile.
Demi-Baſtion.
Cannon.
Culvering.
Diſtance.
Gorge.
Depth of a Squadron.
Deſcents.
Deſcent into a Ditch.
Detachment.
Diminiſhed Angle.
Diſmount.
Diſport.
Diſtance of the Baſtions.
Draught-Hooks.
Draw-Bridges.
Dulledge.
Durable Fortification.

E.

Earth-Bags.
Elevation of a Gun.
Embraſures.
Embattlement.
Enciente.
Enfans Perdus.
Enfilade.
Enfile.
Enſconced.
Envelope.
Epaule.
Epaulement.
Eſcalade.
Eſcarpe.
Eſconade.
Eſpaule.
Eſpaulement.
Eſplenade.
Etappé.
Etappier.
Evolution.
Exterior Polygon.
Talus.

F.

Face of a Baſtion.
Place.
Face Prolonged.
Falcon.
Falconet.
Falſe Attack.
Falſe Braye.
Faſcines.
Faucon.
Fauconet.
Fichant Flank.
Line of Defence.
Field-fort.
Field-Colours.
Pieces.
Staff.
Fellows.
Fights.
File.
Fire-Maſter.
Workers.
Fixed Line of Defence.
Flank in War.
Flank of the Courtine.
Low.
of the covered Fichant.
ritered Raſant.
of the ſecond Simple.
of a Place.
Flanking Angle of Defence.
Flanked Tenaille.
Angle.
Flat Baſtion.
Flat-bottomed Moat.
Flying-Camp.
Flying-Bridges.
Foot-Banks.
Foreland.
Forlorn-Hope.
Former.
Fort.
Royal.
Star.
Fortification.
Fortins.
Foucade.
Fougaſs, or Fougade.
Fourneau.
Fraiſes.
Fraiſing a Batallion.
*Freezeland* Horſe.
Front.
Fuſe of a Bomb.
Fuſiliers.

G.

Gabions.
Galleries.
Gallery of a Mine.
Gariſons.
Gazons.
General.
Glaſis.
Gorge of a Baſtion.
Ravelin.
Granado.
Grenado.
Guard.
Guerite.
Guve d'Hyrond.

H.

Half-Moon.
Handſpike.
Hendecagon.
Heriſſon.
Herſe.
Herſillon.
Hobelers.
Hobits.
Hollow-Tower.
Square.
Honey-combs.
Horizontal Range.
Horn-work.
Horſe-ſhoe.

I.

Ichnography.
Inſconſed.
Interior Polygon.
Talus.
Inward Flanking Angle.

Irregular

Irregular Fortification.

L.

Ladle.
Langreſs-Shot.
Lanſpeſade.
Legion.
Limbers.
Linch-Pins.
Line Capital.
Cognitel.
of Defence.
Fitchant.
Raſant.
of Approach.
Circumvallation.
Contravallation.
Lines within-ſide.
without.
of Communication.
Line of the Baſe.
a Work.
Lines.
Line-Hedges.
Lined Moat.
Linſtock.
Liziere.
Local.
Lockſpit.
Lodgment.
of an Attack.
Lower Flank.
Lunettes.

M.

Madrier.
Magazine.
Main Body.
Major-General.
of a Brigade.
Regiment.
Town.
Mal-Voiſin.
Mantelets.
Matraſſes.
Merlon.
Metal.
Military Architecture.
Execution.
Mine.
Minion.
Moat.
Moineau.
Montpagnot.
Mortar-piece.
Mortars of *Coborne*.
Murderers.
Musket-Baskets.

N.

Nailing of Cannon.

O.

Open Flank.
Opening the Trenches.
Order.
Ordnance.
Orillon.
Orgues.
Orteil.
Outward Angle.
Out-works.

P.

Paliſadoes.
Paliſadoes-turning.
Parade.
Parapet.
Park of the Artillery.
Proviſions.
Pate.
Patroul.
Pedrero.
Petterero.
Perſpective Military.
Petard.
Phalanx.
Picket.
Pioneers.
Place of Arms.
Plane.
Plat-Baſtion.
Form.
Polygon Exterior.
Interior.
Ponton.
Pont-Volant.
Port-Cullice.
Port-Fire.
Poſt.
Poſtern.
Prieſts-cap.
Priming-Iron.
Profile.
Provoſt-Marſhal.

Q.

Quadrat.
Quarter.
Quarter-wheeling.
Quarters (Winter.)
of Refreſhment.
Quarter-Maſter.
at a Siege.
Quue de Hyronde.

R.

Rabanet.
Rabinet.
Rammer.
Rampart.
Randezvous.
Random-Shot.
Range.
Rank.
Raſant Line.
Ration.
Ravelin.
Rear Guard.
Half Files.
Line.
Rank.
Redoubt.
Re-entring Angle.
Reform.
Reformed Officer.
Regiment.
Regular Fortification.
Re-inforced Ring of a Cannon.
Relayes.
Retirade.
Retired Flank.
Retrenchment.
Returns of a Trench.
Rideau.
Rondell.
Rounds.
Royal Fort.
Parapet.

S.

Sacker.
Sacks of Earth.
Saigner a Moat.
Saker.
Saliant Angle.
Sally.
Sand-Bags.
Sappe.
Saraſin.
Sauſage.
Sauciſſons.
Scalado.
Scarp.
Sconces.
Semi-diameter.
Shott.
Round.
Croſs-Bar.
Langrell.
Chain.
Caſe.
Shouldring.
Sillon.
Simple Flank.
Tenaille.
Sixain.
Solid Baſtion.
Spunging a Gun.
Square Battalion.
Square Rallow.
Star.
Straiks.
Stratarithmetry.
Swallow-Tail.
Superficial Fourneau.

T.

Tacticks.
Talu.
Talus.
Exterior.
Interior.
Superior.
Taper-bored.
Temporary Fortification.
Tenaille.
Single.
Double.
of the Place.
Terre-plain.
Tertiate.
Tompion.
Traverſe.
Trenches.
Trunnions.

V.

Van-Guard.
Vedette.
Vent.
Void-Baſtion.

W.

Wad-hook.
Way of the Rounds.
Wing.
Windage of a Gun.
Word.

*Logick, Metaphyſicks,* and *Ethicks.*

A.

ABolition.
Abſtraction.
Abſtract.
Abſtract Numbers.
Accident.
Adequate.
Ideas.
Adjunct.
Analogical.
Analytick.
Annihilation.
Antagoniſt.
Antecedent.
Antipredicaments.
Apogogical.
Apodictical.
Apprehenſion.
Attention.
Attributive Juſtice.

B.

Baroco.
Bocardo.

C.

Categoria.
Categorema.
Cauſal Propoſitions.
Circumſtances.
Contradictory Propoſitions.
Contrary Propoſitions.
Converſion of Propoſitions.
Copula.
Copulative Propoſitions.

D.

Definition.
Demonſtration.
Dialectical.
Difference.
Dilemma.
Diſcourſe.
Diſcretive Propoſitions.
Diſtributive Juſtice.
Duration.

E.

Ens.
Entelecheia.
Enthymeme.
Enunciation.
Epanorthoſis.
Epicherema.
Equipollence.
Equivalence.
Equivocal.
Eſſence.
Eſſential Properties.
Ethicks.
Exceptive Propoſitions.
Expanſion.

F.

Figurative Speeches.
Figures.
Final Cauſes.
Finite.
Fortitude.

G.

Genus.

H.

Habitude.
Homologous.

I.

Idea.
Idea's.
Identity.
Imagination.
Impenetrability.
Inadequate Idea's.
Inanity.
Incomplex Terms.
Indefinite.
Individuum.
Vagum.
Determinatum.
Demonſtrativum.
Ex Hypotheſi.
Infinite.
Innate Principles.
Inſtant.
Intuition.
Irony.
Judgment.

L.

Litotes.
Locus.
Logick.

M.

Method.
Moral Philoſophy.
Actions.

O.

Oſtenſive Demonſtrations.

P.

Paralipſis.
Paralogiſm.
Perception.
Petitio Principii.
Prædicable.
Prædicament.
Prolepſis.
Proſopopœia.
Prudence.

Q.

Quantity.

R.

Ratiocination.
Recollection.
Reduplication.
Reflexion.
Relative Propoſitions.
Remembrance.
Reminiſcence.
Repetition.
Retention.

S.

Sincerity.
Species.
Subalternate Propoſitions.
Sub-contrary Propoſitions.
Subſtance.
Summum Bonum.
Sympathy.
Synecdoche.
Synonomy.

V.

Virtue.

*Aſtronomy,* and the *Doctrine* of the *Sphere.*

A.

ABſis.
Abſolute Equation.
Acherner.
Achronical.
Acronical.
Æquator.
Aldebaran.
Algeneb.
Algol.
Albioth.
Alliot.
Almacanters.
Almicanters.
Alpheta, *a Star.*
Alramech, *a Star.*
Altitude of the Pole.
of the Sun.
of a Star.
Amphiſcii.
Amplitude.
Magnetical.
Anabibaſon.
Analemma.
Andromeda.
Angle of Right Aſcenſion.
of the Ecliptick.
of Evection.
of the Meridian and Ecliptick.
of the Meridian and Horizon.
of the Parallax.
of the Sun's Poſition.
Diameter.
Spherical.
of Longitude.
of Inclination of a Planet's Orbit.
Anomaly.
of the Orbit.
of the Centre.
True equal.
Mean.
Equable.
Annual Equation.
Anomalous.
Anſes, *or* Anſæ, of Saturn.
Antares.
Antartick.
Antæci.
Antecedentia.
Antichthones.
Antiæci.
Antipodes.
Antiſcii.
Aphelium.
Apogæum.
Apogee of the Equant.
of the Epicycle.
Apparent.
Place.
Conjunction.
Horizon.
Apſis.
Aquarius.

# *An Alphabetical* INDEX


Aquila.
Ara.
Arctick Circle.
Arctophylax.
Arctos Minor.
Arcturus.
Argo Navis.
Argument of Inclination.
of the Moon's Latit.
Aries.
Ark of Direction.
Retrogradation.
Armillary Sphere.
Artick Pole.
Circle.
Artificial Day.
Aſcendant.
Aſcenſion.
Aſcenſional Difference.
Aſcii.
Aſpect.
Aſteriſm.
Aſtrolabe.
Aſtrology.
Aſtronomical Calendar.
Numbers.
Place of a Star.
Hours.
Aſtronomy.
Auge.
Auriga.
Aurora Borealis.
Auſtral.
Aux.
Axis.
Azimuth.
of the Sun.

B.

*Babyloniſh* Hours.
Baſilicus.
Bear.
Biquintile.
Biſſextile.
Boötes.
Boreal Signs.
Biquartile.

C.

Calendar Aſtron.
Cancer.
Canicula.
Canis.
Caniculus.
Capella.
Cardinal Points.
Caſſiopæia.
*Caſtor.*
Catabibazon.
Cauda Lucida.
Cegynus.
Centaure.
Centre of a Dial.
of the Equant.
of Attraction.
Cepheus.
Cetus.
*Charles*'s Wain.
Chryſtalline Heavens.
Circle Equant.
of Altitude.
of Perpetual Apparition.
Occultation.
Circle of Inclination.
of Poſition.
Circular Velocity.
Circum-polar Stars.
Colures.
Combuſts.
Comets.
Conjunction.
Conſtellation.
Contingent Line.
*Copernican* Syſtem.
Cor Caroli.
Hydræ.
Leonis.
Corona Borealis.
Meridionalis.
Crater.
Corvus.
Coſmical.
Cronical.
Croſiers.
Culminate.
Cycle of the Sun,
Moon.
Indiction.
Cygnus.

D.

Daily Motion of a Planet.
Day.
Declination.
of a Wall.
Apparent.
of the Sun: *See Tables of it under Right Aſcenſion.*
True.
of a Plane.
Declinatorum.
Declining Dials.
Declinatory.
Deferent.
Degree.
Delphinus.
Deneb.
Depreſſion of the Pole.
Deſcenſion Oblique.
Right.
Diacentros.
Dial.
Dial Planes.
Dialling.
Difference of Aſcenſion of Longitude.
Dihelios.
Direct.
Dials.
Sphere.
Motion of a Planet.
Diſcus.
Disk.
Diurnal Motion.
Ark.
Parallax.
Dodecatemory.
Dominical Letter.
Double Horizontal Dial.
Draco.
Dragons Head and Tail.

E.

Earth.
Eccentricity.
Eccentricity Simple.
Double.
of the Earth.
Eccentrick Circles.
Equation.
Place of a Planet.
Eclipſe.
Ecliptick.
Elevation of the Pole.
Elongation.
Emboliſm.
Emergent.
Emerſion.
Engonæſus.
Enneadecaterides.
Epact.
Ephemeris.
Epicycle.
Equable Motions.
Equation Total.
Phyſical.
Optical.
of the Orbit.
Annual.
of the Centre.
Moon's Motion.
of Time.
Equator.
Equiculus.
Equinoctial.
Colure.
Dial.
Orient.
Occident.
Equinoxes.
Erect Declining Dials.
Planes.
Erect Direct Planes.
Direct E. or W. Planes.
N. or S. Planes.
Erichthonius.
Errones.
Eſtival Orient.
Occident.
Solſtice.
Evection.
Excentrick.

F.

Faculæ.
Falcated.
Faſciæ of *Mars.*
Finitor.
Firmament.
First Mover.
Fixed Signs of the Zodiack.
Stars: *See Tables of their Right Aſcenſion, under Right Aſcenſion.*
Fomahant.
Furniture of Dials.

G.

Galaxy.
Geocentrick.
Latitude.
Place.
Gibbous.
Globe, or Sphere.
Gnomon.
Gnomonicks.
Golden Number.


Great

Great Bear.
Circles of the Sphere.
*Gregorian* Year.

H.

Hegyra.
Height of the Pole.
Heliacal Rising.
Setting.
Helice Major.
Minor.
Heliocentrick Place.
Hemisphere.
Heniochus.
Heteroscii.
Hircus.
Horizon.
Sensible.
Rational.
Horizontal Dials.
Parallax.
Line.
Horologiography.
Horometry.
Horoscope.
Hour Circles.
Lines.
of the Day, to find it.
Hybernal Occident.
Orient.
Hydra.
Hydrographical Charts.
Hydrography.
Hyemal Solstice.

I.

Ides.
*Jewish* Hours.
Illuminative Month.
Immersion.
Inclination of the Axis.
of a Planet.
Plane.
Inequality of Natural Days.
Informed Stars.
Ingress.
Intercalary Day.
Interstellar.
*Julian* Year.
Period.
*Jupiter*.

K.

Kalendar.
Kalends.

L.

Latitude of a Place.
Star.
Heliocentrick.
Leap-Year.
Leo.
Lesser Circles of the Sphere.
Libra.
Libration.
Like Arks.
Limit of a Planet.
Line of Measures.
Linea Apsidum.
Line of greater and lesser Longit.
mean Longitude.
Motion.
true Motion.
Horizontal.
Line of the Anomaly.
of the Apogee.
of the Nodes.
Synodical.
of the true Syzygies.
of mean Syzigy.
of a Planet's Place.
of Measures.
of Direction of the Earth's Axis.
Substilar.
Equinoctial.
Lines Horary.
Longitude of a Place.
in the Sun or Stars.
in Dialling.
on the Globe.
Lucida Corona.
Hydræ.
Lyræ.
Luminaries.
Lunary Months.
Cycle.
Lunations.
Luni-Solar Year.
Lupus.

M.

*Mars*.
Mathematical Horizon.
Mean Motion of the Sun.
*Mercury*.
Meridian.
on the Globe.
Line.
Magnetical.
Meridional Distance.
Parts.
Miles.
Micrometer.
Milky-way.
Minute.
Moon.
Moon's Parallax.
Motion of the Apogee.

N.

Nadir.
Nebulous Stars.
Nocturnal Ark.
Nodus.
Nonagesimal Degree.
Northern Signs.
Nucleus.

O.

Oblique Ascension.
Plane.
Angle.
Sphere.
Occident.
Estival.
Hybernal.
Equinoctial.
Occidental.
Occultation.
Octant.
Octile.
Olor.
Ophiucus.
Opposition.
Optick Place of a Star.
Orbis Magnus.
Orbit of a Planet.
Orient.
Oriental.
Orion.
Orthographick Projection.

P.

Paracentrick Motion
Sollicitation.
Parallax.
Parallax Diurnal of the Sun.
of Latitude.
of Longitude.
Parallactick Angle.
Parallel Sphere.
Parallels of Altitude.
Latitude.
Declination.
Parallel Planes.
Circles.
Parallelism of the Earth's Axis.
Paraselene.
Path of the Vertex.
Pegasus.
Penumbra.
Periæci.
Perigæum.
Perihelion.
Periodical.
Month.
Periscii.
Perseus.
Phases.
of the Planets.
Phrocion.
Pisces.
Meridianus.
Place of the Sun, Planet, or Star.
Place apparent of a Planet.
true.
Plane of a Dial.
Horizontal.
of the Projection.
Planets.
Planisphere.
Pleiades.
Poetical Rising.
Points of Station.
Polar Circles.
Dials.
Projection.
Pole-Star.
of the World.
Ecliptick.
*Pollux*.
Procession of the Equinoxes.
Primary Planets.
Prime of the Moon.
Prime Vertical Dials.
Primum Mobile.
Projection of the Sphere.
Projective Dialling.
Prostaphæresis.
Pseudostella.
*Ptolomaick* System.
*Pythagorean* System.

Q.

Quadrant of Altitude.
Astronomical.
Quadrantal Triangle.
Quadratures of the Moon.
Quartile.
Quintile.

R.

# An Alphabetical INDEX.


R.

Rainbow.
Rational Horizon.
Real.
Receſſion of Equinoxes.
Reclination of a Plane.
Reclining Dials.
Reduction.
Reflecting Dials.
Reflexion.
Reflexion of the Moon.
Refracted Dials.
Refraction Aſtronomical.
Horizontal.
Regel.
Rigel.
Regions.
Retroceſſion of the Equinoxes.
Retrograde.
Retrogradation of a Planet.
Revolution.
Right Aſcenſion of the Sun or Moon.
Ring of Saturn.

S.

Sagitta.
Sagittarius.
Satellite.
Inſtrument.
Satellites of Jupiter.
Mars.
Saturn.
Sciography.
Sciothericum Teleſcopium.
*Scorpio.*
Second.
Secondary Circle.
Planets.
Semi-quadrate.
quartile.
quintile.
ſextile.
Semita Luminoſa.
Senſible Horizon.
Serpentarius.
Septentrional Signs.
Seſquiquadrate.
Seſquiquintile.
Sexagenary Tables.
Sexageſimal Fractions.
Sextile.
Sidereal Year.
Simple Eccentricity.
Single Eccentricity.
Sirius.
Solar Comet.
Cycle.
Year.
Solſtice.
Eſtival.
Hybernal.
Solſtitial Colure.
Sound.
South Direct Dials.
Southern Signs.
Sphere.
Spots in the Sun.
Station.
Stationary.
Stereographick Projection.
Stile.
Style.
Subſtilar Line.
Succeſſion of the Signs.
Summer Solſtice.
Sun.
*Sunday*-Letter.
Superior Planets.
Swift in Motion.
Sydereal Year.
Synodical Month.
Revolution.
Syſtem.
Syzygy.

T.

*Taurus.*
Teleſcopes.
Teleſcopical Stars.
Temperate Zone.
Terraqueous Globe.
Terreſtrial Globe.
Torrid Zone.
Trajectory of a Comet.
Tranſit of the Moon.
Triangulus Septentrionalis.
Trine Aſpect.
Tropicks.
True Place.
Conjunction.
Twilight.
*Tychonian* Syſtem.

V.

Variation.
Vector.
Venus.
Verſed Sine.
Vertex.
Vertical Circles.
Point.
Line.
Veſpertine.
Via Lactea.
Vindimiatrix.
Virgo.
Viſible Horizon.
Place of a Star.
Umbelicus.
Volva.
Vortex.
Urſa Major.
Minor.

W.

Winter Solſtice.

Y.

Year.

Z.

Zenith.
Diſtance.
Zodiac.
of the Comets.
Zone.


THE END.

THE END

BSB Bayerische StaatsBibliothek
MDZ Münchener DigitalisierungsZentrum Digitale Bibliothek

Harris, John

Lexicon Technicum: Or, An Universal English Dictionary Of Arts And Sciences Explaining not only the Terms of Art, but the Arts Themselves

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